3 DESCRIPTION OF THE AFFECTED ENVIRONMENT

This section establishes a baseline for current conditions at the Idaho National Engineering and Environmental Laboratory (INEEL) site. The baseline provides a starting point from which to assess impacts of the proposed action described in Section 2.3. This baseline may include regional features and conditions, but where practicable, it is focused on the Idaho Nuclear Technology and Engineering Center (INTEC) facility, the site of the proposed action. Much of the information in this section is taken from the U.S. Department of Energy (DOE) Programmatic Spent Nuclear Fuel (SNF) Environmental Impact Statement (EIS) (DOE, 1995), the DOE Idaho High-Level Waste (HLW) and Facilities Disposition EIS (DOE, 2002a), and the U.S. Nuclear Regulatory Commission (NRC) EIS for the Three-Mile Island Independent Spent Fuel Storage Installation (ISFSI) (NRC, 1998). Specific information on the proposed Idaho Spent Fuel Facility has been taken from the environmental and safety analysis reports submitted by Foster Wheeler Environmental Corporation (FWENC) in support of its license application to NRC (FWENC, 2001a,b,c).

3.1 Site and Facility Description

This description of the INEEL facility is based on information provided in the DOE Idaho HLW and Facilities Disposition EIS (DOE, 2002a, Section 4.2).

3.1.1 The INEEL

The proposed Idaho Spent Fuel Facility is to be located at the INEEL, one of nine multiprogram laboratories within the DOE complex. The INEEL covers about 230,850 ha [570,000 acres] in southeast Idaho (Figure 3-1). Most of the INEEL is undeveloped, and only about 2 percent of the total area {4,617 ha [11,400 acres]} has been developed to support the DOE mission at INEEL.

The INEEL has nine primary facility areas. The proposed Idaho Spent Fuel Facility would be sited adjacent to the southeast corner of the INTEC, a facility with the mission to receive and store SNF and radioactive wastes (see Figure 2-1). Other INEEL facilities include Test Area North, Naval Reactors Facility, Test Reactor Area, Central Facilities Area, Power Burst Facility, Auxiliary Reactor Area, Argonne National Laboratory–West, and the Radioactive Waste Management Complex (Figure 3-2). These facilities are not directly involved in the proposed action.

The INEEL is remote from major population centers, permanent

Existing and Proposed Facilities

Idaho National Engineering and Environmental Laboratory (INEEL)—This existing facility is managed for the U.S. Department of Energy and contains about 230,850 ha [570,000 acres], most of which is undeveloped, but under controlled access.

Idaho Nuclear Energy Technology and Engineering Center (INTEC)—This existing facility, formerly known as the Idaho Chemical Processing Plant (ICPP), consists of about 150 buildings located on 101 ha [250 acres] in the south central part of the INEEL. It is the current site of HLW and SNF storage activities at INEEL, including current interim storage for the Peachbottom and Shippingport SNF.

Idaho Spent Fuel Facility—This proposed facility is the focus of the proposed action. If licensed, this facility would provide dry storage for SNF from the Peachbottom and Shippingport commercial reactors, as well as SNF from training, research, and isotope reactors built by General Atomics (TRIGA reactor).

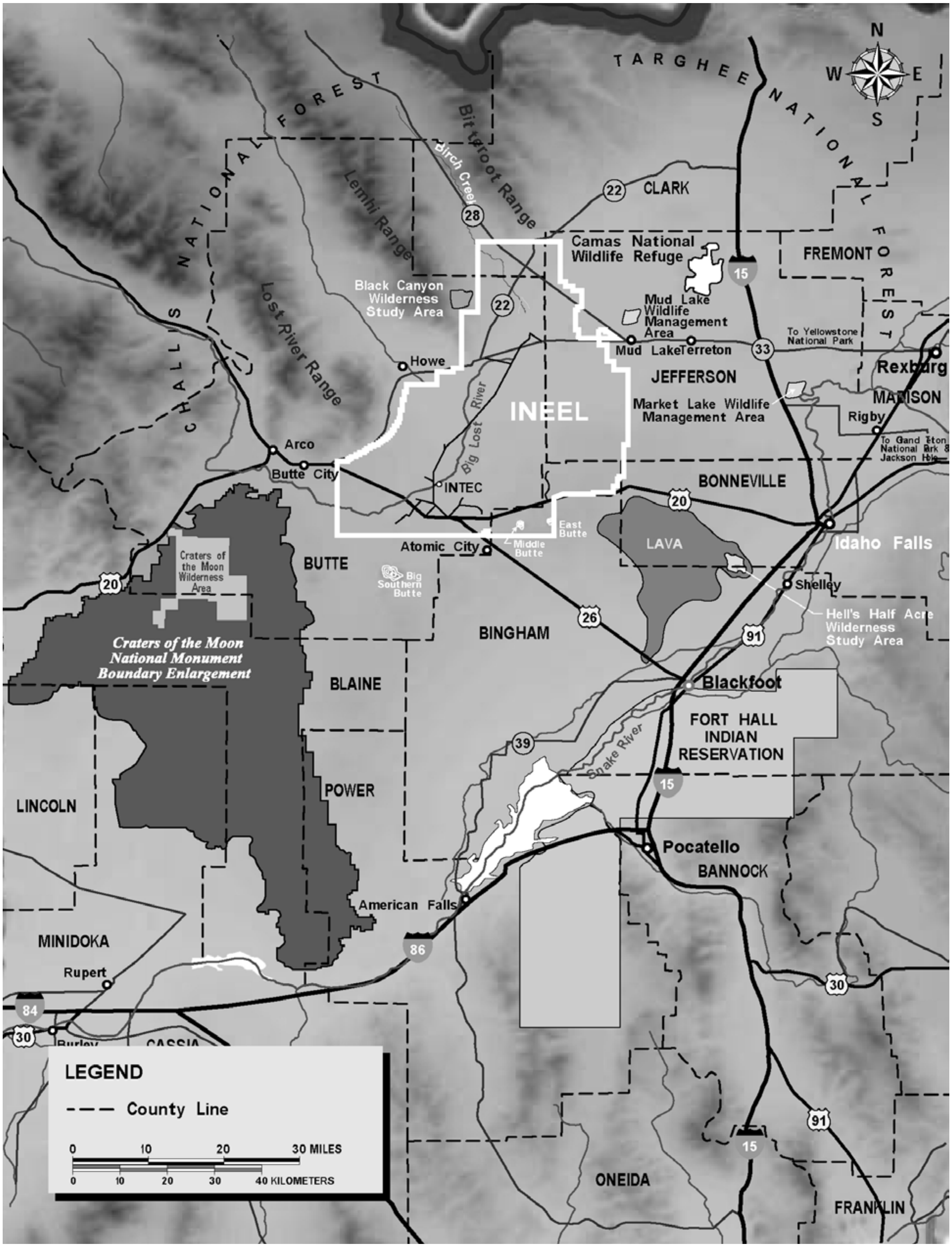


Figure 3-1. Regional Location of INEEL (Modified from FWENC, 2001a)

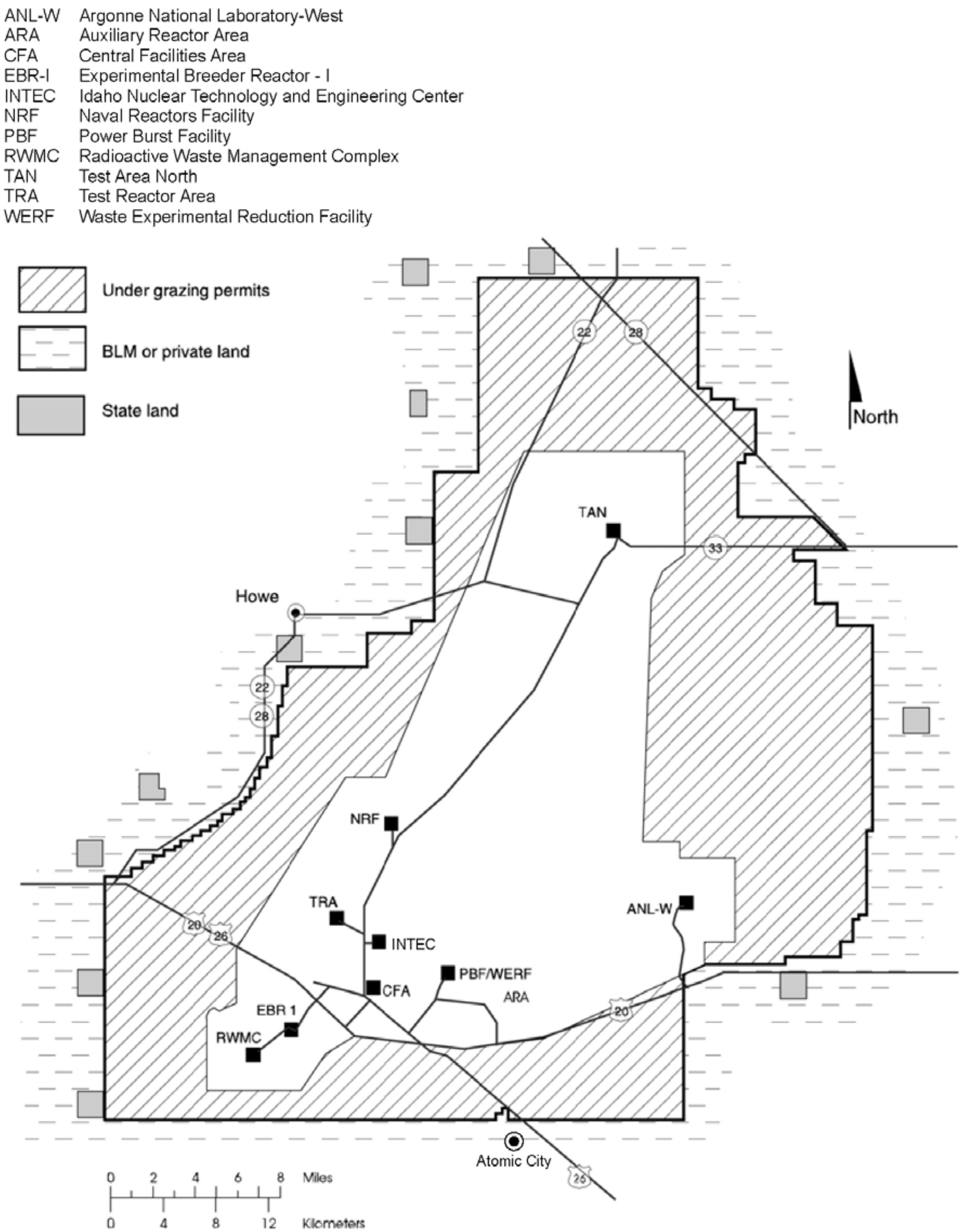


Figure 3-2. Current Land Use at INEEL (Modified from FWENC, 2001a)

waterways, and interstate transportation routes. INEEL has no permanent residents, and access to the INEEL facilities is controlled by DOE. Visitor access to the INEEL is also restricted, except for persons driving through INEEL on one of four public highways and visitors to the Experimental Breeder Reactor-1, a national historic landmark open to the public during summer months.

The INEEL is located entirely in the state of Idaho, mostly within Butte County, but with portions in Bingham, Bonneville, Jefferson, and Clark Counties. Nearby cities include Mud Lake and Terreton to the east; Arco, Butte City, and Howe to the west; and Atomic City to the south. Larger communities at are further from the INEEL include Idaho Falls {80 km [50 mi]} and Rexburg {132 km [82 mi]} to the east; and Blackfoot {64 km [40 mi]} and Pocatello {80 km [50 mi]} to the southeast.

Tourist and recreation destinations surrounding the INEEL site include Craters of the Moon National Monument and Preserve, Hell's Half Acre Wilderness Study Area, Black Canyon Wilderness Study Area, Camas National Wildlife Refuge, Market Lake Wildlife Management Area, North Lake State Wildlife Management Area, Targhee and Challis National Forests, and the Snake River (Figure 3-1).

3.1.2 The INTEC

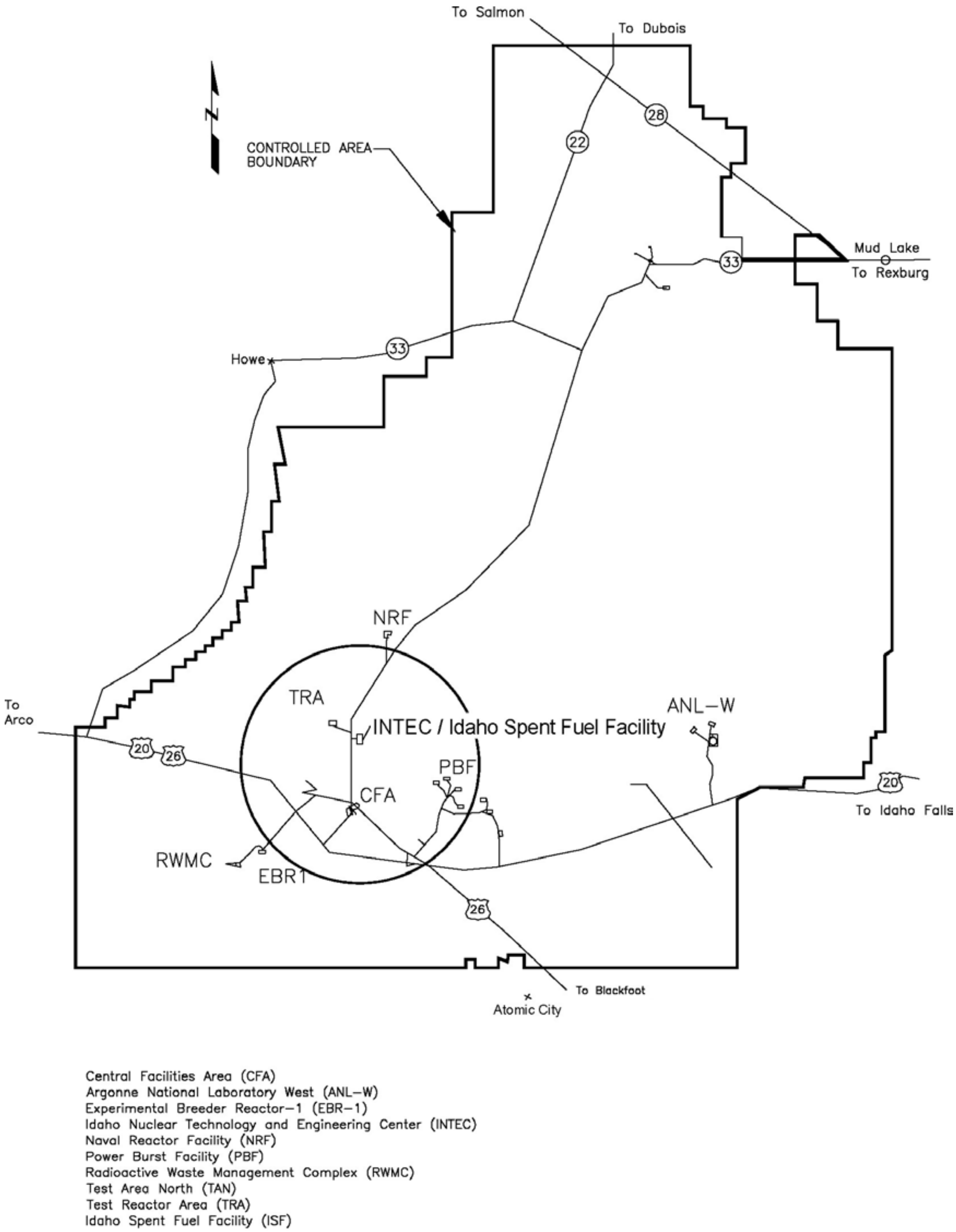
If licensed, the proposed Idaho Spent Fuel Facility (Figure 3-3) would be constructed adjacent to the eastern boundary of the INTEC. The INTEC facility consists of about 150 buildings located on 101 ha [250 acres] in the south-central part of the INEEL. The facility is located about 13.7 km [8.5 mi] north of the southern boundary, and the closest community is Atomic City, 16.9 km [10.5 mi] to the southeast (Figure 3-2). The INTEC facility is the current storage location of the Peachbottom and Shippingport SNF and the majority of the TRIGA fuel. It is also the location of the Three-Mile Island Unit 2 ISFSI (see Figure 1-1).

INTEC was originally constructed in the 1950s to reprocess and recover uranium-235 from SNF from government reactors. In addition, a treatment process known as calcining was developed at INTEC to reduce the volume of liquid radioactive waste generated during reprocessing and place it in a more-stable solid form. The INTEC was renovated and facilities upgraded during the 1980s. However, with a continued low demand for highly enriched uranium, reprocessing activities at INTEC ended in 1992.

The site for the proposed Idaho Spent Fuel Facility is a flat-lying area near the Big Lost River in the south-central part of the INEEL. The area is underlain by approximately 9 to 18 m [30 to 60 ft] of Big Lost River alluvial silts, sands, and gravels, which lie on an alternating sequence of basalt lava flows and interbedded sediments extending to a depth of about 600 to 700 m [2,000 to 2,300 ft]. Landforms in the vicinity of ISFSI consist of braided channels (some abandoned) of the Big Lost River to the west and north of the site and irregular flow lobes of basalt lavas to the east of the site (DOE, 2002a).

3.1.3 The Proposed Idaho Spent Fuel Facility

If constructed, the Idaho Spent Fuel Facility would be located on a previously disturbed site adjacent to the southeast corner of INTEC (Figure 2-1). The land currently serves as a construction laydown area for INTEC. It is sparsely vegetated, with only about 5 percent



1 **Figure 3-3. Location of Major Operating Facilities on INEEL (Modified from FWENC, 2001a)**

coverage (FWENC, 2001a). The site is located above the estimated 100- and 500-year flood plains. The roads nearest to the proposed facility are INEEL-controlled access and include Spruce Avenue on the north, Balsa Street on the east, and East Perimeter road to the west. A railroad spur line from the Mackay Branch of the Union Pacific Railroad is just south of the site. No cities or towns are within a 16-km [10-mi] radius of the site (Figure 3-1).

3.2 Land Use

This description of existing and planned land uses for the INEEL and the surrounding area summarizes the current and projected land uses based on the discussion presented in the DOE Idaho HLW and Facilities Disposition EIS (DOE, 2002a, Section 4.2).

3.2.1 INEEL Land Use

DOE is the designated federal agency with the responsibility and authority for effectively managing the INEEL lands in accordance with a series of Land Withdrawal Public Land Orders PLO 318, PLO 545, PLO 637, and PLO 691 that include approximately 204,930 ha [506,000 acres]. In addition, approximately 8,505 ha [21,000 acres] of state land and 17,415 ha [43,000 acres] of private land were transferred to DOE ownership and management, for a total of approximately 230,850 ha [570,000 acres] (Peterson, 1995). DOE is responsible for ensuring that the future use and management of these lands are in accordance with the Public Land Orders.

Most of the INEEL is undeveloped high-desert terrain, and most of the operations are performed within the nine primary facility areas that occupy 823 ha [2,032 acres]. A 139,725-ha [345,000-acre] security and safety buffer zone surrounds these developed areas. Approximately 6 percent of INEEL {13,770 ha [34,000 acres]} is devoted to utility rights-of-way and public roads (Figure 3-2). U.S. Highway 20 runs east and west and crosses the southern portion of INEEL, U.S. Highway 26 runs southeast and northwest, and Idaho State Highways 22, 28, and 33 cross the northeastern part of INEEL (DOE, 1995). Up to 137,700 ha [340,000 acres] of INEEL are leased for cattle and sheep grazing (DOE, 1995, volume 2, Part A, Section 4.2), with grazing permits administered by the Bureau of Land Management (BLM). However, livestock grazing is prohibited within 0.8 km [0.5 mi] of any primary facility boundary and within 3.2 km [2 mi] of any nuclear facility. In addition, 365 ha [900 acres] located on the northeast boundary of the INEEL at the junction of Idaho State Highways 28 and 33 serve as the U.S. Sheep Experiment Station as a winter feedlot for sheep (DOE, 1997a).

On July 17, 1999, the Secretary of Energy and representatives of the U.S. Fish and Wildlife Service, BLM, and Idaho State Fish and Game Department designated 29,672 ha [73,263 acres] of the INEEL as the Sagebrush Steppe Ecosystem Reserve. The sagebrush steppe ecosystem was identified as critically endangered across its entire range by the National Biological Service in 1995. The INEEL Sagebrush Steppe Ecosystem Reserve, designated to ensure this portion of the ecosystem receives special consideration, is located in the northwest portion of the area. The southern boundary of the reserve runs east and west along section lines and is 17.6 km [11 mi] north of INTEC at the closest point. A natural resources management plan is being developed for the reserve (DOE, 2002a, Section 4.2).

In preparing its programmatic EIS for SNF management, DOE projected land-use scenarios at INEEL for the next 25, 50, 75, and 100 years (DOE, 1995). In general, the DOE analyses

indicate that energy research and waste management activities would continue in the existing facility areas and, in some areas, expand into adjacent undeveloped areas. Future industrial development is projected to take place in the central portion of INEEL within existing major facility areas (DOE, 1993, 1997a, 2002a).

At INTEC, where most of the activities under the proposed action would take place, primary facilities include storage and treatment facilities for SNF, mixed HLW, and mixed transuranic waste/sodium-bearing waste, and process development and robotics laboratories. The original mission of INTEC was to function as a processing facility to extract uranium-235 from government-owned nuclear fuels from research and defense reactors. INTEC recovered uranium and rare gases from SNF so that these materials could be reused. Currently, INTEC operations include receipt and storage of DOE-assigned SNF; management of HLW prior to disposal in a repository; technology development for final disposition of SNF, mixed HLW, and mixed transuranic waste/sodium-bearing waste; and development of new waste management technologies.

Other than of activities directly associated with the DOE mission, there are other uses for the land at INEEL. For example, recreational uses of the INEEL include public tours of general facility areas and the Experimental Breeder Reactor-1, a national historic landmark. Controlled hunting is also permitted on INEEL to assist the Idaho Department of Fish and Game in reducing crop damage caused by wild game on adjacent private agricultural lands. These hunts are restricted to specific locations. INEEL is a designated National Environmental Research Park, functioning as a field laboratory set aside for ecological research and evaluation of the environmental impacts from nuclear energy development.

INEEL does not lie within any of the land boundaries established by the Fort Bridger Treaty of 1868. The entire INEEL is land occupied by DOE; therefore, the provision in the Fort Bridger Treaty that allows the Shoshone–Bannock Tribes to hunt on unoccupied lands of the United States does not presently apply to any land upon which INEEL is located.

3.2.2 Off-Site Land Use

Approximately 75 percent of the land adjacent to the INEEL is managed by the federal government and administered by the BLM for wildlife habitat, mineral and energy production, grazing, and recreation. Approximately 1 percent of the adjacent land is owned by the State of Idaho and used for purposes similar to that of the federal government. The remaining 24 percent of the land adjacent to INEEL is privately owned and is primarily used for grazing and crop production (DOE, 2002a, Section 4.2).

In addition to the areas described in Section 3.1.1, the region surrounding INEEL has recreation and tourist attractions including Yellowstone National Park, Grand Teton National Park, the Jackson Hole recreation complex, Sawtooth National Recreation Area, Sawtooth Wilderness Area, and Sawtooth National Forest.

Lands surrounding INEEL are governed by federal and state planning laws and regulations. Land-use planning in the State of Idaho is derived from the Local Planning Act of 1975. Currently, the State of Idaho does not have a land-use planning agency (DOE, 2002a, Section 4.2). Therefore, the Idaho legislature requires that each county adopt its own land use planning and zoning guidelines. At present, most of the surrounding counties have

implemented guidelines to focus development adjacent to previously developed areas, with a goal of avoiding urban sprawl and the pressures that it might place on existing infrastructure. Because INEEL is remotely located, adjacent areas are not likely to experience residential and commercial development, and no new development is planned. However, recreational and agricultural uses are expected to increase in the surrounding area in response to greater demand for recreational areas and the conversion of rangeland to cropland (DOE, 2002a, Section 4.2).

3.3 Transportation and Infrastructure

Transportation and infrastructure at INEEL are described in the DOE Idaho HLW and Facilities Disposition EIS (DOE, 2002a, Section 4.10). Two interstate highways serve the regional area surrounding INEEL. Interstate 15, a north-south route that connects several cities along the Snake River, is 40 km [25 mi] east of INEEL. Interstate 86 intersects Interstate 15 approximately 64 km [40 mi] south of INEEL and provides linkage to points west. Interstate 15 and U.S. Highway 91 are primary access routes to the Fort Hall reservation. U.S. Highways 20 and 26 are the main access routes to the southern portion of INEEL. State Route 33 provides access to the northern INEEL facilities. Table 3-1 provides average daily and peak hourly traffic data for selected local highway segments in the vicinity of INEEL.

INEEL contains an on-site road system of approximately 140 km [87 mi] of paved service roads that are closed to the public (DOE, 1995, Volume 2, Part A, Section 4.1). Most of the roads undergo continuous maintenance and are adequate for the current level of normal transportation activity. On-site roads presently have the capacity for increased traffic volume.

Railroad access to INEEL is provided by a DOE-owned spur line at Scoville Siding that is connected to a Union Pacific Blackfoot-to-Arco branch off a main line that follows the Snake River to the Pacific Northwest (DOE, 2002a). Rail shipments to INEEL include bulk commodities, SNF, and radioactive waste. Non-DOE air traffic over INEEL is limited to altitudes

Table 3-1. Baseline Traffic for Selected Highway Segments in the Vicinity of INEEL[a]

Route	Average Daily Traffic	Peak Hourly Traffic[b]
U.S. Highway 20—Idaho Falls to INEEL	2,100	315
U.S. Highways 20/26—INEEL to Arco	1,900	285
U.S. Highway 26—Blackfoot to INEEL	1,400	210
State Route 33—West from Mud Lake	600	90
Interstate 15—Blackfoot to Idaho Falls	11,000	1,650

EIS = environmental impact statement
INEEL = Idaho National Engineering and Environmental Laboratory

[a] DOE. DOE/EIS–0287–F, "Idaho High-Level Waste and Facilities Disposition Final Environmental Impact Statement." Idaho Falls, Idaho: DOE, Idaho Operations Office. 2002.
[b] Estimated as 15 percent of average daily traffic

greater than 305 m [1,000 ft] over buildings and populated areas. Primary air traffic includes high-altitude commercial jets.

Hazardous, radioactive, industrial, commercial, and recyclable wastes are transported to and from INEEL. Hazardous materials include commercial chemical products and hazardous wastes that are nonradioactive and are regulated and controlled by the Department of Transportation based on the material's chemical reactivity, toxicity, and flammability. Table 3-2 summarizes shipments associated with INEEL from 1998 through 2001 based on data from the Enterprise Transportation Analysis System (DOE, 2002a). These shipments include express mail packages, radioactive waste shipments, and SNF shipments. Nonhazardous materials shipments accounted for more than 95 percent of INEEL shipments. Radioactive materials and hazardous materials shipments accounted for 1.2 percent and 3.2 percent of the shipments, respectively.

Occupational and public exposures from radioactive waste shipments have been estimated in prior EISs (DOE, 2002a, 1996c,d, 1995). These past estimates have indicated doses and estimated latent cancer fatalities from radioactive material transportation are small and indicate no adverse environmental impacts are associated with radioactive material transportation to INEEL.

3.4 Geology and Soils

This description of the general geology of the affected environment at the INEEL facility is based on information provided in the DOE Programmatic SNF EIS (DOE, 1995, Volume 2, Part A, Section 4.6).

Table 3-2. Annual Average Shipments to and from INEEL (1998–2001) by Type of Cargo and Transportation Mode[a]

Mode	Hazardous	Nonhazardous	Radioactive	Total
Air	221	18,549	177	18,947
Motor[b]	294	4,439	109	4,842
Other[c]	273	229	5	507
Rail	0	3	1	4
Total	788	23,220	292	24,300

EIS = environmental impact statement
INEEL = Idaho National Engineering and Environmental Laboratory

[a] Enterprise Transportation Analysis System (DOE. DOE/EIS–0287–F, "Idaho High-Level Waste and Facilities Disposition Final Environmental Impact Statement." Idaho Falls, Idaho: DOE, Idaho Operations Office. 2002.)
[b] Commercial motor carriers
[c] Freight forwarder, private motor carrier, government vehicles, or parcel carriers

3.4.1 General Geology

The INEEL site is located on the Eastern Snake River Plain in southeast Idaho (Figure 3-4). Geologically, the Eastern Snake River Plain can be summarized as a broad northeast-trending basin that began filling with volcanic deposits approximately 6 million years ago. Most of the Plain that is visible today was shaped by volcanic eruptions of lava flows and domes during the last 1.2 million years. Overlying the lavas are thin, discontinuous deposits of wind-blown sand and loess, floodplain, riverbed and lake sediments, and landslope debris. These sedimentary deposits are often found between the lava flows, showing that a quiet period occurred between past volcanic eruptions. To the northeast, the Plain merges with the Yellowstone Plateau. Higher elevation mountains and valleys of the Basin and Range Province bound the Plain to the north and south. These mountains are formed by rocks more than 70 million years old, which have been folded and faulted. This Basin and Range deformation, which began 20 to 30 million years ago, affects some ongoing volcanic and tectonic processes in the INEEL area.

Earthquake histories and seismic characteristics of the Eastern Snake River Plain and the adjacent Basin and Range Province are different (Figure 3-5). The Plain historically has produced only infrequent, small-magnitude earthquakes (King, et al., 1987; Pelton, et al., 1990; Woodward-Clyde Consultants, 1992; Jackson, et al., 1993). Larger historical earthquakes and active faulting are associated with tectonic activity in the Basin and Range Province. For example, the 1959 Hebgen Lake Earthquake (moment magnitude 7.5) occurred approximately 150 km [93 mi] from the INEEL. The October 28, 1983, Borah Peak earthquake (moment magnitude 6.9, Richter magnitude 7.3) occurred along the Lost River fault approximately 100 km [62 mi] from the INEEL site. Although the Borah Peak earthquake produced peak ground accelerations of 0.022 *g* to 0.078 *g* at INEEL (Jackson, 1985), INEEL facilities were not damaged significantly (Guenzler and Gorman, 1985).

The tectonic forces that control nearby Basin and Range Province faulting likely affected the development of four northwest-trending volcanic zones that cross the Plain (Figure 3-5). Along with a northeast-trending zone that runs along the axis of the Plain, these zones have localized volcanism during the last 1.2 million years (Bowman, 1995; Hackett and Smith, 1992; Kuntz, et al., 1990). Most of this volcanism has consisted of thin basaltic lava flows and small volcanic vents like those on the island of Hawaii. Some past eruptions of rhyolite, however, have been more energetic and produced ash deposits and steep-sided volcanoes called domes. The last of these rhyolite eruptions occurred about 300,000 years ago (Kuntz, et al., 1990). The nearest volcano to the proposed Idaho Spent Fuel Facility site is 3 km [1.8 mi] to the northwest and is approximately 600,000 years old (Kuntz, et al., 1994). Although lava flows younger than approximately 200,000 years old are exposed within 5 km [3 mi] of the proposed Idaho Spent Fuel facility site, the young volcanoes that produced these lavas all occur more than 10 km [6 mi] from the site (Kuntz, et al., 1994).

3.4.2 Soils

According to FWENC (2001a, Section 2.5), “surficial sediments … at the ISF [proposed Idaho Spent Fuel] Facility site consist mostly of gravel, gravelly sands, and sands,” and vegetative cover is only about 5 percent. Soils have been characterized and consist of 1.5 m [5 ft] of silt of “loose to medium-dense consistency” of aeolian and fluvial origin, underlain by “about 7.6 m [25 ft] of dense sand and gravel” (FWENC, 2001a, Section 6.1). The proposed Idaho Spent Fuel Facility would be built on a previously disturbed site.

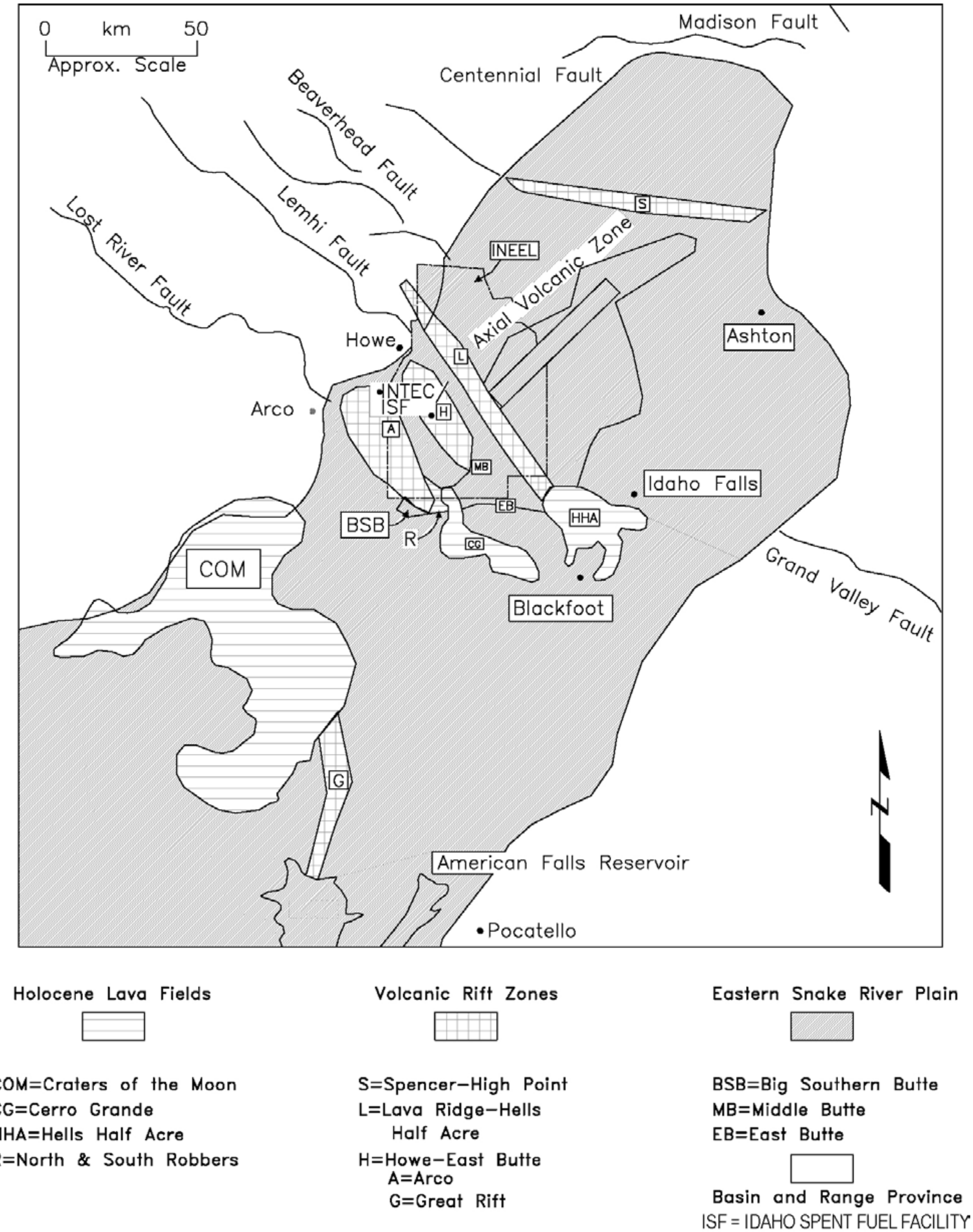


Figure 3-4. Volcanic Zones on the Eastern Snake River Plain (Modified from FWENC, 2001a)

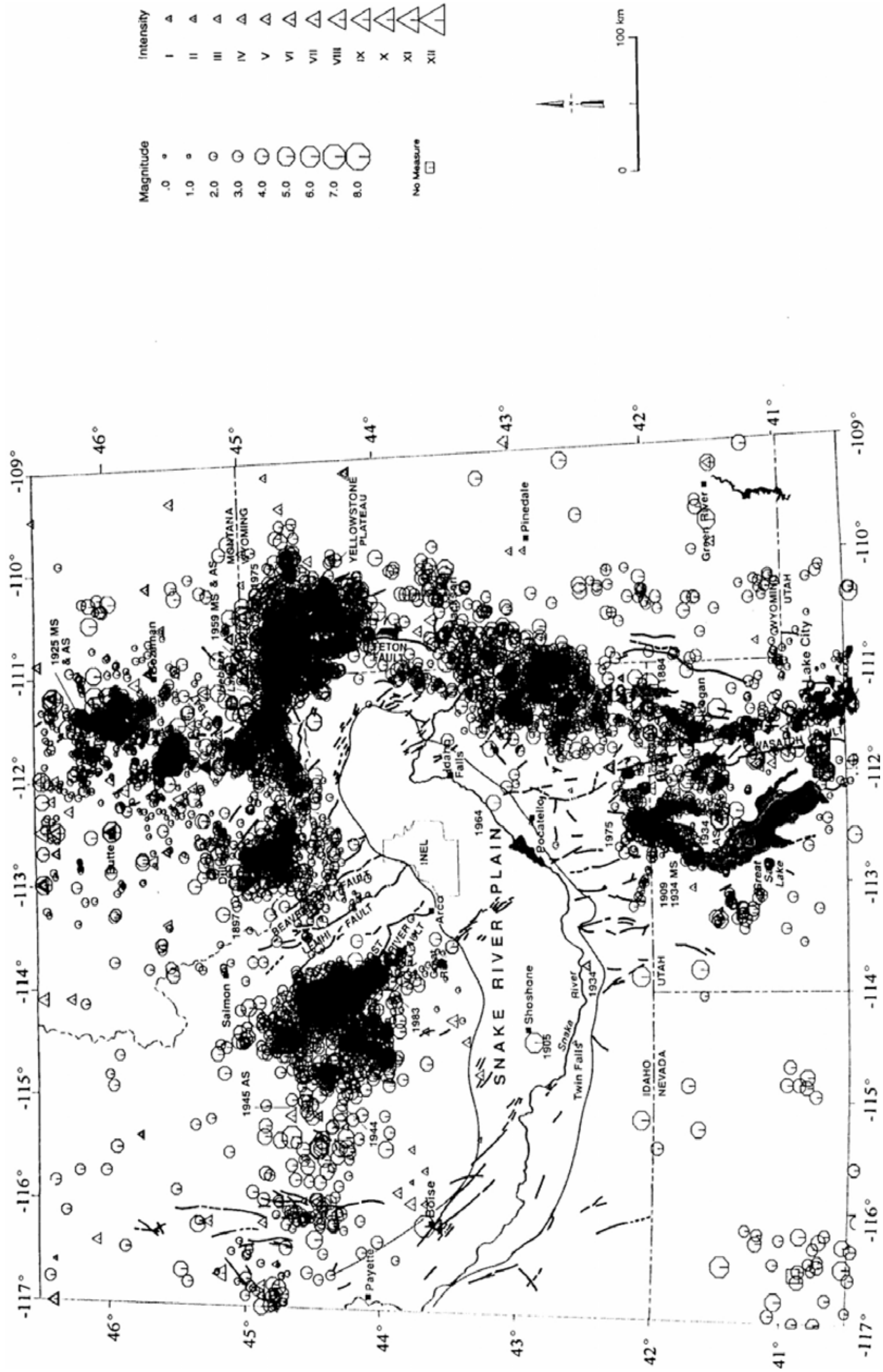


Figure 3-5. Historical Seismicity in the Region Surrounding INEEL (from FWENC, 2001b)

A remedial investigation of the INTEC site did not identify the proposed Idaho Spent Fuel Facility site as contaminated (Rodriguez, et al., 1997). Site investigations, in which soil contaminant levels were measured, were subsequently carried out by the DOE and FWENC on the proposed Idaho Spent Fuel Facility site. A radiological screening was performed in 2002, and all measured cesium-137 concentrations were well below the risk-based soil remediation goal of 23 pCi/g defined in the INTEC final record of decision (Idaho Department of Environmental Quality, 1999); in fact, none exceeded the INEEL background value of 0.8 pCi/g, also from that report. Because cesium-137 is consistently the highest activity soil contaminant elsewhere at INTEC and has the lowest activity remediation goal among radionuclides of concern (Idaho Department of Environmental Quality, 1999, Sections 5 and 8), it is an appropriate marker for establishing soil contamination. Therefore, the proposed Idaho Spent Fuel Facility site is not radiologically contaminated.

Nonradiological soil contamination is also of concern as a potential health hazard. FWENC performed sampling and analyses for nonradiological contaminants in 2000; results are shown in Table 3-3, which is reproduced from FWENC (2003). FWENC used a five-step process to eliminate contaminants from consideration. In the first two steps, metals were eliminated if the maximum measured concentration was below background or if the metal is considered an essential nutrient. Table 3-3 presents the metals eliminated by these comparisons. The maximum measured iron concentration was 24,100 mg/kg [24,100 ppm], which is slightly higher than the background value of 24,000 mg/kg [24,000 ppm] (LMITCO, 1996). However, this difference is not considered significant. First, there are uncertainties in both the measurement and the statistical method used for calculating the background value that, though not reported in FWENC (2003), will exceed the 0.4 percent difference. Second, the 24,000-mg/kg [24,000-ppm] background value is an upper tolerance limit for composite samples. Lockheed Martin Idaho Technologies Company (LMITCO) (1996) states that the upper tolerance limit for composite samples should not be applied to grab samples. The corresponding LMITCO (1996) upper tolerance limit for grab samples is 35,000 mg/kg [35,000 ppm]. Thus, it is concluded that iron has been appropriately screened out.

In Step 3, organic constituents and remaining metals were compared to U.S. Environmental Protection Agency (EPA) Preliminary Remediation Goals (PRGs) for residential soil. For arsenic, the higher noncancer PRG was appropriately used because the cancer-based PRG was below background. Although all contaminants for which PRGs were available were below the PRG levels (Step 3 in Table 3-3), the potential combined effects must be considered. FWENC addressed this issue by stating that because the PRGs were based on a carcinogenic risk level of 1×10^{-6}, combining their effects would still result in risk below the INEEL-employed risk level of 1×10^{-4}. However, this rationale is not appropriate for the 13 contaminants for which noncancer PRGs were used. The potential additive risk can be evaluated by applying the methodology recommended in EPA (2002, Section 3.3), in which carcinogenic and noncarcinogenic risks are considered separately using maximum concentrations. The additive carcinogenic risk is below 1×10^{-6}, and the noncarcinogenic Hazard Index is below one. Thus, the additive risks are below the respective levels of concern. (Note: if arsenic is considered, the noncarcinogenic Hazard Index is 1.2; however, considering the high natural background, this value is not considered a significant exceedence of the level of concern.)

The first three screening steps eliminated all contaminants for which PRGs are defined. Step 4 compared the two remaining organic contaminants (phenanthrene, total petroleum hydrocarbons–diesel) to EPA Ecologically Based Screening Levels (EBSLs) (EPA, 1999). An

Table 3-3. Idaho Spent Fuel Site Soil Contamination Screening Results[a]

Detected Contaminant	Number of Samples	Sample Results		Step 1		Step 2	Step 3		Step 4		Step 5
		Minimum Concentration (mg/kg)	Maximum Concentration (mg/kg)	Background (Composite) (mg/kg)	Is Maximum Concentration Greater Than Background?	Non-Toxic Metal?	Region IX PRG[b] (mg/kg)	Is Maximum Concentration Greater Than PRG?	Region IV EBSL[c] (mg/kg)	Is Maximum Concentration Greater Than EBSL?	Potential Concern?
Aluminum	16	3,850	15,400	16,000	No	—	—	—	—	—	No
Arsenic	16	2.3	8.9	5.8	Yes	No	22[d]	No	—	—	No
Barium	16	59.2	234	300	No	—	—	—	—	—	—
Beryllium	16	0.24	0.96	1.8	No	—	—	—	—	—	No
Cadmium	2	0.12	0.25	2.2	No	—	—	—	—	—	—
Calcium	16	8,080	42,700	24,000	Yes	Yes	—	—	—	—	No
Chromium	16	9.0	32.6	33	No	—	—	—	—	—	No
Cobalt	16	2.5	8.8	11	No	—	—	—	—	—	No
Copper	16	5.3	19.3	22	No	—	—	—	—	—	No
Iron	16	6,340	24,100	24,000	No	—	—	—	—	—	No
Lead	16	4.2	98.9[e]	17	Yes	No	400	No	—	—	No
Magnesium	16	3,600	9,170	12,000	No	—	—	—	—	—	No
Manganese	16	158	542	490	Yes	No	1,800	No	—	—	No
Mercury	4	0.03	0.05	0.05	No	—	—	—	—	—	No
Nickel	16	6.2	25.2	35	No	—	—	—	—	—	No
Potassium	16	1,040	4,060	4,300	No	—	—	—	—	—	No
Selenium	16	0.52	1.7	0.22	Yes	No	390	No	—	—	No

Table 3-3. Idaho Spent Fuel Site Soil Contamination Screening Results[a] (continued)

Detected Contaminant	Number of Samples	Sample Results		Step 1		Step 2	Step 3		Step 4		Step 5
		Minimum Concentration (mg/kg)	Maximum Concentration (mg/kg)	Background (Composite) (mg/kg)	Is Maximum Concentration Greater Than Background?	Non-Toxic Metal?	Region IX PRG[b] (mg/kg)	Is Maximum Concentration Greater Than PRG?	Region IV EBSL[c] (mg/kg)	Is Maximum Concentration Greater Than EBSL?	Potential Concern?
Sodium	16	243	636	320	Yes	Yes		—	—	—	No
Thallium	11	0.22	0.86	0.43	Yes	No	5.2	No	—	—	No
Vanadium	16	13.2	50.0	45	Yes	No	550	No	—	—	No
Zinc	16	26.4	104	150	No	—	—	—	—	—	No
AcetoneChromium 16 9.0 32.6 33 No — — — — — No	14	0.002	0.054	NA	NA	No	1,600	No	—	—	No
Trichlorofluoromethane	1	0.003	0.003	NA	NA	No	390	No	—	—	No
2-Methylnaphthalene	2	0.25	0.45	NA	NA	No	1,600[f]	No	—	—	No
Benzo(b)fluoranthene	1	0.073	0.073	NA	NA	No	0.62	No	—	—	No
Bis(2-Ethylhexyl)phthalate	7	0.088	1.1	NA	NA	No	35	No	—	—	No
Chrysene	1	0.091	0.091	NA	NA	No	62	No	—	—	No
Dibenzofuran	2	0.081	0.12	NA	NA	No	290	No	—	—	No
Fluoranthene	2	0.082	0.13	NA	NA	No	2,300	No	—	—	No
Naphthalene	2	0.17	0.32	NA	NA	No	56	No	—	—	No
Phenanthrene	2	0.15	0.21	NA	NA	No	No PRG	No PRG	0.1	Yes	Yes
Pyrene	2	0.079	0.10	NA	NA	No	2,300	No	—	—	No

Table 3-3. Idaho Spent Fuel Site Soil Contamination Screening Results[a] (continued)

Detected Contaminant	Number of Samples	Sample Results		Step 1		Step 2	Step 3		Step 4		Step 5
		Minimum Concentration (mg/kg)	Maximum Concentration (mg/kg)	Background (Composite) (mg/kg)	Is Maximum Concentration Greater Than Background?	Non-Toxic Metal?	Region IX PRG[b] (mg/kg)	Is Maximum Concentration Greater Than PRG?	Region IV EBSL[c] (mg/kg)	Is Maximum Concentration Greater Than EBSL?	Potential Concern?
TPH-Diesel	1	>51	>51	NA	NA	No	No PRG	No PRG	No EBSL	No EBSL	No
Motor Oil	3	>100	>100	NA	NA	No	No PRG	No PRG	No EBSL	No EBSL	No

EBSL = Ecologically Based Screening Level
EPA = U.S. Environmental Protection Agency
FWENC = Foster Wheeler Environmental Corporation
NA = Not applicable
PRG = preliminary remediation goal
TPH = total petroleum hydrocarbons

[a] FWENC. "Foster Wheeler Environmental Corporation Idaho Spent Fuel Facility Response to NRC Request for Additional Information Related to Environmental Review." NRC Docket No. 72-25. TAC No. L20768. Table 5-1-1. Letter (March 7) from R.D. Izatt to NRC. FW–NRC–ISF–03–0048. Richland, Washington: FWENC. 2003.
[b] EPA Region IX, Preliminary Remediation Goals Table 2002 Update, Residential Soils (EPA. "Region 9 PRGs Table Users Guide/Technical Background Document." San Francisco, California: EPA, Region 9. 2002. <http://www.epa.gov/region09/waste/sfund/prg/files/02userguide.pdf>
[c] EPA Region IV, Recommended Ecological Screening Values (mg/kg) for soil (EPA. "Region 4 Waste Management Division Soil Screening Values for Hazardous Waste Sites." Atlanta, Georgia: EPA Region 4. <http://www.epa.gov/region04/waste/ots/epatab4.pdf> 1999. .
[d] The residential soils PRG for arsenic is 0.39 mg/kg [0.39 ppm]. However, when the natural background is higher than the risk-based concentration, EPA Region 4 allows use of the noncancer PRG {22 mg/kg [22 ppm]} to evaluate the site.
[e] Only one lead sample was greater than background; it is likely that a minute piece of metal was part of this sample and represents a hot spot.
[f] EPA Region III, Risked Based Concentration Table (EPA. "Region III Risk-Based Concentration Table." Philadelphia, Pennsylvania: EPA Region 3. <http://www.epa.gov/reg3hwmd/risk/rbc1002.pdf> 2002. Region 9 PRG not available

NOTE: To convert mg/kg to parts per million (ppm), multiply by 1..

EBSL is defined only for one—phenanthrene—and it exceeded the EBSL. All three contaminants were then passed to Step 5, in which alternative considerations were made. The maximum phenanthrene concentration was twice as high as the EBSL, but the total for all polycyclic aromatic hydrocarbons (a group to which phenanthrene belongs) was below the corresponding EBSL for the group. In addition, the maximum phenanthrene concentration of 0.21 mg/kg [0.21 ppm] was well below the 5 mg/kg [5 ppm] value defined as moderate soil contamination that requires additional study (Beyer, 1990). Finally, FWENC (2003) shows that total petroleum hydrocarbons–diesel and motor oil are well below levels of concern.

3.4.3 Geologic Natural Resources

No geologic resources are identified at the site of the proposed Idaho Spent Fuel Facility. Known mineral resources inside the INEEL boundary are limited to several quarries or pits that supply sand, gravel, pumice, silt, clay, and aggregate for road construction and maintenance, new facility construction and maintenance, waste burial activities, and ornamental landscaping cinders. Outside the INEEL site boundary, mineral resources include sand, gravel, pumice, phosphate, and base and precious metals (Strowd, et al., 1981; Mitchell, et al., 1981). The geologic history of the Plain makes the potential for petroleum production at the INEEL very low. In 1979, INEEL drilled a geothermal exploration well to 3,159 m [10,365 ft]. Researchers measured a temperature of 142 °C [288 °F] but identified no commercial quantities of geothermal fluids (Idaho Department of Water Resources, 1980).

3.4.4 Seismic Hazard

The distribution of earthquakes at and near the INEEL from 1884 to 1989 clearly shows that the Eastern Snake River Plain has a low rate of seismicity, whereas the surrounding Basin and Range Province has a relatively high rate (Figure 3-5) (Woodward-Clyde Consultants, 1992). The mechanism for faulting and generation of earthquakes in the Basin and Range Province is attributed to northeast-southwest directed crustal extension.

Major seismic hazards include the effects from ground shaking and surface deformation (faulting, tilting). Other potential seismic hazards (e.g., avalanches, landslides, mudslides, soil settlement, and soil liquefaction) are not likely to occur at the INEEL because the local geologic conditions are not conducive. Based on the seismic history and the geologic conditions, earthquakes greater than moment magnitude 5.5 (and associated strong ground shaking and surface fault rupture) are not likely to occur in the Plain. However, moderate to strong ground shaking from earthquakes in the Basin and Range Province can affect the INEEL. Researchers use patterns of seismicity and locations of mapped faults to assess potential sources of future earthquakes and to estimate levels of ground motion at the site. The sources and maximum magnitudes of earthquakes that could produce the maximum levels of ground motions at all INEEL facilities include the following (Woodward-Clyde Consultants, 1990, 1992):

- A moment magnitude 7.0 earthquake at the southern end of the Lemhi fault along the Howe and Fallert Springs segments;

- A moment magnitude 7.0 earthquake at the southern end of the Lost River fault along the Arco segment;

- A moment magnitude 5.5 earthquake associated with dike injection in either the Arco or Lava Ridge–Hell's Half Acre Volcanic Rift Zone and the Axial Volcanic Zone; and

- A random moment magnitude 5.5 earthquake in the Eastern Snake River Plain.

3.4.5 Volcanic Hazard

Potential volcanic hazards to the proposed Idaho Spent Fuel Facility arise primarily from lava flows and airborne ash-falls. Lavas are hot {1,100 °C [2,000 °F]}, heavy {2,600 kg/m^3 [4,374 lb/yd^3]} flows of molten rock that can travel down slopes at several miles per hour. Lava flows that could possibly affect the site would likely originate from a new basaltic volcano that formed in either the Axial Volcanic Zone or the Arco Volcanic Rift Zone (Figure 3-4). These volcanic zones are closest to the proposed Idaho Spent Fuel Facility and contain volcanoes younger than 400,000 years old. Based on an analysis of past volcanic eruptions in the INEEL area, the Volcanism Working Group (1990) estimated a likelihood of $<2 \times 10^{-5}$ per year for a new volcano forming in these zones and erupting a lava flow that would be long enough to reach the general area of the proposed Idaho Spent Fuel Facility.

Volcanic ash is a relatively hard, highly abrasive, fine-grained particulate that can produce loads on horizontal surfaces, readily clog air- and water-filtration systems, rapidly abrade pumps and seals, and short electrical systems. Volcanic ash-falls could occur at the site from eruptions as far away as the Cascade Mountains. Hoblitt, et al. (1987) calculated a 10^{-3} annual probability for a 1-cm- [0.4-in-] thick ash deposit forming at the INEEL from a Cascade volcano eruption. This annual probability decreases to 10^{-6} for a 10-cm- [4-in-] thick ash deposit (Hoblitt, et al., 1987). Rhyolite dome volcanoes, such as Big Southern Butte or East Butte, also have the potential to produce ash-fall deposits within tens of kilometers from the volcano (e.g., Scott, 1987). In addition, large-volume eruptions from the Yellowstone Volcanic Zone could produce appreciable ash-fall deposits at INEEL in the unlikely event that regional winds were directed to the southwest during a potential eruption (Figure 3-4).

3.5 Water Resources

3.5.1 Surface Water Resources

This description of the surface water resources in the affected environment at the INEEL is based on the DOE Idaho HLW and Facilities Disposition EIS (DOE, 2002a, Section 4.8). Other than surface-water bodies formed from accumulated runoff during snowmelt or heavy precipitation and artificial infiltration and evaporation ponds, there is little surface water at the site.

3.5.1.1 Regional Drainage

INEEL is located in the Mud Lake–Lost River Basin (also known as the Pioneer Basin). Figure 3-6 shows major surface water features of this basin. This closed drainage basin includes three main streams—the Big and Little Lost Rivers and Birch Creek. These three streams drain the mountain areas to the north and west of INEEL, although most flow is diverted for irrigation in the summer months before it reaches the site boundaries.

The Big Lost River drains approximately 3,755 km^2 [1,450 mi^2] of land before reaching the site. Approximately 48 km [30 mi] upstream of Arco, Idaho, Mackay Dam controls and regulates the

flow of the river, which continues southeast onto the Eastern Snake River Plain. The river channel then crosses the southwestern boundary of the INEEL, where the INEEL Diversion Dam controls surface-water flow. During heavy runoff events, the dam diverts surface water to a series of natural depressions, designated as spreading areas (Figure 3-6). During periods of high flow or low irrigation demand, the Big Lost River continues past the diversion dam to the northeast. It passes within 61 m [200 ft] of INTEC and 1,200 m [4,000 ft] of the proposed Idaho Spent Fuel Facility to an area of natural infiltration playas or sinks about 24 to 32 km [15 to 20 mi] northeast of INTEC. In dry years, surface water does not usually reach the western boundary of the site. Because INEEL is located in a closed drainage basin, surface water does not flow off the site.

Birch Creek drains an area of approximately 1,940 km^2 [750 mi^2]. Upstream of INEEL, surface water from Birch Creek is diverted during the summer to provide irrigation and to produce hydropower. In the winter, water flow crosses the northwest corner of the site, entering a humanmade channel 6.4 km [4 mi] north of Test Area North, where it then infiltrates into channel gravels.

The Little Lost River drains an area of approximately 1,825 km^2 [705 mi^2]. Streamflow is diverted for irrigation north of Howe, Idaho. Surface water from the Little Lost River has not reached the site in recent years; however, during high stream flow years, water would reach the site and infiltrate into the subsurface (DOE, 2002a, Section 4.8).

3.5.1.2 Local Drainage

INTEC is located on an alluvial plain and its northwest corner is approximately 61 m [200 ft] east of the Big Lost River channel. Located at the southeast corner of INTEC, the proposed Idaho Spent Fuel Facility is about 1,220 m [4,000 ft] east of the channel. Surface water generated from local precipitation would flow into lower areas on the site. This surface water either evaporates or infiltrates into the ground, increasing subsurface saturation and enhancing subsurface migration (Wilhelmson, et al., 1993). Localized flooding can occur at the site when the ground is frozen and melting snow combines with heavy spring rains. In 1969, rapid snowmelt caused extensive flooding in the lower Birch Creek Valley, and Test Area North was flooded (DOE, 2002a, Section 4.8).

INTEC is surrounded by a storm water drainage ditch system (DOE, 2002a, Section 4.8). The drainage system, including dikes and erosion-prevention

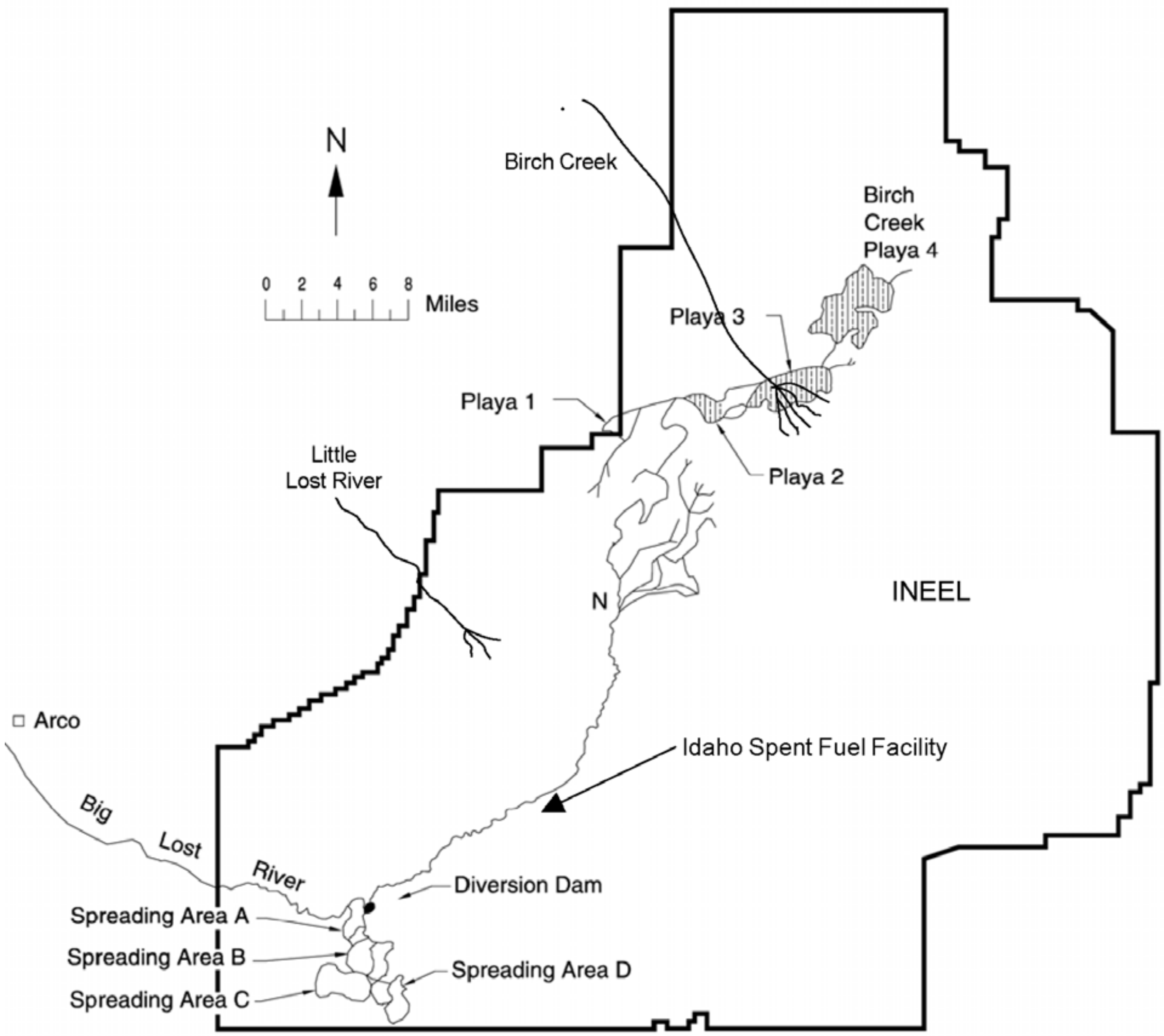
Flood Frequency Terms

Flood frequency is typically characterized by the *recurrence interval* of a flood (or flow). This term is the average period of time that elapses between floods of a given size. Larger floods are more infrequent, and therefore have a larger recurrence interval. Recurrence intervals are calculated based on historical measurements of flow and on geologic evidence of flooding.

<u>100-Year Flood</u>—The 100-year flood does not necessarily occur only once every 100 years, but rather has a 1/100 (1 percent) probability of occurring in any given year.

<u>500-Year Flood</u>—Similar to the 100-year flood, the 500-year flood may occur more or less than once in a 500-year period, but has only a 1/500 (0.2 percent) probability in any given year.

<u>Probable Maximum Flood</u>—This hypothetical flow scenario is used to place an upper bound on the impacts of flooding. It is not assigned a probability, but is intended to represent the combination of events (snowmelt, precipitation, dam failure) that could lead to maximum streamflow.



1 **Figure 3-6. Surface Drainages Associated with the Big Lost River System (Modified from FWENC, 2001b)**

features designed to mitigate potential surface water flooding, is being upgraded (DOE, 2001a, 2002a). Storm water runoff from most areas of INTEC flows through the ditches to an abandoned gravel pit on the northeast side of INTEC. From the gravel pit, the runoff infiltrates and provides potential recharge to the Snake River Plain aquifer. The system is designed to handle a maximum 24-hour storm event with a 25-year recurrence interval. DOE built a secondary system around the facility to hold water if the first system overflows. Because the land is relatively flat (slopes of generally less than 1 percent) and annual precipitation is low, storm water runoff volumes are small and are generally spread over large areas where they evaporate or infiltrate the ground surface. Annual precipitation at INEEL averaged 22 cm/yr [8.7 in/yr] from 1951 through 1994. Annual net evaporation from large water surfaces in the Eastern Snake River Plain is 84 cm/yr [33 in/yr] (Rodriguez, et al., 1997).

Artificial surface water features at INTEC consist of two percolation ponds used for disposal of water from the service waste system and sewage-treatment lagoons and infiltration trenches for treated wastewater. Service water consists of raw water, demineralized water, treated water, and steam condensate (Rodriguez, et al., 1997). The sewage-treatment plant receives an average sanitary sewage flow of 159,000 L/day [42,000 gal/day]. The percolation ponds receive approximately 5.7 to 9.5 million L/day [1.5 to 2.5 million gal/day] of service wastewater per day and are each approximately 1.8 ha [4.5 acres] in size (Rodriguez, et al., 1997).

3.5.1.3 Flood Plains

Flood studies at the INEEL (Figure 3-7) include the examination of the flooding potential at INEEL facilities from a probable maximum flood (Koslow and Van Haaften, 1986) caused by the hypothetical failure of Mackay Dam, 73 km [45 mi] upstream of the INEEL. The U.S. Geological Survey has published a preliminary map of the 100-year flood plain for the Big Lost River on the INEEL (Berenbrock and Kjelstrom, 1998). As a result of this screening analysis, which indicated that INTEC may be subject to flooding from a 100-year flood, DOE commissioned additional studies (Ostenaa, et al., 1999) consistent with the requirements contained in DOE standards for a comprehensive flood hazard assessment (DOE, 1996a). There is no historical record of any flooding at the INTEC from the Big Lost River, although evidence of prehistoric flooding exists in the geologic sediments at the site.

Estimates of the 100- and 500-year flows for the Big Lost River were most recently published by the U.S. Geological Survey (Berenbrock and Kjelstrom, 1996) and the U.S. Bureau of Reclamation (Ostenaa, et al., 1999). The U.S. Geological Survey 100-year flow estimate is 205 m^3/s [7,260 ft^3/s] at the Arco gauging station 19 km [12 mi] upstream of the INEEL Diversion Dam. This estimate is based on 60 years of stream gauge data and conservative assumptions to account for the effects of Big Lost River regulation and irrigation. The U.S. Geological Survey published a preliminary map of the Big Lost River flood plain (Berenbrock and Kjelstrom, 1998) based on the 205-m^3/s [7,260-ft^3/s], 100-year flow estimate. In this study, it was assumed that the INEEL Diversion Dam did not exist and that 29.4 m^3/s [1,040 ft^3/s] would be captured by the diversion channel and flow to the spreading areas southwest of the Diversion Dam. The model then routed the remaining 176 m^3/s [6,220 ft^3/s] down the Big Lost River channel on the INEEL. A U.S. Army Corps of Engineers analysis of existing data (Bhamidipaty,1997) and an INEEL geotechnical analysis (LMITCO, 1998) both concluded that the INEEL Diversion Dam could withstand flows up to 170 m^3/s [6,000 ft^3/s]. Culverts running through the diversion dam could convey a maximum of 25 m^3/s [900 ft^3/s] downstream, but their condition and capacity as a function of water elevation is unknown (Bhamidipaty, 1997). Although the net capacity of the

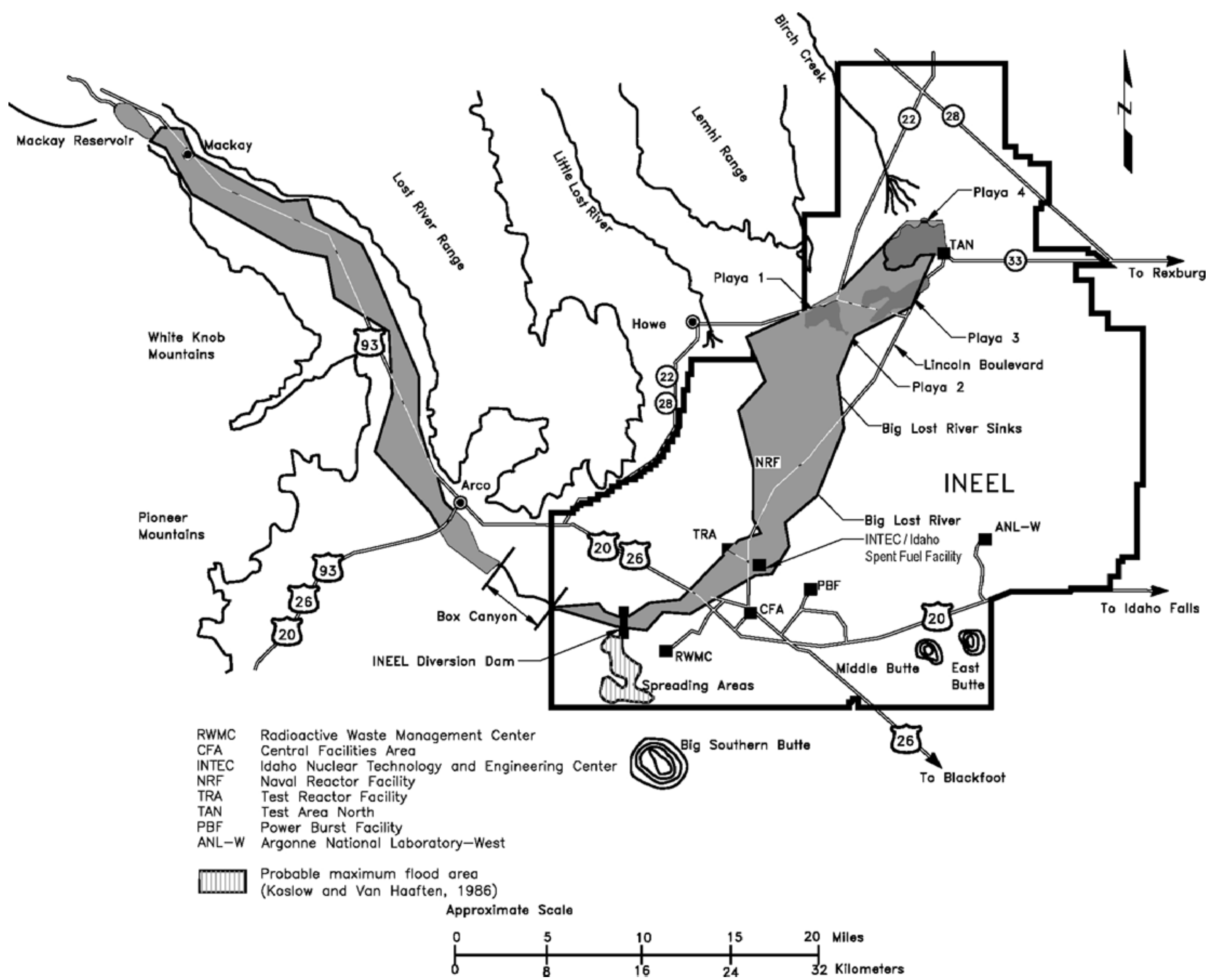


Figure 3-7. Predicted Inundation Area at INEEL for a Probable Maximum Flood Event with Overtopping of the Mackay Dam (Modified from FWENC, 2001b)

INEEL Diversion Dam may exceed U.S. Geological Survey 100-year flow estimates, it is not certified or used as a flood control structure for flood plain mapping purposes. The estimated 100-year flood plain covers the northern part of INTEC, but does not reach the southeast corner where the proposed Idaho Spent Fuel Facility would be located (DOE, 2002a, Figure 4-9).

The flows and frequencies in the U.S. Bureau of Reclamation study are based on statistical analyses with inputs from stream gauge data and two-dimensional flow modeling constrained by geomorphic evidence. Radiocarbon dating indicates that the geologic evidence records Big Lost River flow history over the last 10,000 years. The mean Bureau of Reclamation estimate for the 100-year flow of the Big Lost River is 82 m^3/s [2,910 ft^3/s]. The 100-year flood plain was estimated based on a flow with a 97.5-percent chance of not being exceeded in 100 years {92.6 m^3/s [3,270 ft^3/s]}. The mean Bureau of Reclamation estimate for the 500-year Big Lost River flow is 104 m^3/s [3,669 ft^3/s]. The 500-year flood plain was estimated based on a flow with a 97.5-percent chance of not being exceeded in 500 years {116 m^3/s [4,086 ft^3/s]}. These flood plain maps were generated assuming one-dimensional flow, no infiltration or flow loss along the Big Lost River flow path, and no diversion dam. With these conservative assumptions, small areas of the northern portion of INTEC could flood at the estimated 97.5 quantile 100- and 500-year flows. However, the southeast corner of INTEC where the proposed Idaho Spent Fuel Facility would be located is not within the estimated 97.5 quantile 100- and 500-year flood plains (DOE, 2002a, Figure 4-9). Additional work is underway at INEEL by both the U.S. Geological Survey and the Bureau of Reclamation to refine flow frequency estimates further for the Big Lost River in the vicinity of INTEC.

3.5.1.4 Surface Water Quality

Water quality in the Big Lost River has remained fairly constant over the period of record. Applicable drinking water quality standards for measured physical, chemical, and radioactive parameters have not been exceeded (DOE, 1995, Volume 2, Part A, Section 4.8). The chemical composition of the water reflects the carbonate mineral composition of the surrounding mountain ranges northwest of INEEL and the chemical composition of return irrigation water drained to the Big Lost River (DOE, 2002a, Section 4.8). INEEL activities do not directly affect the quality of surface water outside the site because discharges are to humanmade seepage and evaporation basins or storm water injection wells. Effluents are not discharged to natural surface waters. In addition, surface water does not flow directly off the site (Hoff, et al., 1990). However, water from the Big Lost River, as well as seepage from evaporation basins and storm water injection wells, does infiltrate the Snake River Plain Aquifer (DOE, 2002a, Section 4.8). These areas are inspected, monitored, and sampled as stipulated in the INEEL Storm Water Pollution Prevention Program (DOE, 2001a).

DOE measures surface water quality at INTEC at two storm water monitoring locations, the percolation ponds and the sewage-treatment lagoons. The storm water monitoring locations are at the inlet to the retention basin on the northeast side of INTEC and on the south side of a coal pile at the discharge to a ditch. The coal pile is located on the southeast side of INTEC. DOE monitors for metals, inorganics, radiological constituents, and volatile organic compounds in storm water (LMITCO, 1997). EPA-specified nonradiological benchmarks (EPA, 1995) and radiological benchmarks from the Derived Concentration Guides from DOE Order 5400.5 form the baseline values from which DOE monitors. INTEC data for 1996 indicate that contaminants are below benchmark levels (DOE, 2002a, Section 4.8). Benchmarks are the pollutant concentrations above which EPA and DOE have determined represent a level of concern. The

level of concern is the concentration at which a storm water discharge could potentially impact or contribute to water quality impairment or affect human health as a result of ingestion of water or fish.

Liquid effluents monitored at INTEC include effluent from the service waste system to the percolation ponds and effluent from the sewage-treatment plant prior to discharge to the rapid infiltration trenches. Wastewater Land Application Permits from the State of Idaho have been issued for these discharges. Monitoring results for the percolation pond in 1996 indicate the effluent constituent concentrations are within acceptable ranges, and annual flow volumes are within the limits specified in the permits (LMITCO, 1997). In 2000, the sewage treatment plant effluent did not exceed the 100-mg/L [100-ppm] total suspended solids limit, or the flow limit specified in the permit. The 20-mg/L [20-ppm] total nitrogen limit for the sewage treatment plant effluent was exceeded in three monthly samples during the calendar year. However, the 2000 total nitrogen average was 15.6 mg/L [15.6 ppm]. As part of the ongoing nitrogen study, an indepth inventory of nitrogen sources contributing to the INTEC sewage treatment plant was performed. The study did not identify any new sources. Additional corrective actions are planned (DOE, 2001b).

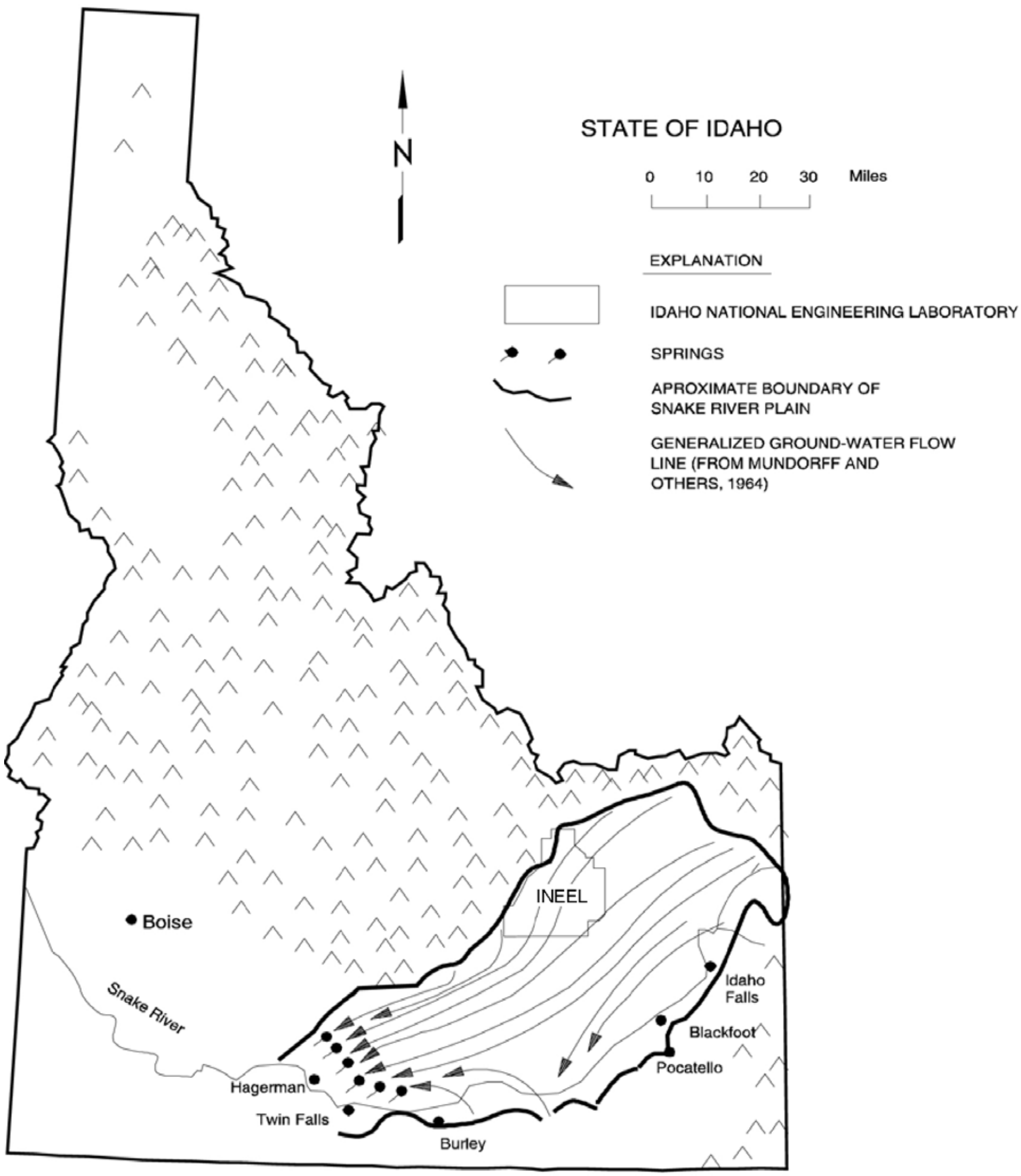
3.5.2 Groundwater Resources

This description of the subsurface water resources in the affected environment at the INEEL is based on the DOE Idaho HLW and Facilities Disposition EIS (DOE, 2002a, Section 4.8). Subsurface water at the site occurs in the Snake River Plain Aquifer and the vadose zone. Generally, the term groundwater refers to usable quantities of water that enter freely into wells under confined and unconfined conditions within an aquifer.

3.5.2.1 Local Hydrogeology

The INEEL overlies the Snake River Plain Aquifer, the largest aquifer in Idaho (Figure 3-8). This aquifer is the major source of drinking water for southeast Idaho and has been designated a sole-source aquifer by EPA. This aquifer underlies the Eastern Snake River Plain and covers an area of approximately 24,900 km^2 [9,611 mi^2]. The aquifer flows to the south and southwest. Depth to the top of the aquifer ranges from 61 m [200 ft] in the northern part of INEEL to about 274 m [900 ft] in the southern part. Beneath the proposed Idaho Spent Fuel Facility, the depth to water is estimated to be 140 to 146 m [460 to 480 ft] (Rodriquez, et al., 1997). The aquifer, with estimates of thickness ranging from 76 m [250 ft] to more than 914 m [3,000 ft], consists of thin basaltic flows, interspersed with sedimentary layers.

The drainage basin recharging the Snake River Plain Aquifer covers an area of approximately 90,640 km^2 [35,000 mi^2] (DOE, 1995, 2002a). The aquifer is recharged by infiltration of irrigation water, seepage from stream channels and canals, underflow from tributary stream valleys extending into the watershed, and direct infiltration from precipitation (DOE, 2002a, Section 4.8). Most recharge is from irrigation water and by valley underflow from the mountains to the north and northeast of the plain and along the northeastern margins of the plain. Some recharge also occurs directly from precipitation (Rodriguez, et al., 1997). Groundwater in the aquifer generally flows south and southwestward across the Snake River Plain. The estimated water storage in the aquifer is 2.5×10^{12} m^3 [2 billion acre-ft]. A typical irrigation well can yield as much as 26,500 L/min [7,000 gal/min] (DOE, 1995) or 13.9 billion L/yr [3.7 billion gal/yr] of



1 **Figure 3-8. Regional Groundwater Flow in the Snake River Plain Aquifer Beneath INEEL (Modified from FWENC, 2001b). To Convert Miles to Kilometers, Multiply by 1.6.**

water if pumped every day (DOE, 2002a, Section 4.8). The Snake River Plain Aquifer is among the most productive aquifers in the nation.

Groundwater discharges primarily from the aquifer through springs that flow into the Snake River and from pumping for irrigation. Major springs and seepages that flow from the aquifer are located near the American Falls Reservoir (southwest of Pocatello) and the Thousand Springs area between Milner Dam and King Hill (near Twin Falls) (DOE, 2002a, Section 4.8).

The aquifer's ability to transmit water (transmissivity) and its ability to store water (storativity) are important physical properties of the aquifer. In general, the hydraulic characteristics of the aquifer enable the easy transmission of water, particularly in the upper portions. The rate at which water moves through the ground depends on the hydraulic gradient (change in elevation and pressure with distance in a given direction) of the aquifer, the effective porosity (percentage of void spaces), and hydraulic conductivity (capacity of a porous media to transport water) of the soil and bedrock. The local hydraulic gradient is low, 2×10^{-4} m/km [1.2 ft/mi], compared to the regional gradient of 8×10^{-4} km/mi [4 ft/mi] (Rodriguez, et al., 1997). In the INTEC area, the hydraulic conductivity ranges over five orders of magnitude {0.03 to 3,048 m/day [0.10 to 10,000 ft/day]}, with an average of 246 m/day [1,300 ft/day] (Rodriguez, et al., 1997). Because aquifer porosity and hydraulic conductivity decrease with depth, most of the water in the aquifer moves through the upper 61 to 152 m [200 to 500 ft] of the basalts. Estimated flow rates within the aquifer range from 1.5 to 6.1 m [5 to 20 ft] per day (Barraclough, et al., 1981).

3.5.2.2 Vadose Zone Hydrology

The vadose zone extends down from the ground surface to the regional water table (the top of the Snake River Plain Aquifer). Within the vadose zone, water and air occupy openings in the geologic materials. Subsurface water in the vadose zone is referred to as vadose water. At the site, this complex zone consists of surface sediments (primarily clay and silt, with some sand and gravel) and many relatively thin basaltic lava flows, with some sedimentary interbeds. Thick surficial deposits occur in the northern part of the site, which thin to the south where basalt is exposed at the surface. Perched water bodies are the exception. The vadose zone at INTEC extends from the ground surface to 140 to 146 m [460 to 480 ft] below the ground surface (Rodriguez, et al., 1997). The vadose zone protects the groundwater by filtering many contaminants through adsorption, buffering dissolved chemical wastes, and slowing the transport of contaminated liquids to the aquifer. The vadose zone also protects the aquifer by storing large volumes of liquid or dissolved contaminants released to the environment through spills or migration from disposal pits or ponds, allowing natural decay processes to occur.

Travel times for water through the vadose zone are important for an understanding of contaminant movement. The flow rates in the vadose zone depend directly on the extent of fracturing, the percentage of sediments versus basalt, and the moisture content of vadose zone material. Flow increases under wet conditions and slows under dry conditions. During dry conditions, transport of contaminants downward toward the aquifer is slow. Measurements taken at the INEEL Radioactive Waste Management Complex during unsaturated flow conditions indicated a downward infiltration rate ranging from 0.55 to 1.7 mm/yr [0.14 to 0.43 in/yr] (Cecil, et al., 1992). In another study during near-saturated flow conditions in the same area, standing water infiltrated downward 2.1 m [6.9 ft] in less than 24 hours (Kaminsky, 1991). During 1994, an infiltration study was conducted at INTEC that showed significant increase in moisture to a depth of 3 m [10 ft] after 2 hours (LMITCO, 1995).

3.5.2.3 Perched Water

Perched water occurs when water migrates vertically and laterally from the surface until it reaches an impermeable layer above the regional water table (Irving, 1993). As perched water spreads laterally, sometimes for hundreds of meters, it moves over the edges of the impermeable layer and continues downward. In general, perched water bodies slow the downward migration of fluids that infiltrate into the vadose zone from the surface because the downward flow is not continuous (DOE, 2002a, Section 4.8).

Historically at INTEC there have been three zones of perched water ranging from approximately 9 to 98 m [30 to 322 ft] below the ground surface. These zones include (i) a shallow perched water zone in the Big Lost River alluvium above the basalt, (ii) an upper basalt perched water zone, and (iii) a lower basalt perched water zone. Each zone is comprised of a number of smaller perched water bodies that may or may not be hydraulically connected.

The shallow perched water zone in the Big Lost River alluvium in the southern area of INTEC is believed to no longer exist (Rodriguez, et al., 1997). The upper basalt perched water zone occurs between the depths of 30 and 43 m [100 and 140 ft]. At the northern end of INTEC, there is a body of upper basalt perched water beneath the sewage treatment ponds on the eastern side of INTEC extending toward the west under north-central INTEC. The western portion of the northern perched water body receives water from other sources including the Big Lost River, leaking fire water lines, precipitation infiltration, steam condensate dry wells, and lawn irrigation (DOE, 2002a, Section 4.8). In the southern area of INTEC, a large body of perched water in the upper basalt has resulted primarily from discharge to the percolation ponds (Rodriguez, et al., 1997). The lower basalt perched water zone occurs in the basalt between 97 and 128 m [320 and 420 ft] below the ground surface. Two areas of perched water occur in the lower basalt, essentially directly beneath the upper basalt perched water. The northern body of lower basalt perched water is recharged from the sources contributing to the upper perched water. The lower perched water was influenced by the failure of an injection well in the late 1960s and late 1970s that allowed injection of service wastewater directly into the northern lower perched water body. The southern lower basalt perched water body is recharged from the discharge from the percolation ponds (Rodriguez, et al., 1997).

3.5.2.4 Subsurface Water Quality

Natural water chemistry and contaminants originating at the site affect subsurface water quality. The INEEL Groundwater Protection Management Program and DOE perform groundwater monitoring at INTEC and the surrounding area to monitor drinking water, detect unplanned releases to groundwater, identify potential environmental problems, and ensure compliance with federal, State of Idaho, and DOE groundwater regulations and monitoring requirements. Subsurface water quality is also monitored by the U.S. Geological Survey and the Bechtel BWXT Idaho, LLC, Environmental Monitoring Program. This program collects samples from surface water, perched water, and aquifer wells to identify contaminants and contaminant migration to and within the aquifer. Groundwater monitoring at INEEL is generally divided into four categories: drinking water monitoring, compliance monitoring, surveillance monitoring, and special studies.

Several factors determine the natural groundwater chemistry of the Snake River Plain Aquifer beneath the site. These factors include the weathering reactions that occur as water interacts

with minerals in the aquifer and the chemical composition of (i) groundwater originating outside the site; (ii) precipitation falling directly on the land surface; and (iii) streams, rivers, and runoff infiltrating the aquifer (DOE, 2002a, Section 4.8). The chemistry of the groundwater is different, depending on the source areas. For example, groundwater from the northwest contains calcium, magnesium, and bicarbonate leached from sedimentary rocks, and groundwater from the east contains sodium, fluorine, and silicate resulting from contact with volcanic rocks. Although the natural chemical composition of groundwater beneath the site does not exceed the EPA drinking water standards for any component, the natural chemistry affects the mobility of contaminants introduced into the subsurface from INEEL activities. Many dissolved contaminants adsorb (or attach) to the surface of rocks and minerals in the subsurface, thereby retarding the movement of contaminants in the aquifer and inhibiting further migration of contamination. However, many naturally occurring chemicals compete with contaminants for adsorption sites on the rocks and minerals or react with contaminants to reduce their attraction to rock and mineral surfaces.

INTEC drinking water wells are hydrologically upgradient of the INTEC facility. Measured drinking water parameters at INEEL are compared to the maximum contaminant levels established in the Safe Drinking Water Act. State regulations are in the Idaho Rules for Public Drinking Water Systems (Idaho Department of Environmental Quality, 2001a). In 2000, the most recent year with published data, all drinking water samples collected at INTEC had concentrations below the maximum contaminant levels specified in federal and state drinking water regulations (DOE, 2001b).

DOE performs compliance groundwater monitoring at INTEC to meet the requirements of the State of Idaho Wastewater Land Application Permits. The two areas monitored include wells in the vicinity of the percolation ponds and near the sewage treatment pond. The permits require compliance with the Idaho Groundwater Quality Standards in specified downgradient groundwater monitoring wells, annual discharge volume and application rates, and effluent quality limits (Idaho Department of Environmental Quality, 2001b). Permit variance limits were granted for total dissolved solids and chloride at the percolation pond compliance monitoring wells. The primary source of total dissolved solids and chloride in the percolation ponds is the INTEC water treatment processes. The data for 1996 indicate that no permit limits (or permit variance limits) were exceeded at the percolation ponds in 1996 (LMITCO, 1997). At the compliance well for monitoring the sewage treatment plant, maximum allowable concentrations were not exceeded. However, at a shallow well (ICPP–MON–PW–024) adjacent to the sewage treatment plant, levels of total dissolved solids, chloride, and nitrogen compounds were elevated. DOE monitors this well to evaluate the effectiveness of treatment and to detect unplanned releases. Based on the information obtained from the monitoring data, DOE would alter treatment processes to optimize wastewater treatment and remove elevated nitrogen compounds (LMITCO, 1997).

DOE conducts surveillance monitoring at INTEC to meet the requirements of DOE Order 5400.1. This order requires DOE facilities with contaminated (or potentially contaminated) groundwater resources to establish a groundwater monitoring program. The monitoring program is designed to determine and document the impacts of facility operations on groundwater quantity and quality and to demonstrate compliance with federal, state, and local regulations. DOE (2002a, Section 4.8) summarizes monitoring parameters that exceeded surveillance thresholds (Table 3-4). The surveillance thresholds are the Safe Drinking Water Act maximum contaminant levels and secondary maximum contaminant levels.

Table 3-4. Monitoring Parameters That Were Exceeded for INTEC Surveillance Wells[a]

Location	Exceeded Parameter	Maximum Concentration	Surveillance Threshold[b]
PW–1[c]	Aluminum	0.254 mg/L	0.05 mg/L
	Iron	26 mg/L	0.3 mg/L
	Lead	0.0036 mg/L	0 mg/L
PW–2[c]	Aluminum	1.49 mg/L	0.05 mg/L
	Chloride	287 mg/L	250 mg/L
	Iron	2.2 mg/L	0.3 mg/L
	Strontium-90	8.3 ± 3.4 pCi/L	8.0 pCi/L
PW–4[c]	Iron	2.2 mg/L	0.3 mg/L
PW–5[c]	Aluminum	0.0562 mg/L	0.05 mg/L
	Iron	2.93 mg/L	0.3 mg/L
USGS–036[d]	Strontium-90	9.54 ± 1.34 pCi/L	8.0 pCi/L
USGS–052[d]	Gross alpha	15 ± 3.86 pCi/L	15.0 pCi/L
USGS–057[d]	Strontium-90	21.1 ± 3.43 pCi/L	8.0 pCi/L
USGS–067[d]	Strontium-90	11.1 ± 1.47 pCi/L	8.0 pCi/L
ICPP–MON–A–021[e]	Total coliform	20 colonies/100 mL	<1 colony/100 mL
ICPP–MON–A–022[f]	Iron	0.487 mg/L	0.3 mg/L

DOE = U.S. Department of Energy
EIS = environmental impact statement
INTEC = Idaho Nuclear Technology and Engineering Center

[a] DOE. DOE/EIS–0287–F, “Idaho High-Level Waste and Facilities Disposition Final Environmental Impact Statement.” Idaho Falls, Idaho: DOE, Idaho Operations Office. 2002.
[b] Surveillance thresholds are comparison values consisting of maximum contaminant levels and secondary maximum contaminant levels (40 CFR Part 141).
[c] INTEC percolation pond perched water surveillance well
[d] INTEC percolation pond aquifer surveillance well
[e] INTEC upgradient background well (upgradient Sewage Treatment Plant well)
[f] INTEC Sewage Treatment Plant surveillance well

NOTE: To convert liters (L) to gallons (gal), multiply by 0.264; to convert milligrams per liter (mg/L) to parts per million, multiply by 1.0; to convert picocuries (pCi) to Becquerel, multiply by 0.037.

At the perched-water surveillance wells for the percolation ponds, the constituents elevated above the threshold limits include aluminum, chloride, iron, lead, and strontium-90. The causes for the elevated aluminum, lead, and iron concentrations are uncertain, although there may be some corrosion of well components. The chloride concentration is consistent with historical chloride concentrations and reflects the concentration within the percolation ponds. The source of chloride is the water-treatment processes. The strontium-90 concentrations are most likely residual from the historical discharges of radionuclides to the percolation ponds. Most

radionuclide discharges to the percolation ponds were discontinued in 1993 when the INTEC Liquid Effluent Treatment and Disposal Facility began operations.

In 1995, surveillance monitoring at the sewage-treatment plant wells indicated measurements of total coliform, iron, and strontium-90 above threshold levels. DOE suspects that the total coliform measurement is the result of cross-contamination. The source of iron is unknown. Strontium-90 concentrations are consistent with historical values (LMITCO, 1997). In 2000, data were available for USGS–52, indicating the gross alpha concentrations were above threshold levels (DOE, 2002c). Constituents detected above threshold levels in surveillance wells are strontium-90 and tritium. Strontium-90 and tritium values are consistent with historical values and reflect discontinued discharge practices (LMITCO, 1997).

In 1995, an indepth study of soil and groundwater contamination was conducted at INTEC (Rodriguez, et al., 1997), and in 2001, tracer and monitoring studies were conducted on INTEC perched water and the Snake River Plain Aquifer (DOE, 2002c,d). Table 3-5 shows the maximum concentrations of inorganics and radionuclides in the Snake River Plain Aquifer found in these studies and monitoring efforts. The percolation pond perched water body was not monitored as part of the 1995 study, but was previously described as part of the discussion of the surveillance monitoring program. All perched water bodies monitored in the 1995 study had samples exceeding the nitrate and nitrite federal and state drinking water maximum contaminant level of 10 mg/L [10 ppm]. The highest nitrate and nitrite concentration {69.6 mg/L [69.6 ppm]} was found in the northern lower perched water body. For radionuclides, the maximum gross alpha and gross beta concentrations in perched water are in the northern upper perched water body. Tritium, strontium-90, and technetium-99 were found in all perched water bodies. In 2001, all the perched water bodies again exceeded the maximum contaminant level for nitrate and nitrite. However, only half of the 15 sample results were exceedences. The highest nitrate and nitrite concentration {60.3 mg/L [60.3 ppm]} is slightly lower at the same location (MW–1) of the maximum concentration observed in the 1995 study (DOE, 2002a, Section 4.8). The only inorganic found to exceed its maximum contaminant level in perched water was chromium. Chromium exceedences were found in all the perched water bodies. The only organic was methylene chloride from well PW–1. The highest radioactive contaminant levels (strontium-90 and technetium-99) continue to be found in the northern upper perched water body. Tritium is the primary contaminant found in the southern upper perched water body. Gross alpha and beta were not analyzed in 2001. The maximum radiological contaminant levels for strontium-90, technetium-99, and tritium have decreased by as much as 50 percent since the 1995 study (DOE, 2002a, Section 4.8).

For the Snake River Plain Aquifer, the concentrations measured in the 1995 study are primarily related to the past disposal of waste through the INTEC injection well. The injection well was drilled to a depth of 183 m [598 ft] (DOE, 2002a, Section 4.8) and was routinely used for disposal of service waste water through 1984, and permanently closed by pressure grouting in 1989. An estimated 22,000 Ci [8.1×10^{14} Bq] of radioactive contaminants were released through the injection well. Most of the radioactivity is attributed to tritium (96 percent). Americium-241, technetium-99, strontium-90, cesium-137, cobalt-60, iodine-129, and plutonium contribute the remaining radioactivity. The general trend in these contaminants is decreasing with time, including the most current data from 2001 (DOE, 2002a, Section 4.8).

The combined tritium disposal to infiltration ponds at INTEC and the Test Reactor Area from 1992 to 1995 averaged 107 curies per year, compared to 910 curies per year from 1952 to 1983

Table 3-5. Maximum Concentrations of Inorganics and Radionuclides in the Snake River Plain Aquifer in the Vicinity of INTEC[a]

Contaminant	Maximum Concentration	Well	Maximum Contaminant Level[b]	Background
Inorganics (mg/L)				
Aluminum	ND	—	0.2[c]	—
Antimony	4.6×10^{-3}	USGS–59	0.006	—
Arsenic	0.011	USGS–59	0.05	
Barium	0.21	USGS–112	2	0.05–0.07
Beryllium	ND	—	0.004	—
Cadmium	3.0×10^{-3}	USGS–39	0.005	<0.001
Calcium	76	CPP–2	NS	—
Chromium	0.039	USGS–39	0.1	0.002–0.003
Cobalt	1.0×10^{-3}	USGS–85	NS	—
Copper	0.014	CPP–2	1.3	—
Iron	0.13	USGS–123	0.3[c]	—
Lead	0.018	USGS–84	0.015	<0.005
Magnesium	22	USGS–67	NS	—
Manganese	0.044	USGS–122	0.05	—
Mercury	3.6×10^{-4}	USGS–44	0.002	<0.0001
Nickel	5.0×10^{-3}	USGS–123	0.1	—
Potassium	6.80	USGS–122	NS	—
Selenium	3.0×10^{-3}	USGS–47	0.05	<0.001
Silver	7.0×10^{-4}	USGS–77	0.1[c]	<0.001
Sodium	77	USGS–59	NS	—
Thallium	ND	—	0.002	—
Vanadium	0.010	USGS–82	NS	—
Zinc	0.45	USGS–115	5[c]	—
Zirconium	ND	—	NS	—
Radionuclides (pCi/L)				
Gross Alpha	15 ± 3.86	MW–52	15	0–3
Gross Beta	96.5 ± 6	MW–48	<4 mrem/yr[d]	0–7
Tritium	$1.4 \times 10^{4} \pm 771$	USGS–114	20,000	0–40
Strontium-90	45 ± 7.57	MW–47	8	0

Table 3-5. Maximum Concentrations of Inorganics and Radionuclides in the Snake River Plain Aquifer in the Vicinity of INTEC[a] (continued)

Contaminant	Maximum Concentration	Well	Maximum Contaminant Level[b]	Background
Plutonium-238	ND	—	15	0
Plutonium-239/240	ND	—	15	0
Americium-241	0.742 ± 0.0336	LF2–8	15	0
Neptunium-237	ND	MW–18	15	—
Iodine-129	1.06 ± 0.19	LF3–8	1	0
Technetium-99	322 ± 6.6	USGS–52	900	—
Uranium-233/234	1.62 ± 0.153	USGS–123	—	—
Uranium-235/236	0.146 ± 0.057	USGS–35	—	—
Uranium-238	0.851 ± 0.126	USGS–85	—	—

EIS = environmental impact statement
INTEC = Idaho Nuclear Technology and Engineering Center
MCL = Maximum contaminant levels
ND = Not detected
NS = No standard

[a] DOE. DOE/EIS–0287–F, "Idaho High-Level Waste and Facilities Disposition Final Environmental Impact Statement." Idaho Falls, Idaho: DOE, Idaho Operations Office. 2002.
[b] MCL from the Safe Drinking Water Act (40 CFR Part 140) and DOE Order 5400.5 unless otherwise noted.
[c] Secondary MCL from the Safe Drinking Water Act (40 CFR Part 140).
[d] Beta particle/photon radioactivity shall not produce annual dose equivalent to the total body or internal organ greater than 0.04 mSv [4 mrem/yr].

NOTE: To convert liters (L) to gallons (gal), multiply by 0.264; to convert milligrams per liter (mg/L) to parts per million, multiply by 1.0; to convert picocuries (pCi) to Becquerel, multiply by 0.037.

(DOE, 2002a, Section 4.8). The tritium plume with a concentration exceeding 500 pCi/L decreased from an area of 117 km^2 [45 mi^2] in 1988 to approximately 104 km^2 [40 mi^2] in 1991. Since 1991, the concentration has remained nearly unchanged. However, the higher concentration lines have moved closer to their origin at INTEC and the Test Reactor Area. Prior to 1989, strontium-90 concentrations in the Snake River Plain Aquifer were decreasing. The concentrations from 1992 to 2001 have remained fairly constant. This constancy is due to the migration of contamination from the near-surface releases into the perched water bodies and subsequently into the Snake River Plain Aquifer (Rodriguez, et al., 1997). When the Big Lost River flows, the added infiltrating water would tend to reduce the concentrations observed in the Snake River Plain Aquifer due to dilution of the perched water bodies.

Iodine-129 was discharged to the aquifer until 1984 through the injection well previously described. More than 90 percent of the iodine-129 in the aquifer is from the injection well. Smaller contributions include the percolation ponds and contaminated soils. Measurements taken in 1990–1992 indicated the presence of iodine-129 in 32 of 51 wells at INTEC. The concentrations ranged from below the detection limit to 3.82 pCi/L (Rodriguez, et al., 1997). In 2001, only 2 of 41 wells sampled detected iodine-129 above the maximum contaminant level

(1 pCi/L). The two wells are located south of INTEC at the Central Facilities Area landfill. In addition, iodine-129 was not detected in the sample analyzed from well USGS–46 (DOE, 2002b).

3.5.3 Water Use and Rights

The surface and subsurface water use in the affected environment at INEEL is described in the DOE SNF Programmatic EIS (DOE, 1995, Volume 2, Part A, Section 4.8.3).

The INEEL does not withdraw or use surface water for site operations, nor does it discharge effluents to natural surface water. However, the three surface-water bodies at or near the site (Big and Little Lost Rivers and Birch Creek) have the following designated uses: agricultural water supply, cold-water biota, salmonid spawning, and primary and secondary contact recreation. In addition, waters in the Big Lost River and Birch Creek have been designated for domestic water supply and as special resource waters.

Groundwater use on the Snake River Plain includes irrigation; food processing and aquaculture; and domestic, rural, public, and livestock supply. Water use for the upper Snake River drainage basin and the Snake River Plain Aquifer was 16.4 trillion L [4.3 trillion gal] per year in 1985, which was more than 50 percent of the water used in Idaho and approximately 7 percent of agricultural withdrawals in the nation. Most of the water withdrawn from the Eastern Snake River Plain {1.8 trillion L [0.47 trillion gal] per year} is for agriculture. The aquifer is the source of all water used at the INEEL. Site activities withdraw water at an average rate of 7.4 billion L/yr [1.9 billion gal/yr] (DOE, 2002a, Section 4.8). However, the baseline annual withdrawal rate dropped to 6.5 billion L [1.7 billion gal] in 1995. The average annual withdrawal is equal to approximately 0.4 percent of the water consumed from the Eastern Snake River Plain Aquifer, or 53 percent of the maximum annual yield of a typical irrigation well. Of the quantity of water pumped from the aquifer, a substantial portion is returned to the aquifer through seepage ponds, with the remaining water lost to the atmosphere through evaporation (DOE, 2002a, Section 4.13.1).

A sole-source aquifer, as designated by the Safe Drinking Water Act, is one that supplies 50 percent of the drinking water consumed in the area overlying the aquifer. Sole-source aquifer areas have no alternative source or combination of sources that could physically, legally, and economically supply all those who obtain their drinking water from the aquifer. Because groundwater supplies 100 percent of the drinking water consumed within the Eastern Snake River Plain (Gaia Northwest, Inc., 1988) and an alternative drinking water source or combination of sources is not available, the EPA designated the Snake River Plain Aquifer a sole-source aquifer in 1991.

DOE holds a Federal Reserved Water Right for the INEEL, which permits a water-pumping capacity of 2.3 m^3/s [80 ft^3/s] and a maximum water consumption of 43.2 billion L/yr [11.4 billion gal/yr] for drinking, process water, and noncontact cooling. Because it is a Federal Reserved Water Right, the site's priority on water rights dates back to the establishment of INEEL.

3.6 Ecological Resources

During the past decade, many detailed studies have been documented that include descriptions of the ecology at and in the vicinity of INTEC. Several of these studies were reviewed and are summarized here to describe the ecological resources at or near INTEC (Rope, et al., 1993; DOE, 1995, 2002a; NRC, 1998). To ensure that this ecological information was up to date, the NRC consulted with the U.S. Fish and Wildlife Service about potential threatened, endangered, and sensitive species near INTEC. This section discusses the following ecological resources of INEEL: (i) plant communities and associations; (ii) animal communities (both terrestrial and aquatic); (iii) threatened, endangered, and sensitive species; and (iv) wetlands.

3.6.1 Plant Communities and Associations

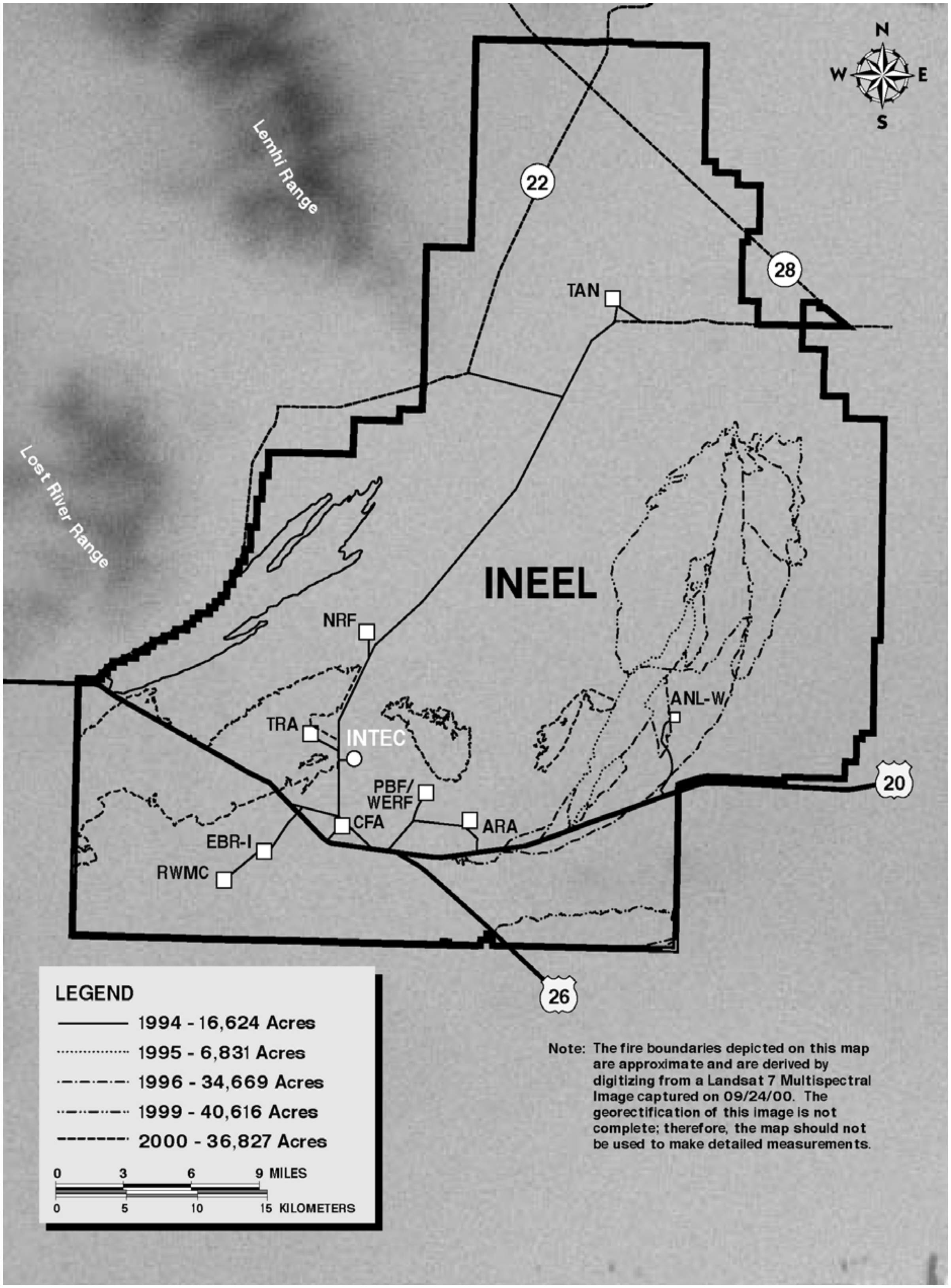
The flora at and near INTEC has been well characterized by previous studies, some for EISs related to other projects at INEEL. A detailed description of the flora of the potentially affected environment near INTEC is provided in the DOE Programmatic SNF EIS (DOE, 1995, Volume 2, Part A, Section 4.9).

Vegetation on the INEEL site is primarily of the shrub-steppe type and is a small fraction of the 45,000 km^2 [17,375 mi^2] of this vegetation type in the Intermountain West. The 15 vegetation associations on the INEEL site range from primarily shadescale-steppe vegetation at lower altitudes through sagebrush- and grass-dominated communities to juniper woodlands along the foothills of the nearby mountains and buttes (Rope, et al., 1993; Kramber, et al., 1992; Anderson, 1991). These associations can be grouped into six basic types: juniper woodland, grassland, shrub-steppe (which consists of sagebrush-steppe and salt desert shrubs), lava, bareground-disturbed, and wetland vegetation. Shrub-steppe vegetation, which is dominated by big sagebrush *(Artemisia tridentata),* saltbush *(Atriplex* spp.), and rabbitbrush *(Chrysothamnus* spp.) covers more than 90 percent of the INEEL. Grasses include cheatgrass *(Bromus tectorum),* Indian ricegrass *(Oryzopsis hymenoides),* wheatgrasses *(Agropyron* spp.), and squirreltail *(Sitanion hysterix).* Herbaceous plants include phlox *(Phlox* spp.), wild onion *(Allium* spp.), milkvetch *(Astragalus* spp.), Russian thistle *(Salsola kali),* and various mustards.

Facility and human-disturbed (grazing not included) areas cover only about 2 percent of the INEEL. Introduced annuals, including Russian thistle and cheatgrass, frequently dominate disturbed areas. These species usually are less desirable to wildlife as food and cover and compete with more desirable perennial native species. These disturbed areas serve as a seed source, increasing the potential for the establishment of Russian thistle and cheatgrass in surrounding less-disturbed areas. Vegetation inside facility boundaries is generally disturbed or landscaped. Species richness on INEEL is comparable to that of like-sized areas with similar terrain in other parts of the Intermountain West. Plant diversity is typically lower in disturbed and modified areas.

Although no wildfires have occurred recently near INTEC, a study conducted for the DOE Idaho HLW and Facilities Disposition EIS (DOE, 2002a, Section 4.9) added information about how large wildfires in 1994, 1995, 1996, 1999, and 2000 have changed the vegetation cover at INEEL in the affected areas.

Large wildfires in 1994, 1995, 1996, 1999, and 2000 played an important role in the vegetation cover at INEEL. Figure 3-9 shows the location of the wildfires. In July 1994, the Butte City fire



1 **Figure 3-9. Approximate Location of Wildfires at INEEL (Modified from DOE, 2002a). To Convert Acres to Hectares, Multiply by 0.405.**

burned 6,928 ha [17,107 acres] along the western boundary of INEEL (Anderson, et al., 1996). In August 1995, 2,767 ha [6,831 acres] along a corridor running north and south of the Argonne National Laboratory–West facility burned (Anderson, et al., 1996). During the summer of 1996, six fires burned a total of 14,762 ha [36,450 acres] on and adjacent to INEEL. These fires burned virtually all the aboveground biomass, resulting in severe wind erosion and, therefore, blowing dust (Patrick and Anderson, 1997). Wildfires in 1999 burned approximately 16,200 ha [40,000 acres] more of the INEEL and in the summer and early fall of 2000, three separate fires burned an additional 14,580 ha [36,000 acres]. The first of these fires in late July 2000 burned approximately 12,150 ha [30,000 acres] northwest of the Radioactive Waste Management Complex. A second fire in early August burned approximately 810 ha [2,000 acres] west of Argonne National Laboratory–West. A third fire in mid-September burned approximately 1,620 ha [4,000 acres] northwest of INTEC.

Although the growth of grasses and forbs that typically follow wildfires in sagebrush-steppe areas of the INEEL offers food for foraging mule deer, pronghorn, and elk (Environmental Science and Research Foundation, Inc., 1999), those plants do not provide suitable winter habitat and food for sage grouse. Sage grouse are dependent on sagebrush, particularly for important winter habitat (ideal winter habitat consists of healthy, mature stands of big sagebrush). The INEEL contains one of the largest contiguous areas of protected sagebrush-steppe habitat in the world, and is one of the most important wintering areas for sage grouse in Idaho (Environmental Science and Research Foundation, Inc., 2000). The wildfires that burned more than 54,675 ha [135,000 acres] of sagebrush steppe on the INEEL since 1994 are certainly cause for concern, particularly in view of sage grouse population declines across the region. DOE is continuing to study the impacts of wildfires on the ecological resources of the site and the region in attempts to better understand the dynamics of that ecosystem and to identify ways of preserving the biodiversity at INEEL.

3.6.2 Animal Communities

The terrestrial fauna at and near INTEC has been characterized by previous studies, some for EISs related to other projects at INEEL. A detailed description of the terrestrial fauna of the potentially affected environment near INTEC is provided in the DOE Programmatic SNF EIS (DOE, 1995, Volume 2, Part A, Section 4.9.).

The INEEL site supports animal communities characteristic of shrub-steppe vegetation and habitats. More than 270 vertebrate species occur, including 46 mammal, 204 bird, 10 reptile, 2 amphibian, and 9 fish species (Arthur, et al., 1984; Reynolds, et al., 1986). Common small-mammal genera include mice *(Reithrodontomys* spp. and *Peromyscus* spp.), chipmunks *(Tamias* spp.*),* jackrabbits *(Lepus* spp.), and cottontails *(Sylvilagus* spp.*).*

Songbirds and passerines commonly observed at the INEEL include the American robin *(Turdus migratorius),* horned lark *(Eremophila alpestris),* black-billed magpie *(Pica pica),* sage thrasher *(Oreoscoptes montanus),* Brewer's sparrow *(Spizella breweri),* sage sparrow *(S. belli),* and western meadowlark *(Sturnella neglecta),* while resident upland gamebirds include the sage grouse *(Centrocercus urophasianus)*, chukar *(Alectoris chukar)*, and grey partridge *(Perdix perdix).* Common migratory bird species, that use INEEL for part of the year include a variety of waterfowl [e.g., mallard *(Anas plaryrhynchos),* northern pintail *(Anas acuta),* Canada goose *(Branta canadensis)*] and raptors [e.g., Swainson's hawk *(Buteo swainsoni),* rough-legged hawk *(B. lagopus),* and American kestrel *(Falco sparverius)*].

The most abundant big-game species that occurs on the INEEL is the pronghorn, but mule deer *(Odocoileus hermonius)*, moose *(Alces alces),* and elk *(Cervus elaphus)* are present in small numbers as transients. Other large mammals observed on the INEEL include the coyote *(Canis latrans),* which is common across the site, and the badger *(Taxidea taxus)* and bobcat *(Felis rufus),* both of which are present across the site but are much less abundant.

A more recent study conducted for the DOE Idaho HLW and Facilities Disposition EIS (DOE, 2002a, Section 4.9) adds that mountain lions have been observed in the area, along with a variety of snakes and lizards.

Numerous researchers have studied effects of radiation exposure from contaminated areas at INEEL on small mammals and birds. They have concluded that subtle sublethal effects (e.g., reduced growth rates and life expectancies) can occur in individual animals as a result of radiation exposure. However, they can attribute no population or community-level impacts to such exposures (Halford and Markham, 1978; Evenson, 1981; Arthur, et al., 1986; Millard, et al., 1990).

The monitoring of radionuclide levels outside the boundaries of the various INEEL facilities and off the INEEL site has detected radionuclide concentrations above background levels in individual plants and animals (Craig, et al., 1979; Markham, et al., 1982; Morris, 1993), but these limited data suggest that populations of exposed animals (e.g., mice and rabbits) as well as animals that feed on these exposed animals (e.g., eagles and hawks) are not at risk.

3.6.3 Aquatic Fauna

The aquatic fauna near INTEC has been characterized by previous studies, some for EISs related to other projects at INEEL. Only intermittent streams cross the INEEL in the vicinity of INTEC. While streams are active, the INEEL site supports nine fish species (Arthur, et al., 1984; Reynolds, et al., 1986). A detailed description of the aquatic fauna of the potentially affected environment near INTEC is provided in the DOE Programmatic SNF EIS (DOE, 1995, Volume 2, Part A, Section 4.9).

3.6.4 Threatened, Endangered, and Sensitive Species

Threatened, endangered, and sensitive species were identified in the applicant's environmental report (FWENC, 2001a, Appendix A). These species were identified using the Idaho Department of Fish and Game's list of Species with Special Status in Idaho (Idaho Conservation Data Center, 1997). This species list is included as Table 3-6 and includes federal- and state-listed species of plants and animals. To ensure that this information is up to date and in accordance with Section 7 of the Endangered Species Act, NRC obtained the most recent list of potential threatened, endangered, and sensitive species at INEEL (U.S. Department of the Interior, 2002).

Protected Species

Endangered Species—Any species in danger of extinction throughout all or a significant portion of its range.

Threatened Species—Any species likely to become endangered within the foreseeable future throughout all or a significant portion of its range.

Table 3-6. Listed Threatened and Endangered Species, Species of Concern, and Other Unique Species That Occur, or Possibly Occur, on INEEL

Species		Classification: Federal[a]	Classification: State[b]	Occurrence on INEEL[a, b]
Amphibians and Reptiles	Northern sagebrush lizard (*Sceloporus graciosus graciosus*)	C[c]	—	Resident
Birds	American peregrine falcon (*Falco peregrinus anatum*)	—	E	Winter visitor
	Bald eagle *(Haliaeetus leucocephalus)*	LT	E	Occasional wintering area
	Ferruginous hawk *(Buteo regalis)*	C	P	Widespread summer resident
	Boreal owl (*Aegolius funereus*)	—	SC	Recorded, but not confirmed
	Flammulated owl (*Otus flammeolus*)	—	SC	Recorded, but not confirmed
	Long-billed curlew *(Numenius americanus)*	C	P	Limited summer distribution
	Greater sage-grouse (*Centrocercus urophasianus*)	C	—	Upland resident
Mammals	Gray wolf *(Canis Lupus)*	XN	E	Several sightings since 1993
	Long-eared myotis *(Myotis evotis)*	C	—	Limited onsite distribution
	Small-footed myotis (*Myotis ciliolabrum*)	C	—	Resident
	Townsend's big-eared bat *(Corynorhinus townsendii)*	C	SC	Resident
	Pygmy rabbit *(Brachylagus idahoensis)*	C	SC	Limited onsite distribution
	Merriam's shrew (*Sorex merriami*)	C	—	Resident
Plants	Ute's ladies tresses *(Spiranthes diluvialis)*	—	INPS–GP2	Found near, but not on, INEEL
	Speal-tooth dodder *(Cuscuta denticulata)*	—	INPS–1	Found near, but not on, INEEL
	Spreading gilia (*Ipomopsis [Gilia] polycladon*)	—	INPS–2	Common in western foothills
	Lemhi milkvetch *(Astragalus aquilonius)*	—	INPS–GP3	Limited distribution
	Painted milkvetch (*Astragalus ceramicus var. apus*)	C	—	Resident
	Winged-seed evening primrose *(Camissonia pterosperma)*	—	INPS–S	Rare and limited

DOE = U.S. Department of Energy
EIS = environmental impact statement
INEEL = Idaho National Engineering and Environmental Laboratory

Federal
LT Listed Threatened
XN Experimental Population
C Of Concern

State
E Endangered
P Protected Non-Game Species
SC Special Concern
INPS–1 Idaho Native Plant Society-State Priority 1
INPS–2 Idaho Native Plant Society-State Priority 2
INPS–GP2 Idaho Native Plant Society-Global Priority 2
INPS–GP3 Idaho Native Plant Society-Global Priority 3
INPS—S Idaho Native Plant Society-Sensitive

[a] From U.S. Fish and Wildlife Service species list number 1–4–02–SP–921 (U.S. Department of the Interior. "Department of Energy, Idaho National Engineering and Environmental Laboratory Species List Update." Letter (September 3) to R.D. Blew. Boise, Idaho: U.S. Department of the Interior, U.S. Fish and Wildlife Service. 2002.)
[b] DOE. DOE/EIS–0287–F, "Idaho High-Level Waste and Facilities Disposition Final Environmental Impact Statement." Idaho Falls, Idaho: DOE, Idaho Operations Office. 2002.
[c] Federal species labeled as "C" are of concern to the U.S. Fish and Wildlife Service, but have no legal status on the Endangered Species Act. However, in the context of ecosystem-level management, the U.S. Fish and Wildlife Service suggests that these species and their habitats be considered in project planning and review.

A detailed description of the threatened and endangered species near INTEC is provided in Volume 2, Part A, Section 4.9.3, Threatened, Endangered, and Sensitive Species, of the DOE SNF Programmatic EIS (DOE, 1995). State and federal regulatory agency lists (DOE, 2002a, Section 4.9, U.S. Department of the Interior, 2002), the Idaho Department of Fish and Game Conservation Data Center list, and information from site surveys provided the information to identify federal- and state-protected, candidate, and sensitive species that potentially occur on INEEL. This information identified one federal-listed threatened (bald eagle), one federal listed nonessential experimental population (gray wolf), and nine special-concern species (northern sagebrush lizard, ferriginous hawk, long-billed curlew, greater sage-grouse, long-eared myotis, small-footed myotis, Townsend's big-eared bat, pygmy rabbit, and Merriam's shrew) as animals that potentially occur on the INEEL site (Table 3-6). Three additional animal species listed by the state as endangered or species of special concern occur on the site. No frequent observations of the federal- or state-listed animal species have occurred near any of the facilities where proposed actions would occur. This analysis did not identify any federal- or state-listed plant species as potentially occurring on the INEEL site. Six plant species identified by federal agencies or the Idaho Native Plant Society as sensitive, rare, or unique occur on the site (U.S. Department of the Interior, 2002; DOE, 2002a).

3.6.5 Wetlands

Results of wetland surveys at INEEL have been reported by DOE (1995, 2002a). The wetlands of the affected environment at the INEEL is described in Wetlands, of the DOE SNF Programmatic EIS (DOE, 1995, Volume 2, Part A, Section 4.9.4). The U.S. Fish and Wildlife Service National Wetlands Inventory has identified more than 130 areas inside the boundaries of INEEL that might possess some wetlands characteristics. However, recent survey results reported in the DOE Idaho HLW and Facilities Disposition EIS (DOE, 2002a, Section 4.9) indicate that no wetland areas occur within the INTEC boundary.

> **Wetlands**
>
> Wetlands are areas that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation adapted for life in saturated soil conditions.

3.7 Meteorology, Climatology, and Air Quality

3.7.1 Meteorology and Climatology

The INEEL is located on a mile-high area of the Eastern Snake River Plain in southeast Idaho. Figure 3-10 provides a simplified topographic map of the area (Clawson, et al., 1989). Topographic cross sections are presented in FWENC (2001b, Figures 2.3-5 through 2.3-12). The climate is semiarid and exhibits low relative humidity, large daily temperature swings near the ground, and large variations in annual precipitation. Average seasonal temperatures measured on-site range from −7.3 °C [18.8 °F] in winter to 18.2 °C [64.8 °F] in summer, with an annual average temperature of 5.6 °C [42 °F] (DOE, 1995). Temperature extremes range from a summertime maximum of 39.4 °C [103 °F] to a wintertime minimum of −45 °C [−49 °F] (DOE, 2002a, p. 4-25). The Centennial and Bitterroot Mountain Ranges restrict most of the cold winter air masses from entering the Eastern Snake River Plain. More detailed information on temperature extremes and ranges is available (FWENC, 2001b,Tables 2.3-1 and 2.3-2). A freeze-thaw cycle {when maximum air temperature exceeds 0 °C [32 °F] and minimum air temperature is 0 °C [32 °F] or colder} occurs, on average, in 42 percent of the days in the year.

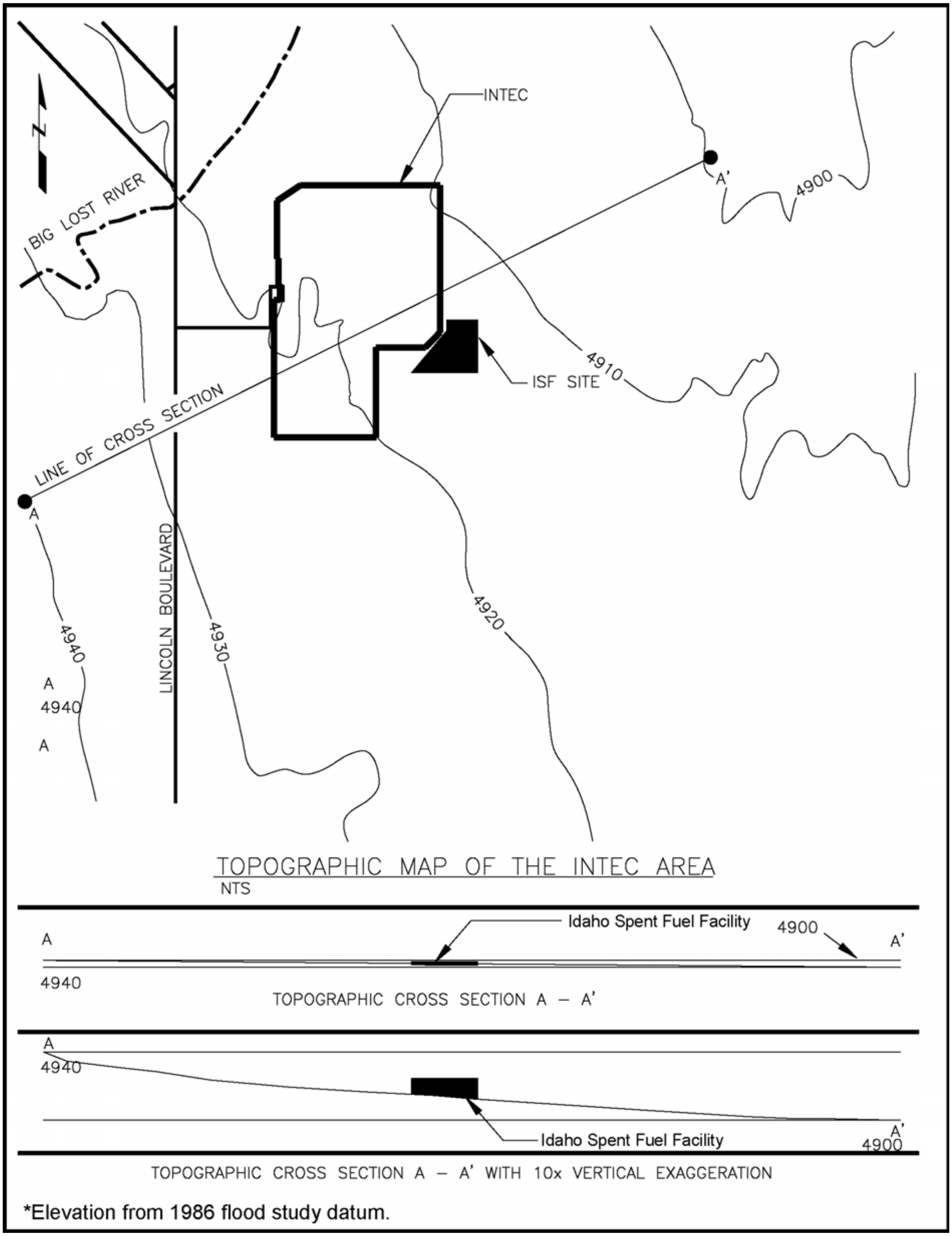


Figure 3-10. General Surface Topography in the Vicinity of the Proposed Idaho Spent Fuel Facility (Modified from FWENC, 2001b). To Convert Feet to Meters, Multiply by 0.3048.

The average midday relative humidity ranges from about 18 percent in summer to about 55 percent in winter. In January (the coldest month), the air temperature averages −8.6 °C [16.5 °F] and the dewpoint averages −13.6 °C [7.4 °F]. In July (the warmest month), the air temperature averages 20.6 °C [69.0 °F] and the dewpoint averages 0.8 °C [33.5 °F].

Annual precipitation is light, averaging 22.1 cm [8.7 in] and ranging from 10 to 35.6 cm [4 to 14 in]. Monthly precipitation extremes are 0 to 12.7 cm [0 to 5 in]. The greatest short-term precipitation rates are primarily attributable to thunderstorms, which occur approximately 2 or 3 days per month during the summer. Maximum storm precipitation amounts for 1-hour and 24-hour time periods have also been presented (FWENC, 2001b,Table 2.3-16). The maximum 1-hour and 24-hour precipitation is 1.37 and 4.2 cm [0.54 and 1.6 in], respectively. Determinations have been made on the average number of days with specified amounts of precipitation and snow (FWENC, 2001b, Tables 2.3-17 and 2.3-18).

Average annual snowfall at the INEEL is 70.1 cm [27.6 in], with extremes of 17.3 to 151.6 cm [6.8 to 59.7 in]. The greatest 24-hour snowfall was 23 cm [9 in]. The maximum snow depth is 56.6 cm [22.3 in], and the average snow depth varies from 0 to 16.3 cm [0 to 6.4 in] (FWENC, 2001b, Table 2.3-19). Considerable blowing and drifting up to several feet high occur when several inches of loose snow are present during moderate to strong winds. Damage from hail has not been experienced to date at the INEEL. Because crops and property have been damaged from hail in nearby areas, hail damage is possible at the INEEL.

Most on-site locations experience the predominant southwest–northeast wind flow of the Eastern Snake River Plain, although terrain features near some locations cause variations from this flow regime. The wind rose diagrams in Figure 3-11 show annual wind flow. These diagrams show the frequency of direction from which the wind blows and the wind speed at three of the meteorological monitoring sites on the INEEL for the period 1988 to 1992. Additional wind rose data are also available (FWENC, 2001b, Figures 2.3-13 through 2.3-16). The orientation of the Eastern Snake River Plain and surrounding mountain ranges results in the predominance of southwesterly winds from storms and daily solar heating. The next most frequent winds blow from the northeast. Winds from this direction are frequently unstable or neutral, promote effective dispersion, and extend to a considerable depth through the atmosphere. At night, cool, stable air frequently drains down the valley in a shallow layer from the northeast toward the southwest. Under these conditions, dispersion is limited until solar heating mixes the plume the following day. Winds above such stable layers exhibit less variability and provide the transport environment for materials released from INEEL sources. More detailed information on the influences of the wind field is available (FWENC, 2001b, Section 2.3.1.2.1).

Monthly-average and highest hourly average wind speeds have been recorded at heights of 6 and 76 m [20 and 250 ft] (FWENC, 2001b, Table 2.3-10). The monthly average wind speeds at 6 m [20 ft] range from 8.2 km/hr [5.1 mi/hr] in December to 14.9 km/hr [9.3 mi/hr] in April and May and blow from the southwest or west-southwest. The highest hourly average near-ground wind speed measured onsite was 82 km/hr [51 mi/hr] from the west-southwest, with a maximum instantaneous gust of 125 km/hr [78 mi/hr] (FWENC, 2001b, Table 2.3-14; Clawson, et al., 1989). Strong gusts may result from pressure gradients from large-scale systems or thunderstorms and can be expected from any direction.

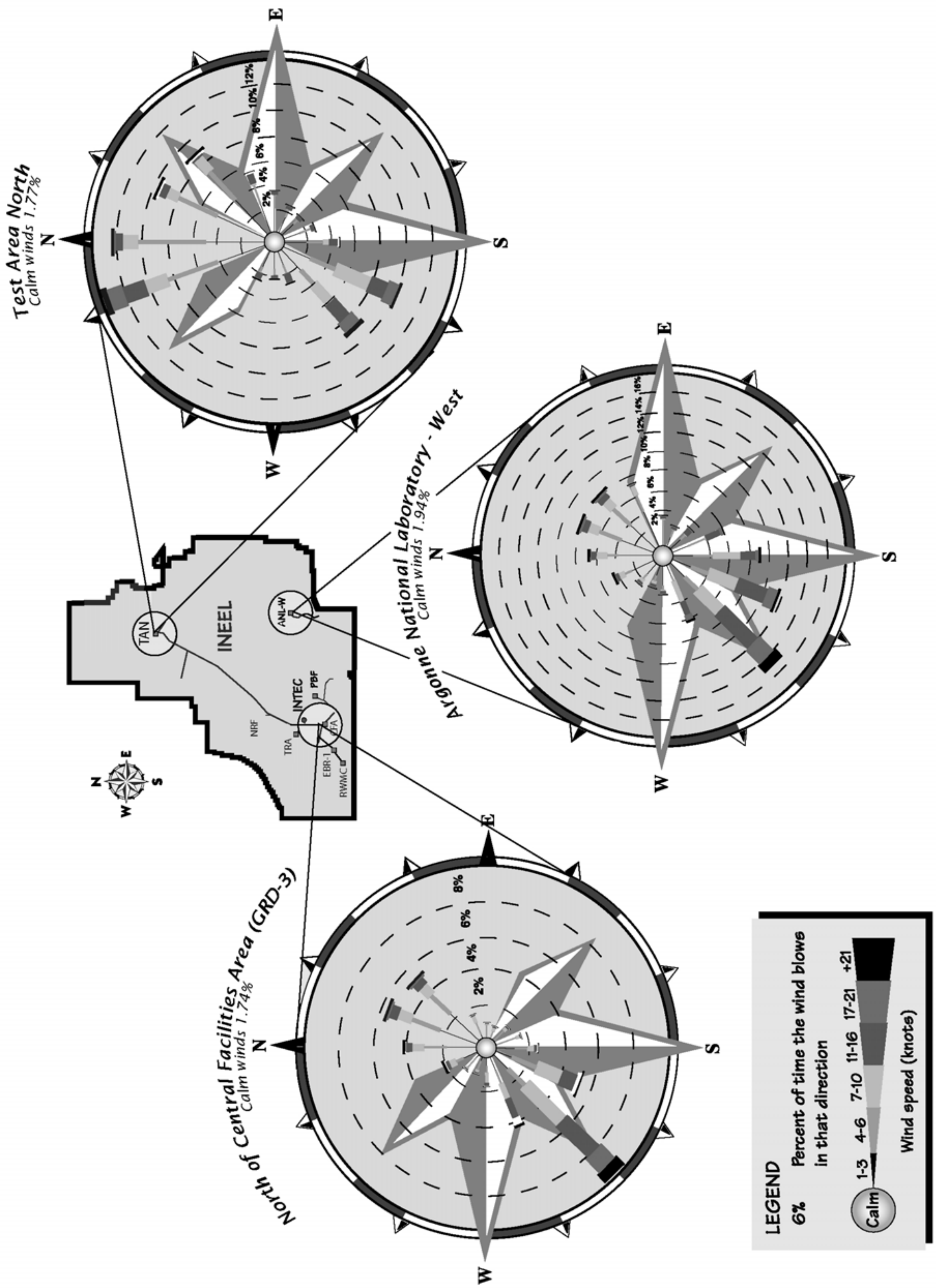


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Figure 3-11. Annual Average Wind Direction and Wind Speed at Meteorological Stations on INEEL (Modified from DOE, 2002a)

Other than thunderstorms, severe weather is uncommon. Five funnel clouds (vortex does not reach the ground) and no tornados (vortex reaches the ground) were reported onsite between 1950 and 1994 (FWENC, 2001b, Section 2.3.1.3.3). Additional information on the probabilities of tornado occurring in the region have been evaluated (Ramsdell and Andrews, 1986). A design-basis tornado has been specified to bound any tornado expected on the INEEL site (FWENC, 2001b, Table 2.3-15). The data reported in Ramsdell and Andrews (1986) indicate that the INEEL site area is a low tornado-hazard area. The average annual probability of any tornado occurring within this geographic region is 6.0×10^{-7} per year. The annual probability that a tornado of Category F–2 or higher wind speeds in excess of 181 km/hr [113 mph] will occur is estimated to be 1.69×10^{-7} per year, and the maximum wind speed that will occur with a probability of 1×10^{-7} per year [the lowest probability that needs to be considered (Ramsdell and Andrews, 1986)] is estimated to be 274 km/hr [171 mph] (Category F–2).

Dust devils are small atmospheric vortices generated over hot land surfaces and are common during the summer months. The resulting dust clouds can cover up to several hundred yards in diameter and extend several hundred feet in the air (Clawson, et al., 1989). Neither hurricanes nor tropical storms occur at INEEL due to the moderating influence of the Pacific Ocean and isolation provided by the surrounding mountains (FWENC, 2001b, Section 2.3.1.3.5).

Visibility in the region is good because of the low moisture content of the air and minimal sources of visibility-reducing pollutants. DOE (2002a) provides additional information on visibility. An average air density of 1.06×10^{-3} g/cm^3 [3.83×10^{-5} lb/in^3] was computed for an average temperature of 5.8 °C [42.4 °F] and average atmospheric pressure of 64 cm [25 in] of mercury (Clawson, et al., 1989).

The average daily atmospheric pressure over the entire year averages a high of 63.86 cm [25.14 in] of mercury and low of 63.47 cm [24.99 in] of mercury (FWENC, 2001b, Table 2.3-11). The average daily high atmospheric pressures range from 63.68 to 64.08 cm [25.07 to 25.23 in] of mercury. The average daily low atmospheric pressures range from 63.25 to 63.60 cm [24.90 to 25.04 in] of mercury. The annual daily pressure range averages to 0.38 cm [0.15 in] of mercury and varies from 0.25 cm [0.10 in] of mercury in the summer to 0.51 cm [0.20 in] of mercury in the winter. Although the maximum pressure changes in 1 hour and 24 hours have not been recorded at INEEL, maximum changes are thought to be bounded by 0.25 cm [0.1 in] of mercury per hour and 2.5 cm [1 in] of mercury per day based on synoptic and climatological records (FWENC, 2001b, Section 2.3.1.2.10).

3.7.2 Air Quality and Emissions

3.7.2.1 Introduction to Air Quality

The description of the air quality at INEEL is based on the characterization performed to support the DOE Programmatic SNF EIS (DOE, 1995, Volume 2, Part A, Section 4.7) and the Idaho HLW and Facilities Disposition EIS (DOE, 2002a, Section 4.7), which provided an update on changes in air resource conditions since the initial characterization. Air quality regulations have been established to protect the public from potential harmful effects of air pollution. These regulations (i) designate acceptable levels of pollution in ambient air, (ii) establish limits on radiation doses to members of the public, (iii) establish limits on air pollution emissions and resulting deterioration of air quality due to vehicular and other sources of human origin,

(iv) require air permits to regulate (control) emissions from stationary (nonvehicular) sources of air pollution, and (v) designate prohibitory rules, such as rules that prohibit open burning.

The Clean Air Act and amendments provide the regulatory framework to protect the nation's air resources and public health and welfare. In Idaho, EPA and the State of Idaho Department of Environmental Quality are jointly responsible for establishing and implementing programs that meet the requirements of the Clean Air Act. INEEL activities are subject to air quality regulations and standards established under the Clean Air Act, the State of Idaho, and the internal policies and requirements of DOE. Table 3-7 contains an overview of the federal, state, and DOE programs for air quality management. Additional background information for air resources is presented in the Idaho HLW and Facilities Disposition EIS (DOE, 2002a, Appendix C.2).

3.7.2.2 Nonradiological Conditions

Persons in the Eastern Snake River Plain are exposed to a variety of nonradiological air pollutants. This section summarizes the sources and levels of these pollutants. Types of pollutants assessed include (i) the criteria pollutants regulated under the National and State Ambient Air Quality Standards and (ii) other types of pollutants with potentially toxic properties called toxic or hazardous air pollutants. Criteria pollutants are nitrogen dioxide, sulfur dioxide, carbon monoxide, lead, ozone, and respirable particulate matter (PM) less than or equal to 10 micrometers {1.0×10^{-6} m [3.9×10^{-7} in]} in size (PM_{10}). PM of that size are small enough to pass easily into the lower respiratory tract. Normally, ozone is not directly emitted into the atmosphere. Instead, ozone is formed by the reactions of nitrogen oxides and oxygen in the presence of sunlight. Volatile organic compounds, sometimes called precursor organics, contribute to the formation of ozone. It is the release of nitrogen oxides and volatile organic compounds into the atmosphere that results in the formation of ozone. Therefore, volatile organic compounds and nitrogen oxides are assessed as precursors leading to the development of ozone. Toxic air pollutants can be divided into two classifications: carcinogens, or cancer-causing agents, and noncarcinogens.

3.7.2.2.1 Sources of Nonradiological Air Emissions

The population of the Eastern Snake River Plain is exposed to air pollutants that come from a variety of sources including agricultural and industrial activities, residential wood burning, wind-blown dust, and automobile exhaust. Many of the activities at INEEL also emit air pollutants. Sources such as thermal treatment processes, boilers, and emergency generators emit both criteria and toxic air pollutants. Nonthermal chemical-processing operations, waste management activities other than combustion, and research laboratories are potential sources of toxic air pollutants. Waste management, construction, and related activities such as excavation also generate fugitive dust.

Background emission rates for existing facilities have been characterized for two separate cases. The actual emissions case represented the collective emission rates of nonradiological pollutants experienced by INEEL facilities and the maximum emissions case represented a scenario in which all permitted sources at INEEL are assumed to operate in such a manner that they emit specific pollutants to the maximum extent allowed by operating permits or applicable regulations. This scenario is appropriate because many facilities operate at levels well below those allowed by operating permits, which set conditions such as maximum hours of operation or emission rates.

Table 3-7. Overview of Federal, State, and DOE Programs for Air Quality Management[a]

Clean Air Act		
Federal Program	**State of Idaho Administration Program**	**DOE Compliance Program**
• **National Ambient Air Quality Standards** Set limits on ambient air concentrations of sulfur dioxide, nitrogen dioxide, respirable particulate matter, carbon monoxide, lead, and ozone (criteria pollutants). Primary standards for protection of public health; secondary standards for protection of public welfare. • **Prevention of Significant Deterioration** Limits deterioration of air quality and visibility in areas that currently meet the National Ambient Air Quality Standards. Requires Best Available Control Technology on major sources in attainment areas. • **New Source Performance Standards** Regulate emissions from specific types of industrial facilities (e.g., fossil fuel-fired steam generators and incinerators). • **National Emission Standards for Hazardous Air Pollutants** Control airborne emissions of specific substances harmful to human health. Specific provisions regulate hazardous air pollutants and limit radionuclide dose to a member of the public to 0.1 mSv [10 mrem] per year. Control emission of hazardous air pollutants from combustion of hazardous waste, as well as other categories of activities that may result in hazardous air pollutant emissions.	• **Rules for the Control of Air Pollution in Idaho** Current Regulations of the State of Idaho Department of Environmental Quality include — **Idaho Ambient Air Quality Standards**—Similar to National Ambient Air Quality Standards but also include standards for total fluorides. — **New Source Program**—Permit to Construct is required for essentially any construction or modification of a facility that emits an air pollutant; major facilities require PSD analysis and Permit to Construct. — **Carcinogenic and Noncarcinogenic Toxic Air Pollutant Increments**—Defines acceptable ambient concentrations for many specific toxic air pollutants associated with sources constructed or modified after May 1, 1994; require demonstration of preconstruction compliance with toxic air pollutant increments. — **Operating Permits**—Required for nonexempt sources of air pollutants; define operating conditions and emissions limitations as well as monitoring and reporting requirements.	Policy to comply with applicable regulations and maintain emissions at levels as low as reasonably achievable. Policy implemented through DOE orders: DOE (Headquarters) orders apply to all DOE and DOE–contractor operations. DOE–Idaho Operations Office supplemental directives provide direction and guidance specific to INEEL. The most relevant DOE orders and their DOE–Idaho Operations Office supplemental directives are DOE Order 5400.1 establishes general environmental protection program requirements and assigns responsibilities for ensuring compliance with applicable laws, regulations, and DOE policies. DOE Order 5400.5 provides guidelines and requirements for radiation protection of the public. DOE Order 5480.1B establishes the Environment, Safety, and Health Program for DOE operations (implemented via DOE–Idaho Operations Office Supplemental Directive 5480.1).

Table 3-7. Overview of Federal, State, and DOE Programs for Air Quality Management[a] (continued)

Clean Air Act		
Federal Program	**State of Idaho Administration Program**	**DOE Compliance Program**
• **Clean Air Act Amendments of 1990** Sweeping changes to the Clean Air Act, primarily to address acid rain, nonattainment of National Ambient Air Quality Standards, operating permits hazardous air pollutants, potential catastrophic releases of acutely hazardous materials, and stratospheric ozone depletion. Specific rules and policies not yet fully developed and implemented in all areas (e.g., hazardous air pollutants).	• **Rules and Standards for Hazardous Waste** Include standards for hazardous waste treatment facilities, including limits on emissions. Consistent with federal standards.	DOE Order 5480.4 prescribes the application of mandatory Environment, Safety, and Health standards that shall be used by all DOE and DOE–contractor operations (implemented via DOE–Idaho Operations Office Supplemental Directive 5480.4). DOE Order 5480.19 provides guidelines and requirements for plans and procedures in conducting operations at DOE facilities (implemented via DOE–Idaho Operations Office Supplemental Directive 5480.19).

DOE = U.S. Department of Energy
EIS = environmental impact statement
INEEL = Idaho National Engineering and Environmental Laboratory
PSD = prevention of significant deterioration

[a] DOE. DOE/EIS–0287–F, “Idaho High-Level Waste and Facilities Disposition Final Environmental Impact Statement.” Idaho Falls, Idaho: DOE, Idaho Operations Office. 2002.

A total of 26 toxic air pollutants have been identified that are emitted from existing INEEL facilities in quantities exceeding the screening levels established by the State of Idaho. The health hazard associated with toxic air pollutants emitted in lesser quantities is considered low enough by the State of Idaho not to require detailed assessment. For a few toxic air pollutants, actual 1996 emissions were greater than the levels assessed in the DOE Programmatic SNF EIS (DOE, 1995, Volume 2, Part A, Section 4.7). These increases were primarily attributable to decontamination and decommissioning activities (DOE, 2002a, Section 4.7).

3.7.2.2.2 Existing Nonradiological Conditions

The assessment of nonradiological air quality described in the DOE Programmatic SNF EIS (DOE, 1995, volume 2, Part A, Section 4.7) was based on the assumption that the available monitoring data are not sufficient to allow a meaningful characterization of existing air quality and that such a characterization must rely on an extensive program of air-dispersion modeling. The modeling program applied for this purpose utilized computer codes, methods, and assumptions considered acceptable by EPA and the State of Idaho for regulatory compliance

purposes. The methodology applied in the assessments performed is described in the DOE Programmatic SNF EIS (DOE, 1995, Appendix F–3).

3.7.2.2.3 On-Site Conditions

The DOE Programmatic SNF EIS (DOE, 1995) contains an assessment of existing conditions for each facility area as a result of cumulative toxic air-pollutant emissions from sources located within all areas of INEEL. Except for public roads, criteria levels are not assessed for on-site locations because standards for these pollutants apply only to ambient air locations (i.e., locations to which the general public has access.) Toxic air pollutants, however, are assessed because of potential exposure of workers to these hazardous substances. Typically, the dominant contributors to pollutant levels at each of these areas are sources within that area. On-site levels of specific toxics are compared to occupational exposure limits established to protect workers.

Table 3-8 contains results from the DOE Programmatic SNF EIS (DOE, 1995) for the highest predicted concentrations of toxic air pollutants at on-site locations for the maximum baseline case at INEEL. None of these concentration levels at the INTEC area of the INEEL site exceeded the occupational exposure limits.

3.7.2.2.4 Off-Site Conditions

Estimated maximum off-site pollutant concentrations were calculated in the DOE Programmatic SNF EIS (DOE, 1995) for locations along the INEEL site boundary, public roads within the site boundary, and at Craters of the Moon Wilderness Area and Preserve. Table 3-9 contains the results for criteria pollutant levels associated with facilities that existed or were projected to operate before mid-1995. These results indicate that all concentrations of criteria pollutants in all areas are well within the ambient air quality standards. Table 3-10 contains the results for carcinogenic toxic air-pollutant levels at INEEL site boundary locations including anticipated increases to the baseline. All carcinogenic air-pollutant levels are below the ambient air quality standards. Table 3-11 contains the results for noncarcinogenic air-pollutant levels at INEEL site boundary locations and public road locations including anticipated increases to the baseline. All noncarcinogenic air-pollutant levels are below the ambient air quality standards. Levels at some public road locations, which are closer to emission sources, are higher than site boundary locations but still below the ambient air quality standards.

Air Quality Terms

PM is dust, smoke, other solid particles and liquid droplets in the air. Particle size is important and is measured in micrometers (µm). A micrometer is 1 millionth of a meter (3.9×10^{-5} in).

Criteria Pollutants are pollutants for which the EPA has set National Ambient Air Quality Standards. The criteria pollutants are sulfur oxides, nitrogen dioxide, carbon monoxide, PM_{10} and $PM_{2.5}$ (PM_{10} and $PM_{2.5}$ are PM with a diameter less than 10 µm and 2.5 µm, respectively), lead, and ozone.

Background is an air concentration value, based on measured pollutant data, that accounts for the impact of emissions from existing facilities.

National Ambient Air Quality Standards are set for the criteria pollutants. The primary standards set maximum limits on outdoor air concentrations of these pollutants to protect public health with an adequate margin of safety. Secondary standards specify maximum concentrations that would protect the public. If both a primary and a secondary standard exist, the more restrictive standard is normally used for assessment purposes.

Table 3-8. Highest Predicted Concentrations of Toxic Air Pollutants at On-Site Locations for the Maximum Baseline Case at INEEL, Including Anticipated Increases to the Baseline[a]

Toxic Air Pollutant	Location of Maximum Concentration[b]	Maximum 8-Hour Concentrations ($\mu g/m^3$)	Occupational Exposure Limit ($\mu g/m^3$)	Percent of Standard
Carcinogens				
Acetaldehyde	ANL–W	1.1×10^{2}	1.8×10^{5}	<1
Arsenic	CFA	2.8×10^{-1}	1.0×10^{1}	3
Benzene	CFA	3.1×10^{3}	3.0×10^{3}	103
Butadiene	TRA	3.8×10^{3}	2.2×10^{4}	17
Carbon Tetrachloride	RWMC	2.5×10^{2}	1.3×10^{4}	2
Chloroform	RWMC	1.7×10^{1}	9.8×10^{3}	<1
Formaldehyde	ANL–W	5.7×10^{1}	9.0×10^{2}	6
Hexavalent Chromium	INTEC/TAN	2.4×10^{0}	5.0×10^{1}	5
Hydrazine	TRA	1.8×10^{-3}	1.0×10^{2}	<1
Methylene Chloride	CFA/INTEC	3.2×10^{0}	1.7×10^{5}	<1
Nickel	CFA	4.1×10^{1}	1.0×10^{2}	41
Perchloroethylene	CFA	4.3×10^{2}	1.7×10^{5}	<1
Trichloroethylene	RWMC	4.0×10^{1}	2.7×10^{5}	<1
Noncarcinogens				
Ammonia	INTEC	9.7×10^{2}	1.7×10^{4}	6
Cyclopentane	CFA	1.1×10^{3}	1.7×10^{6}	<1
Hydrochloric Acid	CFA	1.1×10^{2}	7.0×10^{3}	2
Mercury	INTEC	3.0×10^{0}	5.0×10^{1}	6
Naphthalene	CFA	2.3×10^{3}	5.0×10^{4}	5
Nitric Acid	INTEC	7.7×10^{2}	5.0×10^{3}	15
Phosphorus	TAN	5.5×10^{1}	1.0×10^{2}	55
Potassium Hydroxide	ANL–W	1.4×10^{1}	2.0×10^{3}	<1
Styrene	PBF	3.5×10^{2}	2.1×10^{5}	<1
Toluene	CFA	2.5×10^{4}	1.9×10^{5}	13

Table 3-8. Highest Predicted Concentrations of Toxic Air Pollutants at On-Site Locations for the Maximum Baseline Case at INEEL, Including Anticipated Increases to the Baseline[a] (continued)

Toxic Air Pollutant	Location of Maximum Concentration[b]	Maximum 8-Hour Concentrations (μg/m^3)	Occupational Exposure Limit (μg/m^3)	Percent of Standard
Trimethylbenzene	CFA	1.3×10^4	1.2×10^5	11
Trivalent Chromium	TAN	6.3×10^0	5.0×10^2	1

ANL–W = Argonne National Laboratory–West
CFA = Central Facilities Area
DOE = U.S. Department of Energy
INEEL = Idaho National Technology and Engineering Center
INTEC = Idaho Nuclear Engineering and Technology Center
PBF = Power Burst Facility
RWMC = Radioactive Waste Management Complex
TAN = Test Area North
TRA = Test Reactor Area

[a] DOE. DOE/EIS–0203–F, "Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement." Vol. 2, Part A, Section 4.7. Idaho Falls, Idaho: DOE, Idaho Operations Office. 1995.
[b] Occupational exposure limits are 8-hour, time-weighted averages established by the American Conference of Governmental Industrial Hygienists or Occupational Safety and Health Administration; the lower (most restrictive) of the two limits is used.

NOTE: To convert to μg/m^3 to oz/ft^3, multiply by 1×10^{-9}.

Concentrations of certain criteria pollutants from existing INEEL sources were also compared to Prevention of Significant Deterioration (PSD) regulations, which have been established to ensure that air quality remains good in those areas where ambient air quality standards are not exceeded. The Idaho HLW and Facilities Disposition EIS (DOE, 2002a, Appendix C.2, Section C.2.2.2) contains a detailed description of PSD regulations. The PSD regulations use criteria called increments. These increments are allowable increases over baseline conditions from sources that have become operational after certain baseline dates. Increments have been established for sulfur dioxide, respirable particulates, and nitrogen dioxide. Separate PSD increments are established for pristine areas, such as national park or wilderness areas (termed Class I areas) and for the nation as a whole (termed Class II areas). Craters of the Moon Wilderness Area is the Class I area nearest to the INEEL site, while the site boundary and public roads are the applicable Class II areas. Federal land managers (e.g., BLM or National Park Service) are responsible for the protection of air quality values, including visibility, in land areas under their jurisdiction. The Clean Air Act requires the prevention of any future impairment and the remedying of any existing impairment in Class I federal areas. Section 3.10 of this EIS contains information concerning Visual/Scenic descriptions.

The amount of increment consumed by existing sources subject to PSD regulation described in this EIS is based on estimates presented in the Idaho HLW and Facilities Disposition EIS (DOE, 2002a). The DOE used two air-dispersion models to generate the estimates in the Idaho HLW and Facilities Disposition EIS (DOE, 2002a, Appendix C.2, Section C.2.3.3). Selection of the air-dispersion model was based on the distance from the emission source to the monitoring site. The National Park Service recommends using an air-dispersion model called CALPUFF to assess conditions at receptor locations greater than 50 km [31 mi] from the emission source. The other air-dispersion model, ISCST3, was used to assess conditions at receptor locations

Table 3-9. Ambient Air Concentrations of Criteria Pollutants from the Combined Effects of Maximum Baseline Emissions and Projected Increases[a]

Pollutant	Averaging Time	Maximum Projected Concentration ($\mu g/m^3$)[b]			Applicable Standard[c] ($\mu g/m^3$)	Percent of Standard		
		Site Boundary	Public Roads	Craters of the Moon Wilderness Area		Site Boundary	Public Roads	Craters of the Moon Wilderness Area
Carbon Monoxide	1 hour 8 hours	530 170	1,300 310	140 30	40,000 10,000	1 2	3 3	0.3 0.3
Nitrogen Dioxide	Annual	7.3	11	0.6	100	7	11	1
Sulfur Dioxide	3 hours 24 hours Annual	220 53 2.5	600 140 6.2	62 11 0.3	1,300 370 80	17 15 3	46 38 8	5 3 0.4
Respirable Particulates[d]	24 hours Annual	20 0.77	35 3.5	3.2 0.12	150 50	13 2	24 7	2 0.2
Lead	Quarterly	2.0×10^{-3}	2.0×10^{-3}	10×10^{-4}	1.5	0.2	0.3	0.01

DOE = U.S. Department of Energy

[a] DOE. "Idaho High-Level Waste and Facilities Disposition Final Environmental Impact Statement." Section 4.7. Idaho Falls, Idaho: DOE, Idaho Operations Office. 2002.
[b] Includes contribution from existing sources and projected increases.
[c] All standards are primary air quality standards (designed to protect public health), except for 3-hour sulfur dioxide, which is a secondary standard (designed to protect public welfare).
[d] Assumes all particulate matter emissions are of respirable size (i.e., less than 10 microns). Particulate matter concentrations do not include fugitive dust from activities such as construction. Additional standards for smaller sized particles (2.5 microns and less) have been promulgated. Current air quality levels are well within the proposed standards.

NOTE: To convert to $\mu g/m^3$ to oz/ft^3, multiply by 1×10^{-9}.

Table 3-10. Highest Predicted Concentrations of Carcinogenic Air Pollutants at Site Boundary Locations for the Maximum Baseline Case at INEEL, Including Anticipated Increases to the Baseline[a]

Toxic Air Pollutant	Annual Average Concentrations ($\mu g/m^3$)	Standard[b] ($\mu g/m^3$)	Percent of Standard
Acetaldehyde	1.1×10^{-2}	4.5×10^{-1}	2
Arsenic	9.0×10^{-5}	2.3×10^{-4}	39
Benzene	2.9×10^{-2}	1.2×10^{-1}	24
Butadiene	1.0×10^{-3}	3.6×10^{-3}	28
Carbon Tetrachloride	6.0×10^{-3}	6.7×10^{-2}	9
Chloroform	4.0×10^{-4}	4.3×10^{-2}	<1
Formaldehyde	1.2×10^{-2}	7.7×10^{-2}	16
Hexavalent Chromium	6.0×10^{-5}	8.3×10^{-5}	72
Hydrazine	1.0×10^{-6}	3.4×10^{-4}	<1
Methylene Chloride	6.0×10^{-3}	2.4×10^{-1}	3
Nickel	2.7×10^{-3}	4.2×10^{-3}	65
Perchloroethylene	1.1×10^{-1}	2.1×10^{-0}	5
Trichloroethylene	9.7×10^{-4}	7.7×10^{-2}	1

DOE = U.S. Department of Energy
EIS = environmental impact statement
INEEL = Idaho National Engineering and Environmental Laboratory

[a] DOE. DOE/EIS–0203–F, "Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement." Vol. 2, Part A, Section 4.7. Idaho Falls, Idaho: DOE, Idaho Operations Office. 1995.
[b] Acceptable ambient concentrations for carcinogens listed in Rules for the Control of Air Pollution in Idaho. Acceptable ambient concentrations for carcinogens are increments that apply only to new (not existing) sources and are used here only as reference levels.

NOTE: To convert to $\mu g/m^3$ to oz/ft^3, multiply by 1×10^{-9}.

less than 50 km [31 mi] from the emission source. Table 3-12 contains the CALPUFF model-estimated maximum increment consumption at the Class I area locations for western portions of Craters of the Moon Wilderness Area and Preserve, Yellowstone National Park, and Grand Teton National Park. Tables 3-13 and 3-14 contain the ISCST3 model estimated maximum increment consumption for the eastern portion of the Craters of the Moon Class I area and the Class II area on and around INEEL. The Craters of the Moon area appears in the estimate for both CALPUFF and ISCST3 models because portions of the area were closer than

Table 3-11. Highest Predicted Concentrations of Noncarcinogenic Air Pollutants at Site Boundary and Public Road Locations for the Maximum Baseline Case at INEEL, Including Anticipated Increases to the Baseline[a]

Toxic Air Pollutant	Location	Annual Average Concentration ($\mu g/m^3$)	Standard ($\mu g/m^3$)	Percent of Standard[b]
Ammonia	Public Road Site Boundary	6.0×10^{0} 4.1×10^{-1}	1.8×10^{2}	3 <1
Cyclopentane	Public Road Site Boundary	2.7×10^{0} 3.9×10^{-2}	1.7×10^{4}	<1 <1
Hydrochloric Acid	Public Road Site Boundary	9.8×10^{-1} 9.7×10^{-2}	7.5×10^{0}	13 1
Mercury	Public Road Site Boundary	4.2×10^{-2} 1.3×10^{-2}	1.0×10^{0}	4 1
Naphthalene	Public Road Site Boundary	1.8×10^{1} 1.9×10^{-3}	5.0×10^{2}	4 <1
Nitric Acid	Public Road Site Boundary	6.4×10^{-1} 2.6×10^{-1}	5.0×10^{1}	1 <1
Phosphorus	Public Road Site Boundary	3.0×10^{-1} 8.9×10^{-3}	1.0×10^{0}	30 <1
Potassium Hydroxide	Public Road Site Boundary	2.0×10^{-1} 2.0×10^{-1}	2.0×10^{1}	1 1
Proprionaldehyde	Public Road Site Boundary	3.0×10^{-1} 6.4×10^{-3}	4.3×10^{0}	7 <1
Styrene	Public Road Site Boundary	1.3×10^{0} 2.4×10^{-4}	1.0×10^{3}	<1 <1
Toluene	Public Road Site Boundary	3.7×10^{2} 6.2×10^{-2}	3.8×10^{3}	10 <1
Trimethylbenzene	Public Road Site Boundary	1.0×10^{2} 1.0×10^{-2}	1.2×10^{3}	8 <1
Trivalent Chromium	Public Road Site Boundary	3.6×10^{-2} 2.2×10^{-3}	5.0×10^{0}	<1 <1

DOE = U.S. Department of Energy
EIS = environmental impact statement
INEEL = Idaho National Engineering and Environmental Laboratory

[a] DOE. DOE/EIS–0203–F, "Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement." Vol. 2, Part A, Section 4.7. Idaho Falls, Idaho: DOE, Idaho Operations Office. 1995.
[b] Acceptable ambient concentrations listed in Rules of the Control of Air Pollution in Idaho. Acceptable ambient concentrations are increments that apply only to new (not existing) sources and are used here only as reference levels.

NOTE: To convert to $\mu g/m^3$ to oz/ft^3, multiply by 1×10^{-9}.

Table 3-12. PSD Increment Consumption at Distant Class I Areas by Sources Subject to PSD Regulation[a,b]

Pollutant	Averaging Time	Allowable PSD Increment (μg/m^3)	Craters of the Moon National Monument[c]		Yellowstone National Park[d]		Grand Teton National Park[e]	
			Maximum Predicted Concentration (μg/m^3)	Percent of PSD Increment Consumed	Maximum Predicted Concentration (μg/m^3)	Percent of PSD Increment Consumed	Maximum Predicted Concentration (μg/m^3)	Percent of PSD Increment Consumed
Sulfur Dioxide[f]	3 hours	25	11	44	2.7	11	4	16
	24 hours	5	3.4	68	0.66	13	0.99	20
	Annual	2	0.23	12	0.026	1.3	0.045	2.3
Respirable Particulates	24 hours	8	0.61	7.6	0.22	2.8	0.25	3.1
	Annual	4	0.032	0.8	4.7×10^{-3}	0.12	7.4×10^{-3}	0.19
Nitrogen Dioxide	Annual	2.5	0.27	11	6.6×10^{-3}	0.26	0.022	0.88

DOE = U.S. Department of Energy
EIS = environmental impact statement
INTEC = Idaho Nuclear Technology and Engineering Center
PSD = prevention of significant deterioration

a DOE. DOE/EIS–0287–F, "Idaho High-Level Waste and Facilities Disposition Final Environmental Impact Statement." Section 4.7. Idaho Falls, Idaho: DOE, Idaho Operations Office. 2002.
b Modeled assuming maximum emission rates and full utilization (8,760 hr/yr) for each source.
c The results for Craters of the Moon National Monument represent the impacts predicted 65 km [39 mi] from INTEC, which correspond to the western portion of Craters of the Moon irrespective of direction.
d The results for Yellowstone National Park represent the impacts predicted 160 km [100 mi] from INTEC, which correspond to the closest (southwestern) boundary of Yellowstone, irrespective of direction.
e The results for Grant Teton National Park represent the impacts predicted 160 km [100 mi] from INTEC, which correspond to the closest (westernmost) boundary of Grand Teton, irrespective of direction.
f Based on fuel sulfur content of 0.3 percent.

NOTE: To convert to µg/m^3 to oz/ft^3, multiply by 1×10^{-9}.

Table 3-13. PSD Increment Consumption at the Craters of the Moon Class I Areas by Sources Subject to PSD Regulation[a,b]

Pollutant	Averaging Time	Allowable PSD Increment[c] (μg/m^3)	Maximum Predicted Concentration (μg/m^3)	Percent of PSD Increment Consumed
Sulfur Dioxide[d]	3 hours 24 hours Annual	25 5 2	8.1 1.9 0.12	32 37 6
Respirable Particulates	24 hours Annual	8 4	0.57 0.025	7.2 0.6
Nitrogen Dioxide	Annual	2.5	0.40	16

DOE = U.S. Department of Energy
EIS = environmental impact statement
IDAPA = Idaho Administrative Procedures Act
PSD = prevention of significant deterioration

[a] DOE. DOE/EIS–0287–F, "Idaho High-Level Waste and Facilities Disposition Final Environmental Impact Statement." Section 4.7. Idaho Falls, Idaho: DOE, Idaho Operations Office. 2002.
[b] Assumes maximum emission rates and full utilization (8,760 hr/yr) for each source.
[c] Increments specified are State of Idaho standards (Idaho Department of Environmental Quality. "IDAPA 58, Title 1, Chapter 1, Rules for the Control of Air Pollution in Idaho." Sections 549–581. Boise, Idaho: Idaho Department of Environmental Quality. 2001. <http://www.state.id.hs/adm/adminrules/rules/IDAPA58/0101.pdf> (April 15, 2003)
[d] Sulfur dioxide results have been modified from the original results by a factor of 0.6 to reflect a change in fuel sulfur content from 0.5 to 0.3 percent.

NOTE: To convert to µg/m^3 to oz/ft^3, multiply by 1×10^{-9}.

50 km [31 mi] from the INTEC emission source and portions of the area were farther than 50 km [31 mi] from the emission source. The amount of increment consumed at all Class I and Class II areas remains well within allowable levels.

3.7.2.2.5 Summary of Nonradiological Air Quality

The air quality on and around INEEL is good and within applicable guidelines. The area around the INEEL is either in attainment or unclassified for all National Ambient Air Quality Standards. Portions of Bannock and Power Counties in Idaho, near the region of influence, are in a nonattainment area for PM. For toxic emissions, all INEEL boundary and public road levels have been found to be well below reference levels appropriate for comparison. Current emission rates for some toxic pollutants are higher than the baseline levels assessed in the DOE Programmatic SNF EIS (DOE, 1995), but resulting ambient concentrations are expected to remain below reference levels. Similarly, all toxic pollutant levels at on-site locations are expected to remain below the lower of two occupational limits established by either the Occupational Safety and Health Administration or the American Conference of Government Industrial Hygienists for protection of workers.

Table 3-14. PSD Increment Consumption at Class II Areas at INEEL by Sources Subject to PSD Regulation[a]

Pollutant	Averaging Time	Maximum Predicted Concentration[b]				
		Allowable PSD Increment[c] (μg/m^3)	INEEL Boundary (μg/m^3)	Pubic Road (μg/m^3)	Amount of Increment Consumed (μg/m^3)	Percent of PSD Increment Consumed[d]
Sulfur Dioxide[e]	3 hour	512	80	120	120	23
	24 hour	91	16	27	27	29
	Annual	20	1.1	3.6	3.6	18
Respirable Particulates	24 hour	30	4.9	10	10	34
	Annual	17	0.19	0.53	0.53	3.1
Nitrogen Dioxide	Annual	25	3.3	8.8	8.8	35

DOE = U.S. Department of Energy
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IDAPA = Idaho Administrative Procedures Act
INEEL = Idaho National Engineering and Environmental Laboratory
PSD = prevention of significant deterioration

[a] DOE. DOE/EIS–0287–F, "Idaho High-Level Waste and Facilities Disposition Final Environmental Impact Statement." Section 4.7. Idaho Falls, Idaho: DOE, Idaho Operations Office. 2002.
[b] Modeled assuming maximum emission rates and full utilization (8,760 hours per year).
[c] Increments specified are State of Idaho standards (Idaho Department of Environmental Quality. "IDAPA 58, Title 1, Chapter 1, Rules for the Control of Air Pollution in Idaho." Section 579–581. Boise, Idaho: Idaho Department of Environmental Quality. 2001. <http://www.state.id.hs/adm/adminrules/rules/IDAPA58/0101.pdf> (April 15, 2003)
[d] The amount of increment consumed is equal to the highest value of either the site boundary or public road locations.
[e] Sulfur dioxide results have been modified from the original results by a factor of 0.6 to reflect a change in fuel sulfur content from 0.5 to 0.3 percent.

NOTE: To convert to μg/m^3 to oz/ft^3, multiply by 1×10^{-9}.

3.7.2.3 Radiological Air Quality

This section provides information concerning the levels of airborne radiological exposure to the population of the Eastern Snake River Plain.

3.7.2.3.1 Sources of Radiation

The population of the Eastern Snake River Plain is exposed to radiation that comes from natural background sources and artificial sources. Both of these radiation sources are described in detail in Section 3.13.

3.7.2.3.2 Existing Radiological Conditions

Monitoring and assessment activities are conducted to characterize existing radiological conditions at INEEL and the surrounding environment. Table 3-15 provides a summary of the principal types of airborne radioactivity emitted from INEEL facilities during 1999 and 2000.

Table 3-15. Summary of Airborne Radionuclide Emissions (in Curies) for 1999 and 2000 from Facility Areas at INEEL[a]

Area	Tritium/Carbon-14		Iodines		Noble Gases		Mixed Fission and Activation Products[b]		U/Th/Transuranic[c]	
	1999	2000	1999	2000	1999	2000	1999	2000	1999	2000
Monitored Sources										
Argonne National Laboratory–West	11	2.5	—[d]	—	1.9×10^{3}	400	—	—	—	—
Central Facilities Area	—	—	—	—	—	—	—	—	—	—
INEEL	8.9	13	2.6×10^{-3}	6.1×10^{-3}	—	—	6.9×10^{-4}	7.2×10^{-4}	2.4×10^{-6}	2.8×10^{-6}
Naval Reactors Facility	—	—	—	—	—	—	—	—	—	—
Power Burst Facility	55	2.6×10^{-4}	4.2×10^{-12}	6.1×10^{-3}	—	—	—	—	2.8×10^{-9}	—
Radioactive Waste Management Complex	—	—	—	—	—	—	—	—	—	—
Test Area North	—	93	—	7.9×10^{-3}	—	920	2.7×10^{-6}	3.4×10^{-7}	—	—
Test Reactor Area	—	—	—	—	—	—	—	—	—	—
INEEL Total	75	110	2.6×10^{-3}	0.014	1.9×10^{3}	1.3×10^{3}	7.0×10^{-4}	7.2×10^{-4}	2.4×10^{-6}	2.8×10^{-6}
Other Release Points										
Argonne National Laboratory–West	0.014	0.010	—	—	—	—	—	—	—	—
Central Facilities Area	—	—	—	—	—	—	2.7×10^{-8}	6.6×10^{-8}	3.1×10^{-5}	1.0×10^{-9}
INEEL	1.1×10^{-5}	150	1.6×10^{-7}	6.1×10^{-11}	—	1.2×10^{3}	1.4×10^{-3}	4.4×10^{-3}	2.9×10^{-6}	8.2×10^{-4}
Naval Reactors Facility	0.67	0.69	5.0×10^{-6}	9.0×10^{-6}	0.047	0.68	1.5×10^{-4}	1.1×10^{-4}	—	6.0×10^{-6}
Power Burst Facility	7.1×10^{-5}	0.018	3.3×10^{-10}	1.6×10^{-16}	1.5×10^{-11}	2.8×10^{-13}	7.0×10^{-5}	9.8×10^{-5}	5.6×10^{-9}	4.4×10^{-7}
Radioactive Waste Management Complex	0.021	0.011	—	—	—	—	4.6×10^{-8}	3.1×10^{-7}	1.0×10^{-6}	7.2×10^{-6}
Test Area North	5.3×10^{-4}	1.4×10^{-7}	—	—	—	—	2.7×10^{-7}	4.4×10^{-4}	5.7×10^{-7}	1.1×10^{-6}
Test Reactor Area	170	200	0.13	0.38	1.2×10^{3}	1.5×10^{3}	0.45	2.3	7.4×10^{-6}	1.3×10^{-5}
INEEL Total	170	350	0.13	0.38	1.2×10^{3}	2.7×10^{3}	0.45	2.3	4.3×10^{-5}	8.5×10^{-4}

Table 3-15. Summary of Airborne Radionuclide Emissions (in Curies) for 1999 and 2000 from Facility Areas at INEEL[a] (continued)										
	Tritium/Carbon-14		Iodines		Noble Gases		Mixed Fission and Activation Products[b]		U/Th/Transuranic[c]	
Area	**1999**	**2000**	**1999**	**2000**	**1999**	**2000**	**1999**	**2000**	**1999**	**2000**
Fugitive Sources										
Argonne National Laboratory–West	—	—	—	—	—	—	—	—	—	—
Central Facilities Area	3.5	3.7	—	—	—	2.9×10^{-6}	1.9×10^{-5}	2.6×10^{-4}	1.4×10^{-10}	1.5×10^{-5}
INEEL	8.9×10^{-9}	0.092	3.8×10^{-8}	8.0×10^{-3}	—	7.1	9.2×10^{-6}	0.22	5.9×10^{-8}	1.2×10^{-3}
Naval Reactors Facility	—	—	—	—	—	—	—	3.9×10^{-5}	—	4.9×10^{-8}
Power Burst Facility	0.018	—	—	—	—	—	5.6×10^{-5}	5.6×10^{-5}	2.7×10^{-7}	2.8×10^{-7}
Radioactive Waste Management Complex	55	130	—	—	—	—	3.7×10^{-7}	3.7×10^{-7}	9.5×10^{-9}	9.5×10^{-9}
Test Area North	0.060	0.15	—	—	—	—	1.1×10^{-4}	8.8×10^{-4}	9.4×10^{-8}	9.8×10^{-8}
Test Reactor Area	87	100	1.2×10^{-3}	9.3×10^{-3}	5.0×10^{-5}	2.0×10^{-4}	1.0×10^{-3}	1.6×10^{-3}	7.4×10^{-8}	9.9×10^{-6}
INEEL Total	150	230	1.2×10^{-3}	0.017	5.0×10^{-5}	7.1	1.2×10^{-3}	0.22	5.1×10^{-7}	1.2×10^{-3}
Total INEEL Releases										
Argonne National Laboratory–West	11	2.5	—	—	1.9×10^{3}	400	—	—	—	—–
Central Facilities Area	3.5	3.7	—	—	—	2.9×10^{-6}	1.9×10^{-5}	2.6×10^{-4}	3.1×10^{-5}	1.5×10^{-5}
INEEL	8.9	160	2.6×10^{-3}	0.014	—	1.2×10^{3}	2.1×10^{-3}	0.23	5.5×10^{-6}	2.0×10^{-3}
Naval Reactors Facility	0.67	0.69	5.0×10^{-6}	9.0×10^{-6}	0.047	0.68	1.5×10^{-4}	1.5×10^{-4}	—	6.0×10^{-6}
Power Burst Facility	55	0.018	3.3×10^{-10}	1.6×10^{-10}	1.5×10^{-11}	2.8×10^{-13}	1.3×10^{-4}	1.5×10^{-4}	2.8×10^{-7}	7.2×10^{-7}
Radioactive Waste Management Complex	55	130	—	—	—	—	4.2×10^{-7}	6.8×10^{-7}	1.0×10^{-6}	7.2×10^{-6}
Test Area North	0.061	93	—	7.9×10^{-3}	—	920	1.1×10^{-4}	1.3×10^{-3}	6.6×10^{-7}	1.2×10^{-6}
Test Reactor Area	260	300	0.13	0.39	1.2×10^{3}	1.5×10^{3}	0.45	2.3	7.5×10^{-6}	2.3×10^{-3}
INEEL Total	400	690	0.13	0.41	3.1×10^{3}	4.0×10^{3}	0.45	2.5	4.6×10^{-5}	2.1×10^{-3}

DOE = U.S. Department of Energy
EIS = environmental impact statement
INEEL = Idaho National Technology and Engineering Center

[a] DOE DOE. DOE/EIS–0287–F, "Idaho High-Level Waste and Facilities Disposition Final Environmental Impact Statement." Section 4.7. Idaho Falls, Idaho: DOE, Idaho Operations Office. 2002.
[b] Mixed fission and activation products that are primarily particulate in nature (e.g., cobalt-60, strontium-90, and cesium-137)
[c] U/Th/Transuranic = Radioisotopes of heavy elements such as uranium, thorium, plutonium, americium, and neptunium
[d] Dash indicates amount is negligibly small or zero

An indication of on-site radiological conditions is also obtained by comparing measured levels on and near INEEL with measured levels from locations near the site, but at a distance sufficient no to be affected by the site. Figure 3-12 shows the off-site dosimeter locations, as well as locations where various food products are collected for radioactivity analysis. Results from locations on and near INEEL include contributions from natural background conditions and INEEL site emissions. Results from distant locations represent only natural background conditions because distant locations are not influenced by INEEL emissions. These data show that over the 5-year period from 1995 to 1999, average radiation exposure levels for the boundary locations were no different from those at distant stations. The average annual external dose from natural background sources measured by the Environmental Surveillance, Education and Research Program during 1999 was 1.22 mSv [122 mrem] for distant locations and 1.24 mSv [124 mrem] for boundary community locations (DOE, 2002a, Section 4.7). These differences are well within the range of normal variation.

Radiation and Radioactivity

Radioactivity or Radioactive Decay is the process by which unstable atoms emit radiation to reach a more stable state.

Radiation is the movement of energetic particles or waves through matter and space. Radiation comes from radioactive material or from equipment such as x-ray machines. Radiation may either be ionizing or nonionizing radiation.

Ionizing Radiation is radiation that has enough energy to cause atoms to lose electrons and become ions.

Radiation Dose is the quantity of radiation that is deposited in a material. The radiation dose to humans, commonly referred to as a dose equivalent, is measured in units of sieverts (Sv). One Sv is equivalent to 100 rem.

Collective Dose is the sum of the individual doses received in a given period of time by a specified population. The unit of collective dose is person-sieverts or person-rem. For example, 1,000 people who each receive a 0.01 Sv [1 rem] dose, receive a collective dose of 10 person-Sv [1,000 person-rem].

On INEEL, dosimeters around some facilities may show slightly elevated levels, because many are intentionally placed to monitor the dose rate in areas adjacent to the radioactive material storage areas or areas of known soil contamination (DOE, 2002a, Section 4.7).

3.7.2.3.3 Summary of Radiological Conditions

Radioactivity and radiation levels resulting from INEEL site emissions are low, well within applicable standards, and negligible when compared with doses received from natural background sources.

3.8 Noise

As discussed in this section of the EIS, noise is used to indicate unwanted sound that can be a byproduct of activities at INEEL. The common range of sound intensity varies by a factor of up to 1 million. A common sound measurement used to indicate sound intensity is the A-weighted sound level (decibel-A or dBA). Sounds reported in these

What is a Sievert?

The effects of radiation exposure on humans depend on the kind of radiation received, the total amount of radiation energy absorbed, and the sensitivity and mass of tissues involved. A sievert (Sv) is a unit of radiation dose calculated by a formula that takes these three factors into account. Another common unit of radiation dose is the rem [1 Sv = 100 rem]. The average annual radiation dose to an individual in the United States from natural background and artificial sources is about 0.0036 Sv [0.36 rem] or 3.6 millisievert (mSv) [360 millirem (mrem)]. This average quantity represents the summation of external and internal doses.

1

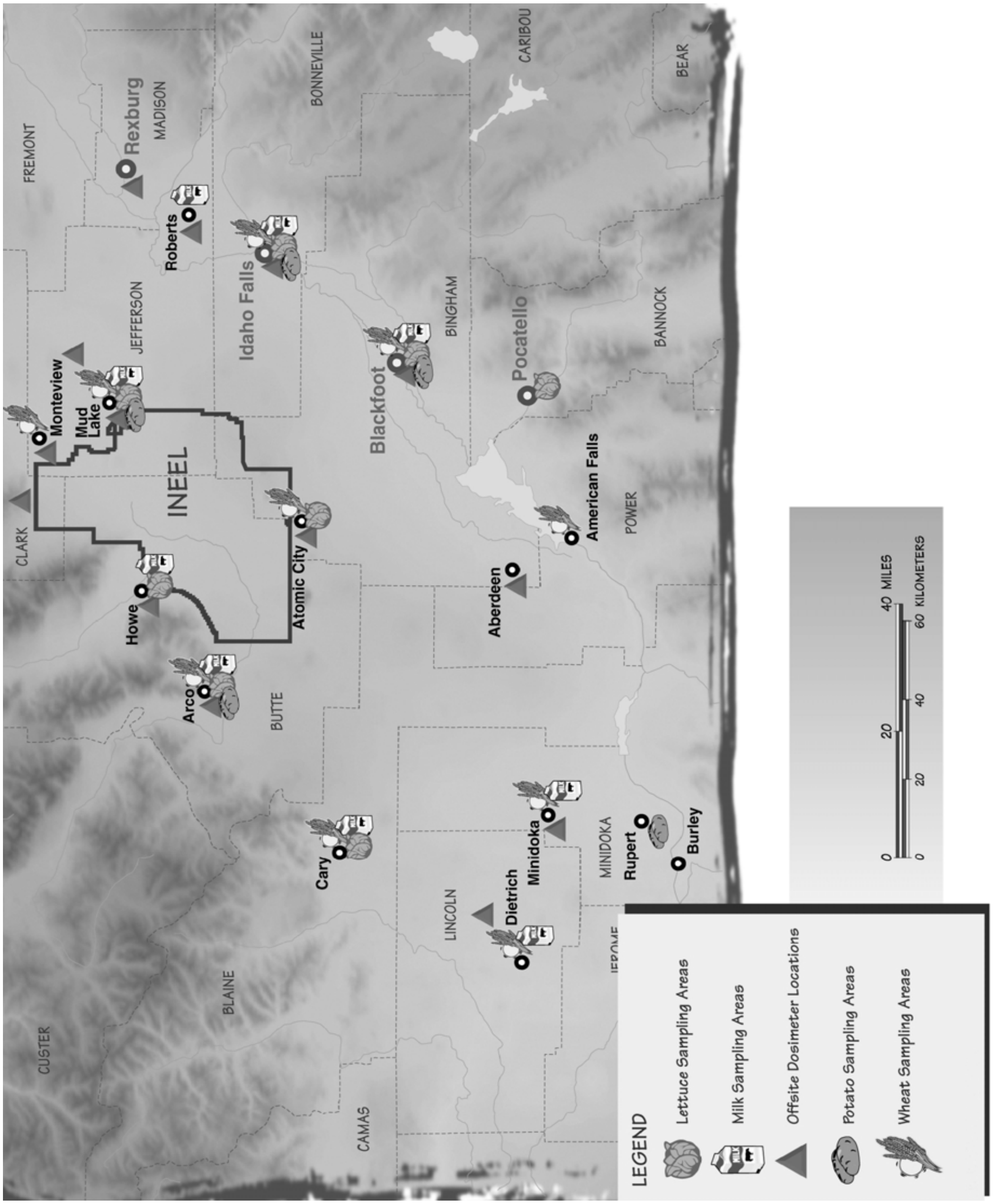


Figure 3-12. Off-Site Environmental Radiological Monitoring and Sampling Locations (Modified from DOE, 2002a, Section 4.7)

units are intended to take into account the sensitivity of the human ear for sounds of different pitches.

At INEEL, noises that affect the public are dominated primarily by vehicle traffic, including buses, private vehicles, delivery trucks, construction trucks, aircraft, and freight trains. During a normal work week, a majority of the 4,000–5,000 employees at the INEEL site are transported to various work areas at INEEL by a fleet of buses covering 72 routes. Approximately 1,200 private vehicles also travel to and from INEEL daily (DOE, 2002a, Section 4.10). There is no airport at INEEL, and noise from an occasional commercial aircraft crossing INEEL at high altitudes is indistinguishable from the natural background noise of the site. Rail transport noises originate from diesel engines, wheel and track contact, and whistle warnings at rail crossings. Normally no more than one train per day, and usually fewer than one train per week, service INEEL via the Scoville spur (DOE, 2002a, Section 4.10).

Noise measurements taken about 15 m [50 ft] from U.S. Highway 20 during a peak commuting period indicate that the sound levels from traffic at INEEL range from 69 to 88 dBA (Leonard, 1993). Buses are the primary source of this highway noise with a sound level of 82 dBA at 15 m [50 ft] (Leonard, 1993). Industrial activities (i.e., shredding) at the Central Facilities Area produce the highest noise levels measured at 104 dBA. Noise generated at INEEL is not propagated at detectable levels offsite, since all primary facilities are at least 4.8 km [3 mi] from site boundaries. However, INEEL buses operate offsite, but are part of the normal levels of traffic noise in the community. In addition, previous studies on effects of noise on wildlife indicate that even high intermittent noise levels at INEEL (over 100 dBA) would not affect wildlife productivity (Leonard, 1993).

The noise level at INEEL ranges from 10 dBA (rustling grass) to 115 dBA, the upper limit for unprotected hearing exposure established by the Occupational Safety and Health Administration from the combined sources of industrial operations, construction activities, and vehicular traffic. The natural environment of INEEL has relatively low ambient noise levels ranging from 35 to 40 dBA (Leonard, 1993). In conducting its industrial operations and construction activities, INEEL complies with Occupational Safety and Health Administration regulations (29 CFR 1910.95). These regulations require that any INEEL personnel exposed to an 8-hour time-weighted average of 85 dBA or greater must be issued hearing protection (DOE, 2002a, Section 4.10). The regulations also require that any exposure to impulse or impact noise should be limited to 140-dBA peak sound pressure level.

3.9 Cultural, Historical, Archaeological, Ethnographical, and Paleontological Resources

3.9.1 Cultural Resources

To date, more than 100 cultural resource surveys have been conducted at INEEL through the auspices of DOE. These surveys and investigations have identified many archaeological and historic sites within the INEEL boundaries. Prehistoric settlement and use of the area date back 12,000 years, as evidenced in archeological investigations that have been conducted. Historic uses of the area include attempts at homesteading, cattle drives, as well as a route for settlers traveling west. The most recent use of the area has facilitated the nuclear technology age with research and development of nuclear power and the subsequent storage of SNF. The

information these surveys has yielded provided baseline data that have been used to develop a predictive model that aids in the identification of areas where densities of sites are highest and also where the potential impacts to significant archaeological resources would increase (Ringe, 1993a,b). Although this model does not replace inventories required by the compliance requirements, this predictive model is crucial to the identification and early mitigation of areas highly likely to be archaeologically sensitive. Other cultural resources, such as those associated with settlement (remnants of homesteads), emigration (historic trails), cattle drives (remnants of camps), scenic vistas (landscapes and viewsheds significant to the Shoshone–Bannock Tribes), military, and nuclear technology (buildings and structures) have been, and are in the process of being, identified and evaluated for historical significance and eligibility for listing on the National Register of Historic Places.

3.9.2 Historical Resources

The southeastern portion of Idaho where INEEL is located is rich with cultural resources that reflect the settlement and development of the region by aboriginal people and the Shoshone–Bannock Tribes, as well as Euroamerican explorers and settlers. As the westward expansion entered the region, resources were left behind that provide a record of historic uses and development of the area. Many of these cultural resources exist within the INEEL boundaries. The region is etched with historic trails used by settlers who attempted to homestead the area. Many of these trails were also used for cattle drives and, in the late 1800s, as stage and freight routes to support mining towns in central Idaho (Miller, 1995). As homesteaders attempted to settle and farm the area along the Big Lost River in the late 1800s and early 1900s, irrigation efforts in the high desert climate failed. Homesteads were abandoned, and Euroamerican settlement and development of the region ceased.

At the start of World War II, terrain of the desert region proved to be useful to the federal government. The military used different areas, such as the Central Facilities Area, as test-firing and bombing ranges. The most significant development of the area occurred in 1949 when the National Reactor Testing Station, later to become INEEL, was established by the government. INEEL was instrumental in the development of nuclear power, with 52 first-of-a-kind reactors constructed since 1949 (Miller, 1995). Many historic sites within INEEL document early development of nuclear power, including the Experimental Breeder Reactor-1, which is listed on the National Register of Historic Places and is a national historic landmark. INTEC, originally named as the Idaho Chemical Processing Plant, was one of the first facilities constructed at INEEL in the 1950s. INTEC was instrumental in the early development of processes and facilities for managing nuclear fuels and waste products. Among the first-in-the-world accomplishments at INTEC are the reprocessing of highly enriched pure uranium on a production scale and solidification of liquid HLW on both plant and production scales (DOE, 2002a, Section 4.4). INTEC comprises many structures and buildings that supported the nuclear waste processing and storage operations. Of the buildings and structures used in this period of nuclear technology, 38 are of historical significance and are potentially eligible for listing on the National Register of Historic Places (DOE, 2002a, Section 4.10) for their association with nuclear reactor testing or post-nuclear reactor test research. The location of the proposed Idaho Spent Fuel Facility is just outside the INTEC complex on an open, previously disturbed 3.2-ha [8-acre] parcel of land immediately east of the INTEC perimeter fence, north of its coal-ash bury pit, and northeast of the coal-fired power plant. The new proposed facility and its associated construction laydown area would be located within a small group of office buildings, warehouses, and trailers built in the 1980s, which are not considered

historic structures. An associated construction laydown area would be located on a previously disturbed 4.1-ha [10-acre] lot a short distance northeast of the proposed Idaho Spent Fuel Facility site.

3.9.3 Archaeological Resources

Archaeological surveys and investigations conducted in southeastern Idaho have provided evidence of human use of the Eastern Snake River Plain for at least 12,000 years. Investigations at a cave approximately 3 km [2 mi] from the INEEL boundary provided evidence of the earliest human occupation, which was radiocarbon-dated at 12,500 years before present. Furthermore, scattered remains of Euroamerican settlement sites, as well as campsites associated with livestock drives, are located in areas throughout INEEL. Archaeological survey coverage in the vicinity of INTEC is expansive. In 1979, 45 ha [111 acres] of the area now enclosed by the INTEC perimeter fence were investigated with no identification of any cultural resources. In 1981, a cultural resource inventory of approximately 3.6 ha [9 acres] proposed for the coal-fired steam generation plant was conducted immediately south of the proposed Idaho Spent Fuel Facility construction area on the east side of the facility, as well as several additional project areas to the south and west. No cultural resources were identified in any of these areas. However, one historic homestead was identified in an undisturbed area some distance to the north. In 1985, survey coverage was significantly expanded with more than 405 ha [1,000 acres] surrounding INTEC being surveyed. Six cultural resources were identified during this survey phase, most of which were related to agricultural pursuits spurred by the Carey Land Act of 1894.

Three archaeological sites were identified in the vicinity of the proposed Idaho Spent Fuel Facility project. Two of the sites contain isolates, are both unlikely to yield any additional information, and are evaluated as ineligible for nomination to the National Register. The other site is the archaeological remains of an historic homestead site that has been evaluated as eligible for listing on the National Register of Historic Places. However, these archaeological resources are outside the areas of potential effect for the proposed Idaho Spent Fuel Facility project (Pace, 2001). Archaeological surveys previously conducted indicate that the area in the vicinity of INTEC contains only limited evidence of prehistoric use. The proposed construction and laydown areas of the proposed Idaho Spent Fuel Facility have been subject to intensive ground disturbance during the past five decades. Nonnative plant species are dominant, and no unique topographic features (buttes, river channels, sand dunes, for example) are present. These factors, along with the absence of any cultural resources, decrease the likelihood that these areas contain resources of special importance to the Shoshone–Bannock Tribes (Pace, 2001).

3.9.4 Ethnographical Resources

Ethnography, a component of cultural anthropology, is concerned with the people of an area, with their cultural systems or ways of life, and with the related technology, sites, structures, other material features, and natural resources. In addition to traditional regimes for resource use and family and community economic and social features, cultural systems include expressive elements that celebrate or record meaningful events and may carry considerable symbolic and emotional significance (National Park Service, 1998). Ethnographic resources are cultural and natural features including structures, objects, sites, landscapes, flora, and fauna that have traditional significance to contemporary people and communities.

Within the area of the proposed action, the ethnographic group that has been identified and recognized is the Shoshone–Bannock Tribes (DOE, 2002a). These people have a long and traditional association with this portion of Idaho, as detailed in the following sections. It is unknown whether other groups or individuals have ethnographic ties to INTEC and the proposed Idaho Spent Fuel Facility areas. Because these areas are located in restricted and secure land ownership and management, it is unlikely that people using the proposed Idaho Spent Fuel Facility area for traditional or other purposes would remain undetected.

3.9.4.1 Early Native American Cultures

The prehistoric archaeological record does not make clear when the ancestors of the Shoshone and Bannock people arrived in southeast Idaho; however, the Shoshone–Bannock Tribes believe that native people were created on the North American continent and, therefore, regard all prehistoric resources at INEEL as ancestral and important to their culture. Prehistoric sites are located throughout INEEL, and all demonstrate the importance of the area for aboriginal subsistence and survival. The ethnographic studies completed by early anthropologists describe the seasonal migration of the Shoshone–Bannock people across the Eastern Snake River Plain (Miller, 1995). The area now occupied by INEEL served as a travel corridor for these groups, with the Big Lost River, Big Southern Butte, and Howe Point serving as temporary camp areas providing fresh water, food, and obsidian for tool making and trade. The Shoshone–Bannock people relied on the environment for all subsistence needs and depended on a variety of plants and animals for food, medicines, clothing, tools, and building materials.

The importance of plants, animals, water, air, and land resources in the Eastern Snake River Plain to the Shoshone–Bannock people is reflected in the sacred reverence in which they hold the resources. Specific places in the Eastern Snake River Plain have sacred and traditional importance to the Shoshone–Bannock people, including buttes, caves, and other natural landforms on or near INEEL.

3.9.4.2 Native American and Euroamerican Interactions

The influence of Euroamerican culture and loss of aboriginal territory and reservation land severely impacted the aboriginal subsistence cultures of the Shoshone–Bannock people. Settlers began establishing homesteads in the valleys of southeastern Idaho in the 1860s, increasing the conflicts with aboriginal people and providing the impetus for treaty-making by the federal government (Murphy and Murphy, 1986). The Fort Bridger Treaty of 1868 and associated Executive Orders designated the Fort Hall Reservation for mixed bands of Shoshone–Bannock people. A separate reservation established for the Lemhi Shoshone was closed in 1907, and the Native Americans were forced to migrate to Fort Hall Reservation across the area now occupied by INEEL.

The original Fort Hall Reservation, consisting of 729,000 ha [1,800,000 acres], has been reduced to approximately 220,320 ha [544,000 acres] through a series of cessions to accommodate the Union Pacific Railroad and the growing city of Pocatello. Other developments, including the flooding of portions of the Snake River Bottoms by the construction of the American Falls Reservoir, have also reduced the Shoshone–Bannock land base (Murphy and Murphy, 1986).

The creation of INEEL also had an impact on the Shoshone–Bannock subsistence culture. Land withdrawals initiated by the U.S. Navy during World War II and continued by the Atomic Energy Commission during the Cold War all but eliminated Tribal access to traditional and sacred areas until recent years. In addition, development of facilities at INEEL during the past 50 years has impacted cultural resources of importance to the Tribes, including traditional and sacred areas and artifacts.

3.9.4.3 Contemporary Cultural Practices and Resource Management

The efforts of the Shoshone–Bannock Tribes to maintain and revitalize their traditional cultures are dependent on having continual access to aboriginal lands, including some areas on INEEL. DOE accommodates Tribal member access to areas on INEEL for subsistence and religious uses. Tribal members continue to hunt big game, gather plant materials, and practice religious ceremonies in traditional areas that are accessible on public lands adjacent to INEEL. In this respect, INEEL continues to serve as a travel corridor for aboriginal people, although traditional routes have changed due to INEEL access restrictions. DOE recognizes the unique interest the Shoshone–Bannock Tribes have in the management of INEEL resources and continues to consult with the Tribes.

The maintenance of pristine environmental conditions, including native plant communities and habitats, natural topography, and undisturbed vistas, is critical to continued viability of the Shoshone–Bannock culture. Contamination from past and ongoing operations at INEEL has the potential to affect plants, animals, and other resources that tribal members continue to use and deem significant. Excavation and construction associated with environmental restoration and waste management activities have the potential to disturb archaeological resources as well as plant communities and habitats. However, the proposed location of the Idaho Spent Fuel Facility and its associated construction laydown area would occur on highly disturbed areas. Due to the degree of

BLM Visual Resource Management Objectives

Class I—Preserve the existing character of the landscape. This class provides for natural ecological changes and does not preclude limited management activity. The level of change to the characteristic landscape should be very low and must not attract attention.

Class II—Retain the existing character of the landscape. The level of change to the characteristic landscape should be low. Management activities may be seen but should not attract the attention of the casual observer. Any changes must repeat the basic elements of form, line, color, and texture found in the predominant natural features of the characteristic landscape.

Class III—Partially retain the existing character of the landscape. The level of change to the characteristic landscape should be moderate. Management activities may attract attention but should not dominate the view of the casual observer. Changes should repeat the basic elements found in the predominant natural features of the characteristic landscape.

Class IV—Provide for management activities that require major modification of the existing character of the landscape. The level of change to the characteristic landscape can be high. These management activities may dominate the view and be the major focus of viewer attention. Every attempt should be made, however, to minimize the impact of these activities through careful location, minimal disturbance, and repeating the basic elements.

previous disturbance and the lack of archaeological resources, it is unlikely that any sensitive tribal resources are present at the proposed construction locations (Pace, 2001).

3.9.5 Paleontological Resources

Survey and evaluation for paleontological remains within the INEEL boundaries have identified several fossils that suggest that the region contains varied paleontological resources. Analyses of these materials and site locations suggest that these types of resources are found in areas of basalt flows, particularly in sedimentary interbeds or lava tubes within local lava flows, and in some wind and sand deposits. Other and more specific areas that these resources are likely to occur are in the deposits of the Big Lost River, Little Lost River, Birch Creek, and Lake Terreton and playas. Vertebrate and invertebrate animal, pollen, and plant fossils have been discovered in caves, in lake sediments, and in alluvial gravels along the Big Lost River. Twenty-four paleontological localities have been identified in published data (Miller, 1995). Vertebrate fossils have included mammoth and camel remains, while a horse fossil was identified in a gravel pit near the Central Facilities Area. None of the types of resources have been identified at the proposed construction location for the proposed Idaho Spent Fuel Facility and its associated construction laydown area.

3.10 Visual/Scenic Resources

The baseline visual characteristics of the INEEL and the surrounding area, including designated scenic areas, are described in the DOE Idaho HLW and Facilities Disposition EIS (DOE, 2002a, Section 4.5).

INEEL is situated on the northwestern edge of the Eastern Snake River Plain. Volcanic cones, domes, and mountain ranges are visible from most areas on INEEL. Features of the natural landscape have a special importance to the Shoshone–Bannock Tribes, and some prominent features of the INEEL landscape are within the visual range of the Fort Hall Indian Reservation. The Bitterroot, Lemhi, and Lost River mountain ranges are visible to the north and west of INEEL. East Butte and Middle Butte can be seen near the southern boundary, while Circular and Antelope Buttes are visible to the northeast. Smaller volcanic buttes dot the natural landscape of INEEL, providing a striking contrast to the relatively flat ground surface. The viewscape in general consists of terrain dominated by sagebrush with an understory of grasses. Juniper is common near the buttes and foothills of the Lemhi range, while crested wheatgrass is scattered throughout INEEL.

Nine primary facility areas, which resemble commercial or industrial complexes, are located on the INEEL (Figure 3-2). Structures generally range in height from 3 to 30 m [10 to 100 ft], with a few emission stacks and towers that reach 76 m [250 ft].

Although many INEEL facilities are visible from public highways, most are located more than 8 km [0.5 mi] from public roads. Approximately 145 km [90 mi] of public highways cross INEEL. U.S. Highway 20, which is traveled the most by the INEEL workforce, runs east to west across the southern portion of the site. U.S. Highway 26 runs southeast and northwest intersecting Highway 20, and State Highways 22, 28, and 33 cross the northeastern portion of INEEL (Figure 3-1).

Lands within and adjacent to INEEL are subject to the BLM Visual Resource Management Guidelines (1986a). Adjacent lands are designated as a visual resource Class II area, which allows for moderate industrial growth, preserving and retaining the existing character of the landscape. Lands within the boundaries of INEEL are designated as Class III and Class IV areas, allowing for partial retention of existing character and major modifications, respectively (BLM, 1984).

Craters of the Moon National Monument is located southwest of INTEC. A wilderness area is located within the boundary of the monument and its eastern boundary is approximately 43 km [27 mi] from the INTEC main stack. The wilderness area must maintain Class I visual resource management objectives. Emission sources proposed for location near Class I areas must exercise consideration that the proposed source would not adversely impact values such as visibility and scenic views. The BLM is considering the Black Canyon Wilderness Study Area, located adjacent to INEEL, for wilderness designation, which, if approved, would result in an upgrade of the BLM Visual Resource Management class for the area from Class II to Class I (1986b).

3.11 Socioeconomics

Information in this section is drawn primarily from the DOE (2002a, Section 4.3). This overview of current socioeconomic conditions includes a seven-county region of influence: Bannock, Bingham, Bonneville, Butte, Clark, Jefferson, and Madison. Also included are the Fort Hall Reservation and the Trust Lands, home of the Shoshone–Bannock Tribes. Figure 3-1 shows towns and major transportation routes in the region of influence.

3.11.1 Population and Housing

Population growth in the region of influence paralleled statewide growth from 1960 to 1990, with approximate average annual rates of 1.3 and 1.4 percent, respectively (DOE, 2002a, Section 4.3). However, from 1990 to 2000, state population growth accelerated to 2.9 percent a year, compared with a region of influence growth of 1.4 percent (DOE, 2002a, Section 4.3). Table 3-16 contains population estimates for the region of influence through 2000, as well as projections for 2005 through 2025. Such projections are not certain due to variability over time of birth, death, emigration and immigration rates, and other unanticipated factors in the region. But trends indicate that region of influence population would reach almost 269,000 by 2005 and 339,700 by 2025 (DOE, 2002a, Section 4.3). For the longer time period of 2000 to 2025, the region is projected to grow by 26 percent, comparing closely with a projected growth of 25 percent for the state as a whole.

Bannock and Bonneville Counties alone accounted for 63 percent of the total region of influence population in 2000. Butte and Clark, in contrast, contain only 1.6 percent of the total. Pocatello (in Bannock County) and Idaho Falls (in Bonneville County), each with 2000 populations of approximately 51,000, comprise the largest cities. During 2000, INEEL employees and their families accounted for 17 percent of the Bonneville County population and comprised almost 22 percent of the Idaho Falls population (DOE, 2002a, Section 4.3). In Bannock and Madison Counties, INEEL employees and their families represent only 2 percent of the population.

Of the 90,000 housing units in the region of influence during 2000, approximately 6.6 percent were vacant. Included in this number are dwellings used for seasonal, recreational, or other

Table 3-16. Population of the INEEL Region of Influence and Idaho: 1980–2025[a]									
County	**1980**	**1990**	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**	**2025**
Bannock	65,421	66,026	72,043	75,565	81,303	84,474	90,894	96,802	102,710
Bingham	36,489	37,583	40,950	41,735	46,214	48,016	51,666	55,024	58,382
Bonneville	65,980	72,207	79,230	82,522	89,415	92,902	99,963	106,460	112,958
Butte	3,342	2,918	3,097	2,899	3,495	3,631	3,907	4,161	4,415
Clark	798	762	841	1,022	948	985	1,060	1,129	1,198
Jefferson	15,304	16,543	18,429	19,155	20,798	21,609	23,251	24,763	26,274
Madison	19,480	23,674	23,651	27,467	26,692	27,733	29,841	31,780	33,720
Region of Influence	206,814	219,713	238,241	250,365	268,865	279,350	300,582	320,119	339,657
Idaho	944,127	1,006,749	1,164,887	1,293,953	1,277,000	1,335,000	1,395,000	1,514,000	1,725,000

DOE = U.S. Department of Energy
EIS = environmental impact statement
INEEL = Idaho National Engineering and Environmental Laboratory

[a] DOE. DOE/EIS–0287–F, "Idaho High-Level Waste and Facilities Disposition Final Environmental Impact Statement." Section 4.3. Idaho Falls, Idaho: DOE, Idaho Operations Office. 2002.

occasional purposes. In the region of influence, rental vacancy rates ranged from 5.9 percent in Bonneville County to 14.7 percent in Butte County. Owned housing vacancy rates ranged from 1.6 percent in Madison and Bonneville Counties to 4.4 percent in Butte County (U.S. Department of Commerce, 2000a). The average rental vacancy rate for the State of Idaho was 7.6 percent, and the average owned housing vacancy rate was 2.2 percent (U.S. Department of Commerce, 2000b). Twenty-six percent of the occupied housing units in the region of influence were rental. This number compares with 25.9 percent for the state as a whole. Bonneville and Bannock Counties, which include the cities of Idaho Falls and Pocatello, had 66 percent of the housing units in the region (U.S. Department of Commerce, 2000a). Housing characteristics for the region of influence are shown in Table 3-17.

3.11.2 Employment and Income

During the 1990s, the region of influence experienced an average annual growth rate in the labor force of just under 2.4 percent (from 105,837 to 131,352), while the State of Idaho's labor force grew at an annual rate of 3.4 percent (from 100,074 to 126,058). Employment in the region of influence grew at an average annual rate of approximately 2.6 percent, while for the state the figure was 3.5 percent (U.S. Bureau of Labor Statistics, 2002). Tables 3-18, 3-19, and 3-20 depict historical trends in labor force, employment, and unemployment. The region of influence experienced the lowest unemployment rate (4.0 percent) in a decade in 2000. This rate was lower than the 4.9 percent for the state, though rates varied widely in the region of influence from 2.5 percent in Madison County to 5.0 percent in Bannock County (U.S. Bureau of Labor Statistics, 1997, 2002).

Table 3-17. Region of Influence Housing Characteristics (Year 2000)[a]

County	Total Housing Units	Number of Owner-Occupied Units	Owned Housing Vacancy Rates (Percent)	Number of Rental Units	Rental Vacancy Rates (Percent)
Bannock	29,102	19,628	2.1	8,705	8.4
Bingham	14,303	10,746	1.7	3,038	9.4
Bonneville	30,484	21,817	1.6	7,739	5.9
Butte	1,290	878	4.4	293	14.7
Clark	521	239	3.3	127	14.2
Jefferson	6,287	5,107	1.9	960	7.0
Madison	7,630	4,286	1.6	3,133	7.0
Region of Influence	89,617	62,701	NA	23,995	NA

DOE = U.S. Department of Energy
EIS = environmental impact statement
NA = Not applicable

[a] DOE. DOE/EIS–0287–F, "Idaho High-Level Waste and Facilities Disposition Final Environmental Impact Statement." Section 4.3. Idaho Falls, Idaho: DOE, Idaho Operations Office. 2002.

Table 3-18. Historical Trends in Region of Influence Labor Force[a]					
County	**1980**	**1985**	**1990**	**1995**	**2000**
Bannock	30,488	33,684	31,342	36,310	39,502
Bingham	15,582	16,892	18,383	20,507	21,908
Bonneville	26,966	35,103	38,632	43,422	46,479
Butte	1,862	1,579	1,447	1,542	1,596
Clark	325	538	549	623	577
Jefferson	4,865	7,131	8,078	9,158	10,269
Madison	9,103	7,802	7,406	9,695	11,021
Region of Influence	89,191	102,729	105,837	121,257	131,352
Idaho	429,000	466,000	492,619	600,493	657,712

DOE = U.S. Department of Energy
EIS = environmental impact statement

[a] DOE. DOE/EIS–0287–F, "Idaho High-Level Waste and Facilities Disposition Final Environmental Impact Statement." Section 4.3. Idaho Falls, Idaho: DOE, Idaho Operations Office. 2002.

Table 3-19. Historical Trends in Region of Influence Employment[a]					
County	**1980**	**1985**	**1990**	**1995**	**2000**
Bannock	28,207	31,064	29,051	34,183	37,533
Bingham	14,419	15,534	17,320	19,363	20,896
Bonneville	25,432	33,267	37,127	41,563	44,921
Butte	1,780	1,491	1,381	1,479	1,537
Clark	295	511	533	596	549
Jefferson	4,480	6,600	7,633	8,685	9,873
Madison	8,683	7,366	7,029	9,373	10,479
Region of Influence	83,296	95,833	100,074	115,242	126,058
Idaho	395,000	429,000	463,484	568,138	625,798

DOE = U.S. Department of Energy
EIS = environmental impact statement

[a] DOE. DOE/EIS–0287–F, "Idaho High-Level Waste and Facilities Disposition Final Environmental Impact Statement." Section 4.3. Idaho Falls, Idaho: DOE, Idaho Operations Office. 2002.

Table 3-20. Historical Trends in Region of Influence Unemployment Rates[a]

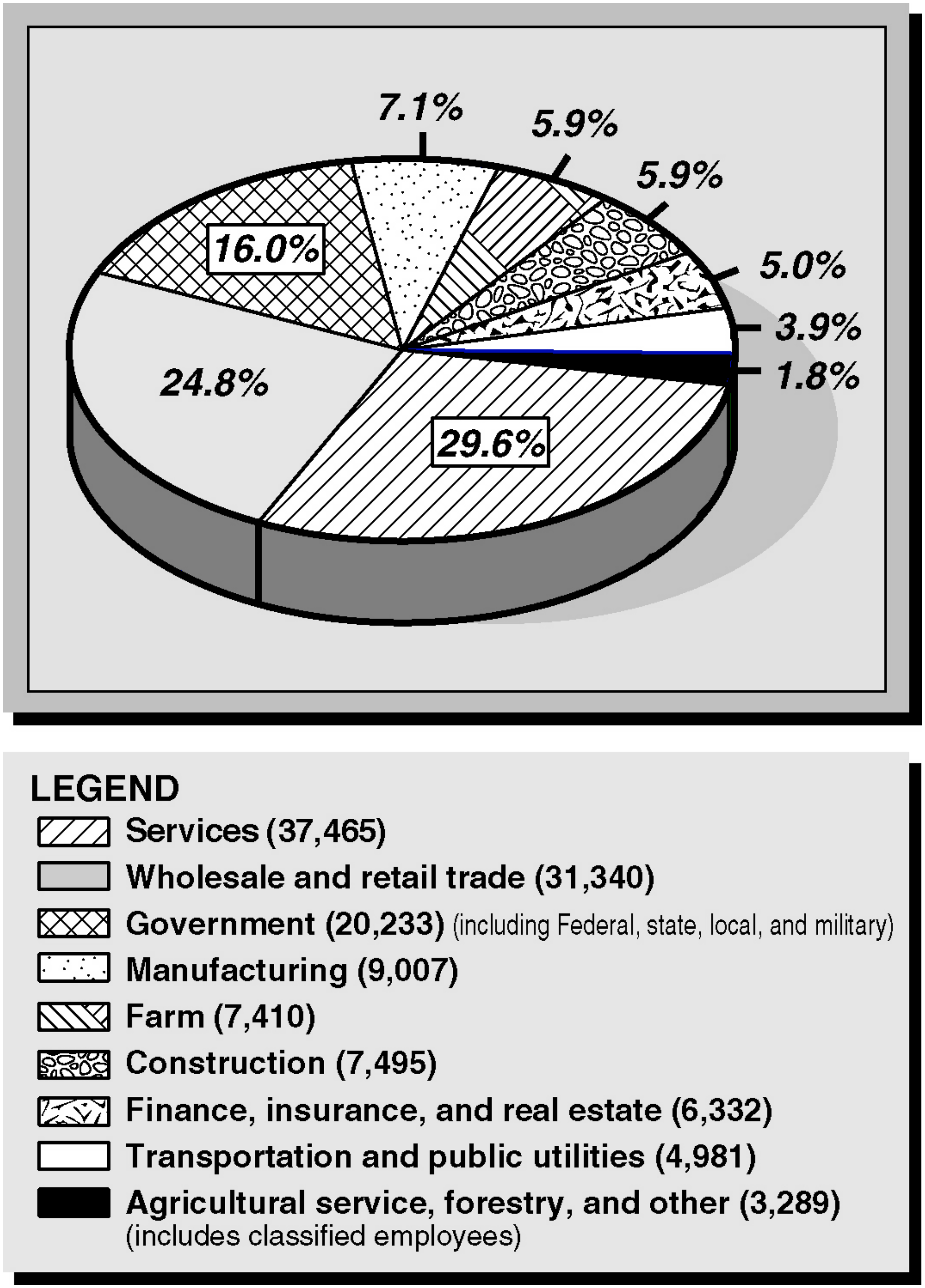
County	1980 (Percent)	1985 (Percent)	1990 (Percent)	1995 (Percent)	2000 (Percent)
Bannock	7.5	7.8	7.3	5.9	5.0
Bingham	7.5	8.0	5.8	5.6	4.6
Bonneville	5.7	5.2	3.9	4.3	3.4
Butte	4.4	5.6	4.6	4.1	3.7
Clark	9.2	5.0	2.9	4.3	4.9
Jefferson	7.9	7.4	5.5	5.2	3.9
Madison	4.6	5.6	5.1	3.3	2.5
Region of Influence	6.6	6.7	5.4	5.0	4.0
Idaho	7.9	7.9	5.9	5.4	4.9

DOE = U.S. Department of Energy
EIS = environmental impact statement

[a] DOE. DOE/EIS–0287–F, "Idaho High-Level Waste and Facilities Disposition Final Environmental Impact Statement." Section 4.3. Idaho Falls, Idaho: DOE, Idaho Operations Office. 2002.

Three sectors of the economy—service, government, and retail and wholesale trade—are the largest sources of employment in the INEEL region of influence. These sectors accounted for 70 percent of the jobs in the region in 1995. This employment is against the backdrop of the area's rural character and an economy that was historically based on natural resources and agriculture. As has been the case in most regions of the country, nonagricultural sectors have fueled economic growth during the past several decades. In 1995, farming and agricultural services, though important to the region of influence economy, accounted for less than 8 percent of jobs. Manufacturing and construction are also important to the area economy, accounting for approximately 13 percent of employment in 1995 (DOE, 2002a, Section 4.3). The State of Idaho reflects similar trends, with the service, government, and retail and wholesale trade sectors being the largest employers—62 percent of total employment. This number is followed by 19 percent in manufacturing and construction. Figure 3-13 depicts employment levels by major sectors for the region of influence.

The INEEL influence on the regional economy is apparent from the fact that in fiscal year 2001, INEEL accounted for 8,100 jobs, or approximately 6 percent of the total in the region of influence (DOE, 2002a, Section 4.3). INEEL is among the top five employers in the State (the state government is the largest) and is the largest in southeast Idaho. Consolidation of contracts and reduction of defense-related activities have reduced the workforce from the 12,500 employee peak experienced in 1991. The job force was projected to stabilize to approximately 8,000 after fiscal year 2000 (DOE, 2002a, Section 4.3). Idaho State University, American Microsystems, Inc., and local school districts are also major employers in the region.



1 **Figure 3-13. 1995 Employment by Sector in the Seven-County Region of Influence (Modified from DOE, 2002a, Section 4.3)**

Per capita income in the region of influence rose 17 percent between 1990 and 1995, from $14,136 to $16,550. Income levels within the area varied from $11,758 for Madison County to $22,444 in Clark County. The per capita income for Idaho in 1995 was $18,895 (DOE, 2002a, Section 4.3). Median household income also varied widely, ranging from $23,000 in Madison County to $30,462 in Bonneville County. Median household income for the state as a whole was $25,257 and for the nation $30,056.

3.11.3 Community Services

Key community services in the region of influence include education, law enforcement, fire protection, and medical services.

The 57,000 school-age children in the region are served by 17 public school districts and 5 private schools. Idaho State University/University of Idaho Center of Higher Education, Ricks College, and the Eastern Idaho Technical College are institutions of higher education.

Fifteen county and municipal police departments employ 373 sworn officers and 149 civilians (1995 figures) to provide law enforcement. Departments range in size from those in Idaho Falls and Pocatello that employ 82 police officers to those in Clark County and the Firth Police Department with two officers each (DOE, 2002a, Section 4.3).

Eighteen municipal fire districts with approximately 500 firefighters (of whom about 300 are volunteers) serve the region of influence (DOE, 1995). In addition, the INEEL fire department provides 24-hour coverage for the site. Its staff includes 50 firefighters, with no less than 16 on each shift. Gingham, Bonneville, Butte, Clark, and Jefferson Counties, which surround INEEL, have developed emergency plans to be implemented in event of a radiological or hazardous materials emergency. Each emergency plan identifies facilities, including those of the INEEL, that have extremely hazardous substances and defines routes for transportation of these substances The emergency plans also include procedures for notification and response, listings of emergency equipment and facilities, evacuation routes, and training programs.

Seven hospitals with a 1,012-bed capacity, averaging 48-percent occupancy, are in the region of influence (DOE, 2002a, Section 4.3). More than 65 percent of the hospital beds are in Bannock and Bonneville Counties. No hospitals are located in either Clark or Jefferson Counties. Although 283 physicians practice in the region, no primary-care physicians are located in Butte or Clark Counties (DOE, 2002a, Section 4.3).

3.11.4 Public Finance

INEEL employees' tax support to southeastern Idaho counties is presented in Table 3-21. These taxes help fund such local services as public schools, libraries, ambulance and other emergency services, road and bridge repairs, police, fire protection, recreational opportunities, and waste disposal. In 1998, INEEL contracts paid $1.4 million to the State of Idaho in Idaho sales taxes and an additional $0.9 million in Idaho franchise tax.

Table 3-21. INEEL Tax Support to Southeastern Idaho Counties (in Millions of 1998 Dollars) Rates[a]

County	Federal Tax	State Tax	Idaho Sales Tax	Property Tax	Total
Bannock	5.8	2.4	1.2	0.7	10.2
Bingham	10.2	4.2	2.1	1.0	17.6
Bonneville	51.0	21.0	10.7	5.9	88.6
Butte	1.7	0.7	0.4	0.1	2.9
Custer	0.7	0.3	0.2	0.04	1.2
Jefferson	5.4	2.2	1.1	0.5	9.1
Madison	1.3	0.5	0.3	0.2	2.3

DOE = U.S. Department of Energy
EIS = environmental impact statement
INEEL = Idaho National Engineering and Environmental Laboratory

[a] DOE. DOE/EIS–0287–F, "Idaho High-Level Waste and Facilities Disposition Final Environmental Impact Statement." Section 4.3. Idaho Falls, Idaho: DOE, Idaho Operations Office. 2002.

3.12 Environmental Justice

Information in this section is drawn primarily from the DOE Idaho HLW and Facilities Disposition EIS (DOE, 2002a, Section 4.12). Executive Order 12898 (The White House, 1998) directs federal agencies to make the achievement of environmental justice part of their mission. This goal is accomplished by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of federal programs, policies, and activities on minority and low-income populations. Where appropriate, federal agencies would also indicate the potential for disproportionately high and adverse human health or environmental effects on low-income populations, minority populations, and Indian tribes. The following analysis is in accordance with the guidelines and procedures for compliance with the Executive Order promulgated by the Council on Environmental Quality (Council on Environmental Quality, 1997).

Demographic information from the U.S. Bureau of the Census (1992, 2000) was used to identify minority populations and low-income populations within an 80-km [50-mi] radius of INTEC.

The 80-km [50-mi] radius was selected because it was consistent with the region of influence for air emissions and because it includes portions of the seven counties that constitute the region for influence for socioeconomics. INTEC occupies the center of the circle, because the actions proposed in this EIS would be accomplished at INTEC.

3.12.1 Community Characteristics

In accordance with Council of Environmental Quality guidelines, demographic maps were prepared using the latest available census data from the U.S. Bureau of the Census. Census tracts are designated areas that encompass from 2,500 to 8,000 people. Block Numbering

Areas follow the same basic criteria as census tracts in counties without formally defined tracts. Both are derived from the U.S. Bureau of the Census TIGER/Line files. Figures 3-14 and 3-15 illustrate census tract distributions for minority populations and low-income populations.

Council on Environmental Quality guidelines define minority as individual(s) who are members of the following population groups: American Indian or Alaskan Native; Asian or Pacific Islander; Black, not of Hispanic origin; or Hispanic (Council on Environmental Quality, 1997). The Council defines these groups as minority populations when either the minority population of the affected area exceeds 50 percent, or the percentage of minority population in the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographical analysis.

In identifying low-income populations, a community may be considered either as a group of individuals living in geographic proximity to one another, or a set of individuals (such as migrant workers or Native Americans), where either type of group experiences common conditions of environmental exposure or effect.

3.12.2 Distribution of Minority and Low-Income Populations

According to year 2000 U.S. Bureau of the Census data for census blocks wholly contained within the 80-km [50-mi] region of influence for INTEC and the proposed Idaho Spent Fuel Facility, 129,670 people resided in the area (U.S. Bureau of the Census, 2000). Of this number, 12 percent (15,546 people) were classified as minority individuals. If the major urban areas of Idaho Falls and Pocatello are excluded from the analysis, the respective figures are a population of 78,486, with minority individuals comprising 15 percent of the total. Thus, outside the primary urban areas, the population is sparse, and minority representation tends to be higher. Figure 3-14 depicts the percent of minority population by census block including those only partly contained within the 80-km [50-mi] radius of INTEC and the proposed Idaho Spent Fuel Facility. Minority composition was primarily Hispanic, Native American, and Asian peoples. The Fort Hall Reservation of the Shoshone–Bannock Tribes lies largely within the region of influence.

With regard to low-income population data, Figure 3-15, based on census tract-level information, reveals that only the Fort Hall area has a population of greater than 25 percent below the poverty level. Table 3-22 reveals data for all incorporated cities and census-designated places within the region of influence in comparison with the state as a whole. The data indicate wide differences in median household income levels—from a low of $9,375 in Atomic City (population 25) to a high of $49,135 in Lewisville (population 467). The median household income for the State of Idaho in 1999 was $37,572. Approximately 13.1 percent of the total population live below the 1999 poverty levels ($8,501 for unrelated individuals).

3.13 Public and Occupational Health and Safety

3.13.1 Public Health

The final EIS for disposition of HLW at INEEL (DOE, 2002a, Section 4.11) describes background radiological and nonradiological conditions in the region of the INEEL facility. The population of the Eastern Snake River Plain is exposed to radiation that comes from natural

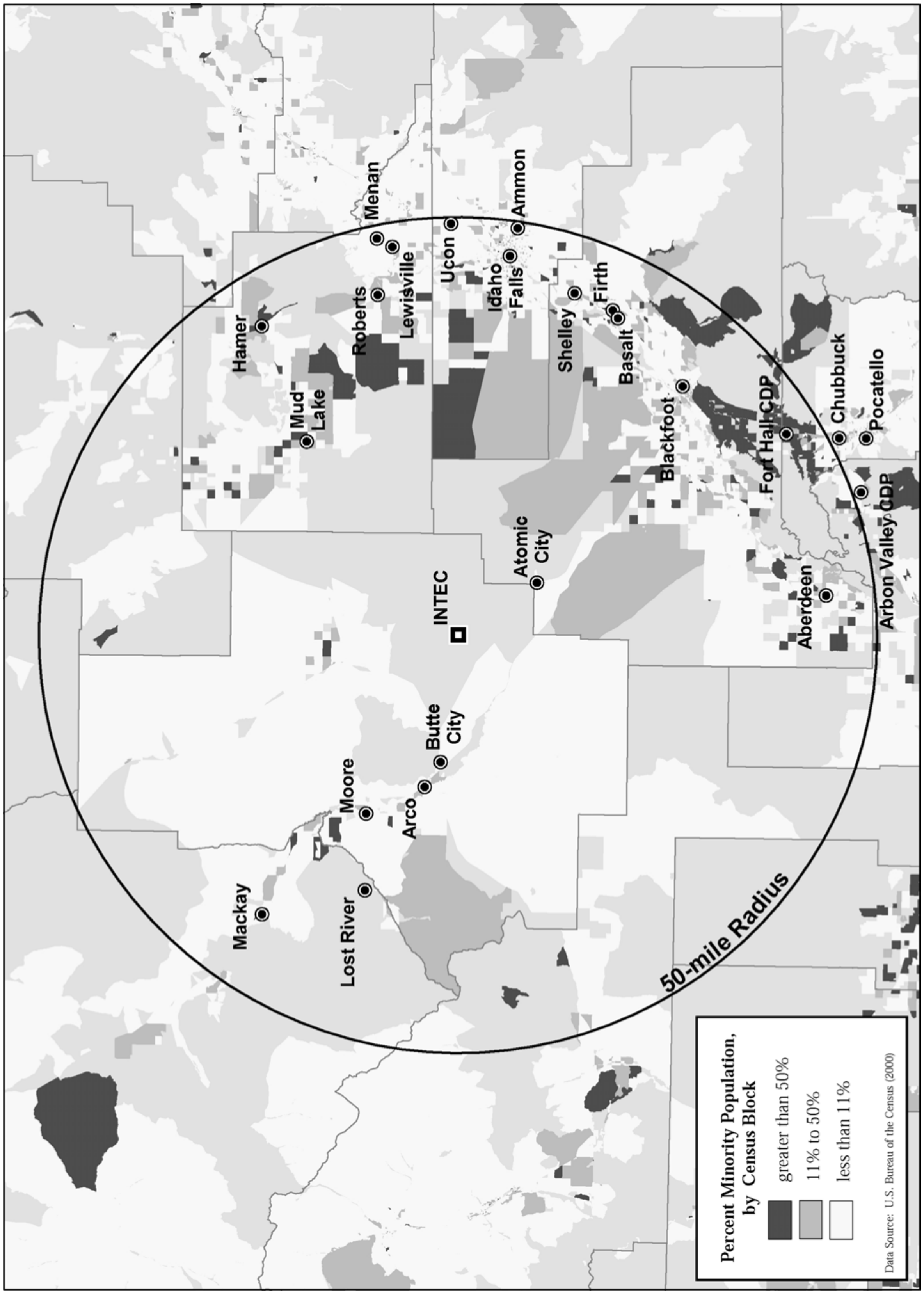


Figure 3-14. Minority Population Distribution within 80 km [50 mi] of the Proposed Idaho Spent Fuel Facility

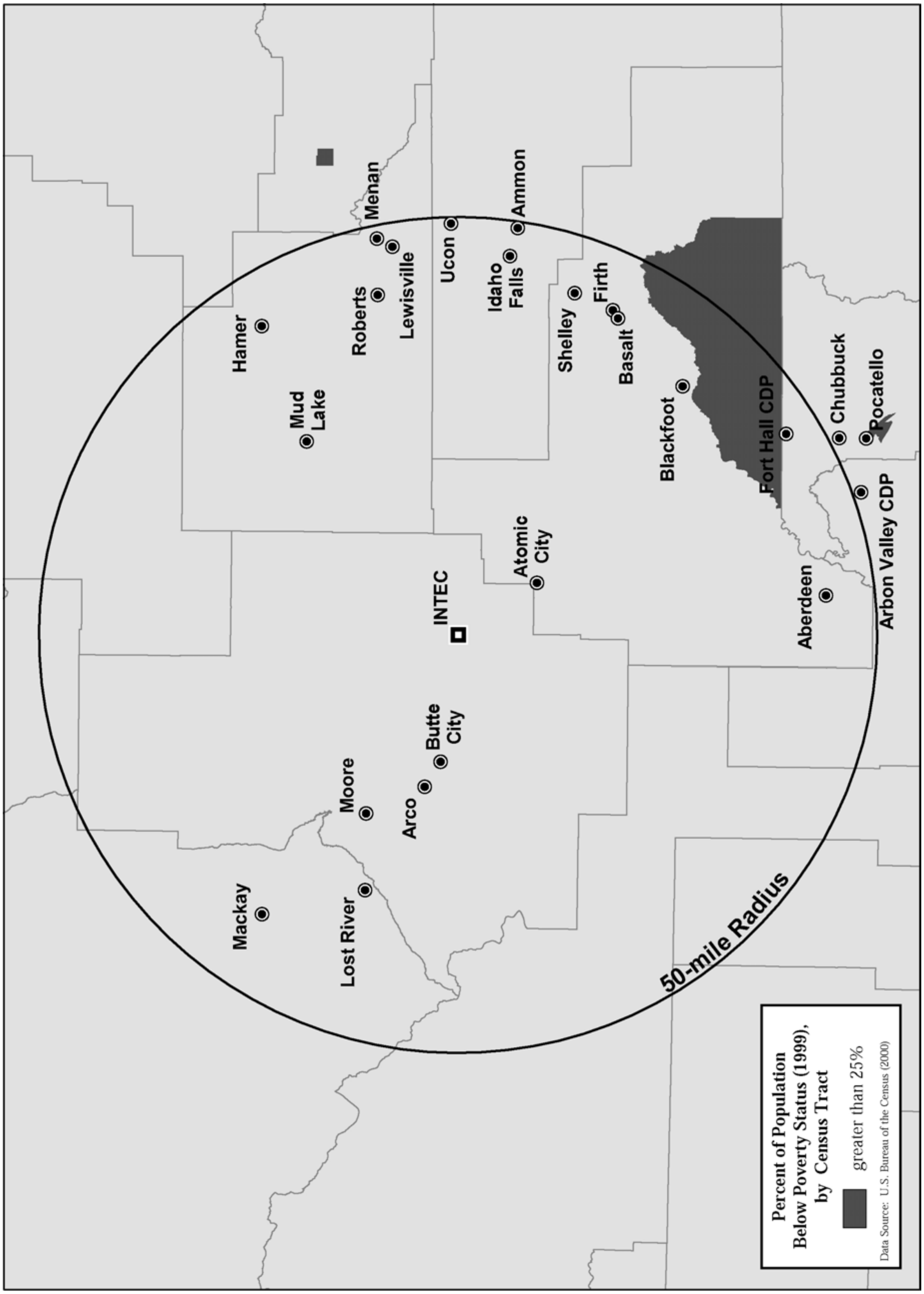


Figure 3-15. Low-Income Population Distribution within 80 km [50 mi] of the Proposed Idaho Spent Fuel Facility

Table 3-22. Population and Selected Socioeconomic Statistics for All Incorporated Cities and Census-Designated Places within 80 km [50 mi] of the Proposed Idaho Spent Fuel Facility[a]

Incorporated City or Census-Designated Places	Total Population		Nonminority Population		Minority Population		Median Household Income (1999)		Individuals Below Poverty Level (1999)		Families Below Poverty Level (1999)	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Aberdeen	1,840	NA	1,220	66.3	620	33.7	$28,625	NA	375	20.5	65	14.9
American Falls	4,111	NA	3,353	81.6	758	18.4	$30,955	NA	702	17.3	134	12.7
Ammon	6,187	NA	5,930	95.8	257	4.2	$47,820	NA	340	5.6	54	3.4
Arbon Valley Census-Designated Places	627	NA	548	87.4	79	12.9	$36,818	NA	78	13.5	13	8.0
Arco	1,026	NA	976	98.1	50	4.9	$27,993	NA	232	22.6	55	19.6
Atomic City	25	NA	24	96	1	4.0	$9,375	NA	12	57.1	5	62.5
Basalt	419	NA	356	85.0	63	15.0	$36,719	NA	53	10.9	9	7.1
Blackfoot	10,419	NA	9,040	86.8	1,379	13.2	$33,004	NA	1,478	14.6	312	11.5
Butte City	76	NA	69	90.8	7	9.2	$17,250	NA	23	30.7	4	25.0
Chubbuch	9,700	NA	8,905	91.8	795	8.2	$41,688	NA	1,160	12.0	232	9.1
Firth	408	NA	287	70.3	121	29.7	$23,239	NA	93	25.7	16	20.0
Fort Hall Census-Designated Places	3,193	NA	965	30.2	2,228	69.8	$30,313	NA	847	27.2	172	22.6
Hamer	12	NA	5	41.7	7	58.3	$24,167	NA	0	0.0	0	0.0
Idaho Falls	50,730	NA	46,717	92.1	4,013	7.9	$40,512	NA	5,403	10.9	1,028	7.8
Lewisville	467	NA	406	86.9	61	13.1	$49,135	NA	38	7.5	12	9.6
Lost River	26	NA	22	84.6	4	15.4	$31,667	NA	2	6.9	0	0.0
Mackay	566	NA	558	98.6	8	1.4	$23,807	NA	106	18.4	20	13.0
Menan	707	NA	616	87.1	91	12.9	$34,406	NA	85	11.9	14	7.3
Moore	196	NA	192	98.0	4	2.0	$28,984	NA	27	13.1	6	10.0
Mud Lake	270	NA	209	77.4	61	22.6	$28,194	NA	62	27.8	13	21.7
Pocatello	51,466	NA	47,513	92.3	3,953	7.7	$34,326	NA	7,688	15.4	1,398	10.7
Roberts	647	NA	322	49.8	325	50.2	$31,071	NA	132	18.9	17	12.6
Shelly	3,813	NA	3,429	89.9	384	10.1	$39,318	NA	369	9.6	79	7.9
Ucon	943	NA	899	95.3	44	4.7	$39,375	NA	96	9.8	17	7.2
State of Idaho	1,293,953	100.0	1,177,304	91.0	116,649	9.0	$37,572	NA	148,732	11.8	28,131	8.3

NA = not applicable

[a] U.S. Bureau of the Census. "2000 Census of Population and Housing." Washington, DC: U.S. Department of Commerce, Bureau of the Census. 2000.

background sources and industrial sources. The major source of radiation in this region is natural background radiation. Sources of radioactivity related to INEEL activities contribute a small amount of additional exposure.

> **Latent Cancer Fatality**
>
> Latent cancer fatalities are a measure of the calculated number of additional cancer deaths in a population as a result of exposure to radiation. Latent cancers can occur from one to many years after the exposure takes place.
>
> The EPA has suggested a conversion factor that for every 100-person-Sv [10,000-person-rem] of collective dose, approximately 0.06 individuals would develop a cancer induced by radiation exposure. If the conversion factor is multiplied by the collective dose to a population, the result is the number of latent cancer fatalities in excess of what would be expected without the radiation exposure.
>
> Because these results are statistical estimates, values for expected latent cancer fatalities can be, and often are, less than 1 for cases involving low doses or small populations.

Natural or background sources of radiation include radiation from radon (a naturally occurring airborne radionuclide), cosmic rays, and radioactivity naturally present in soils, rocks, and the human body. Radioactivity still remaining in the environment as a result of worldwide atmospheric testing of nuclear weapons also contributes to the background radiation level, although in very small amounts. The natural background radiation dose that Eastern Snake River Plain residents receive is estimated at 3.6 mSv/yr [360 mrem/yr]. More than half {about 2 mSv/yr [200 mrem/yr]} of this natural radiation dose (Table 3-23) is attributed to the inhalation of radioactive particles formed by radon decay (DOE, 2002a).

Industrial sources of radiation include radiation released from activities occurring within the INEEL site. These activities can release radioactivity either directly, such as through stacks or venting, or indirectly, such as resuspension of radioactivity from disturbing contaminated soils. Previous environmental documentation on the site indicates airborne emissions represent the primary pathway of concern for potential public health impacts (DOE, 2002a, Section 4.11). While a potential exists for groundwater contamination, significant public health impacts are not expected because of the long distances between the site and public areas. Both nonradiological and radiological emissions are described in detail in Section 3.7.

While ongoing health impact studies are being conducted by the Centers for Disease Control and Prevention (DOE, 2002a), prior environmental documentation (DOE, 2002a) has included estimates of radiological and nonradiological impacts from facility operations to the population in the vicinity of the site. Table 3-24 provides dose and latent cancer fatality probability results from annual exposure to routine airborne releases in 1995, 1996, and 1999 for the maximally exposed off-site individual. The estimated doses are well below the 0.1 mSv/yr [10 mrem/yr] limit provided in 40 CFR Part 61. The estimated dose to the surrounding population and number of latent cancer fatalities from annual exposures in 1995, 1996, and 1999 are provided in Table 3-25. The number of latent cancer fatalities estimated in the population for the next 70 years from the annual estimated exposure levels is less than 1. Lifetime health effects to the off-site population from groundwater pathway exposures were also estimated in a prior EIS to be 1 in 170 million (DOE, 1995).

Health risks to the public from routine nonradiological airborne emissions at INEEL have been previously estimated (DOE, 1995). These estimates considered exposures to a maximally exposed off-site individual and the population within 80 km [50 mi] of the site. With EPA dose

Table 3-23. Sources and Contributions to the U.S. Average Individual Radiation Dose[a,b]		
Source	**Effective Dose Equivalent (mSv/yr)**	**Effective Dose Equivalent (mrem/yr)**
Natural Background Radiation		
Cosmic radiation	0.27	27
Rocks and soil (external)	0.28	28
Internal to body	0.40	40
Radon (internal/inhalation)	2.0	200
Subtotal	≈2.95	≈295
Humanmade Background Radiation		
Weapons test fallout	<0.01	<1
Consumer products	0.10	10
Diagnostic X-rays	0.39	39
Nuclear medicine	0.14	14
Subtotal	0.64	64
TOTAL	≈3.6	≈360

[a] Arnett and Mamatey. "Savannah River Site Environmental Report for 2000." WSRC–TR–2000–0329. Aiken, South Carolina: Westinghouse Savannah River Company. 2001.
[b] National Council on Radiation Protection and Measurements. "Ionizing Radiation Exposure of the Population of the United States: Recommendations of the National Council on Radiation Protection and Measurements." NCRP Report No. 93. Bethesda, Maryland: National Council on Radiation Protection and Measurements. 1987.

Table 3-24. Annual Dose to Individuals from Exposure to Routine Airborne Releases at INEEL[a]		
Maximally Exposed Individual	**Annual Dose (mrem)**	**Latent Cancer Fatality Probability**
On-Site Worker (1998)[b]	0.27	1.1×10^{-7}
Off-Site Public Individual (1995)	0.018	9.0×10^{-9}
Off-Site Public Individual (1996)	0.031	1.5×10^{-8}
Off-Site Public Individual (1999)	0.008	4.0×10^{-9}

DOE = U.S. Department of Energy
EIS = environmental impact statement
INEEL = Idaho National Engineering and Environmental Laboratory

[a] DOE. DOE/EIS–0287–F, "Idaho High-Level Waste and Facilities Disposition Final Environmental Impact Statement." Section 4.7. Idaho Falls, Idaho: DOE, Idaho Operations Office. 2002.
[b] Maximum dose at any on-site area from permanent facility emissions for noninvolved on-site worker.

NOTE: To convert millirems (mrem) to millisieverts (mSv), multiply by 0.01.

Table 3-25. Estimated Increased Health Effects Due to Routine Airborne Releases at INEEL[a]		
Year	**Population Dose (person-Sv)**	**Estimated Number of Latent Cancer Fatalities**
1995	8×10^{-4}	4.0×10^{-5}
1996	2.4×10^{-3}	1.2×10^{-4}
1999	3.7×10^{-4}	1.8×10^{-5}

DOE = U.S. Department of Energy
EIS = environmental impact statement
INEEL = Idaho National Engineering and Environmental Laboratory

[a] DOE. DOE/EIS–0287–F, "Idaho High-Level Waste and Facilities Disposition final Environmental Impact Statement." Section 4.7. Idaho Falls, Idaho: DOE, Idaho Operations Office. 2002.

NOTE: To convert person-Sv to person-rem, multiply by 100.

response values (EPA, 1993, 1994) being used in the calculations, no adverse health impacts for noncarcinogenic constituents in air emissions (including fluorides, ammonia, and hydrochloric and sulfuric acids) were projected. Off-site excess cancer risk from carcinogenic emissions (e.g., arsenic, benzene, carbon tetrachloride, and formaldehyde) ranged from 1 in 1.4 million to 1 in 625 million. Consideration of potential health impacts from drinking water from INTEC wells and distribution systems indicates EPA maximum contaminant levels and State of Idaho drinking water limits have not been exceeded for volatile organic compounds. Risks from chemical carcinogens were estimated at less than 1 occurrence in 1 million (DOE, 2002a) and 0 for noncarcinogenic chemical contaminants.

3.13.2 Occupational Health and Safety

Occupational health conditions at the INEEL facility have been previously described in DOE (2002a). Occupational radiological exposures are typically maintained at levels well below DOE occupational exposure limits through the implementation of radiation protection procedures that emphasize maintaining exposures as low as is reasonably achievable (DOE, 2002a). Effects of long-term occupational exposures are also the subject of ongoing investigations conducted by the Centers for Disease Control and Prevention, an agency of the U.S. Department of Health and Human Services.

Routine exposure measurements of workers have been used to assess potential health effects. Radiation workers at INEEL can be exposed to radiation internally (from inhalation and ingestion) and externally (from direct exposure). In general, the largest fraction of occupational dose received by INEEL workers is external radiation from direct exposure (DOE, 2002a). The average occupational dose at INEEL between 1997 and 2000 was 0.84 mSv [84 mrem], a value well below the annual occupational dose limits of 50 mSv [5,000 mrem] in 10 CFR Part 20.

Nonradiological occupational exposures are controlled through the implementation of industrial hygiene and occupational safety programs. Recordable case rate for injury and illness incidences at INEEL varied from an annual average of 3.1 to 3.7 per 200,000 work hours from 1992 to 1996. During this time, lost workday cases ranged from 1.3 to 1.8 per 200,000 work

hours (DOE, 1997b). The recordable case rate for injury and illnesses for INEEL workers is less than that for DOE and its contractors at other facilities, which varied from 3.5 to 3.8 per 200,000 work hours. Two fatalities occurred at INEEL between 1992 and July 1998, one occurred in a construction fall and the other resulted from carbon dioxide asphyxiation cause by a misactivation of fire-suppression systems during maintenance.

3.14 Waste Management

Waste generated during the construction and operation of the proposed Idaho Spent Fuel Facility will be handled under the existing waste management system at INEEL. Existing waste management activities at INEEL have been described in previous environmental documentation (DOE, 2002a). The following paragraphs describe sources, generation rates, and volumes for wastes, including solid waste, hazardous waste, mixed low-level radioactive waste, low-level radioactive waste, transuranic radioactive waste, and HLW.

INEEL has programs and physical or engineered processes in place to reduce or eliminate waste generation and to reduce the hazard, toxicity, and quantity of waste generated. Waste is also recycled to the extent possible before, or in lieu of, its storage or disposal. In addition, INEEL has reduced the volume of radioactive wastes through more intensive surveying, waste segregation, and administrative and engineering controls. These programs and their results have been described in various documents including site-treatment plans (DOE, 1998) and annual progress reports (DOE, 1997c).

A variety of wastes are generated at INEEL. Table 3-26 provides a summary of waste volumes for individual waste types at INEEL. Industrial and commercial solid waste is disposed of at the INEEL Landfill Complex in the Central Facilities Area. About 91 ha [225 acres] are available for solid-waste disposal at the landfill complex. The capacity is sufficient to dispose of INEEL waste for 30 to 50 years. Recyclable materials are segregated from the solid-waste stream at each INEEL facility. The average annual volume of waste disposed of at the landfill complex from 1988 through 1992 was 52,000 m^3 [68,000 yd^3] (EG&G, Idaho, Inc., 1993). For 1996 and 1997, the volume of waste was approximately 45,000 and 54,000 m^3 [58,850 and 70,625 yd^3], respectively. The average annual volume of waste disposed of from 1998 through 2001 was approximately 43,000 m^3 [56,240 yd^3] (DOE, 2002a).

The INEEL hazardous waste management strategy is to minimize generation and storage and use private sector treatment and disposal. Approximately 120 m^3 [157 yd^3] of hazardous waste are generated at the site each year. Hazardous waste is treated and disposed of at off-site facilities and is transported by the commercial treatment contractor. The waste is packaged for shipment according to waste acceptance criteria at the receiving facility. The waste generator normally holds waste in a temporary accumulation area until it is shipped directly to the off-site commercial treatment facility.

About 2,100 m^3 [2,750 yd^3] of mixed low-level waste are presently at the INEEL site (DOE, 2002b). In addition to the current volume of mixed low-level waste in inventory at the site, approximately 160 m^3 [209 yd^3] of mixed low-level waste is generated annually (DOE, 2002b). Several mixed waste treatment facilities exist at the INEEL.

About 170,000 m^3 [222,340 yd^3] of low-level waste have been disposed of at the Radioactive Waste Management Complex (DOE, 1995, 1997d). Currently, approximately 980 m^3 [1,280 yd^3]

Table 3-26. Summary of Waste Volumes Awaiting Treatment and Disposal at INEEL[a,b]

Waste Type	Current Inventory	Annual Generation (m^3)
Industrial Solid	—[c]	43,000
Hazardous Waste	None[d]	120
Mixed Low-Level Waste	2,100 m^3	160
Low-Level Waste	980 m^3	2,900
Transuranic Waste[e]	65,000 m^3	—
High-Level Waste (calcine)	4,400 m^3	—
Mixed Transuranic Waste/Sodium-Bearing Waste	3,785,000 L	—

DOE = U.S. Department of Energy
EIS = environmental impact statement
INEEL = Idaho National Engineering and Environmental Laboratory

[a] DOE. DOE/EIS–0287–F, "Idaho High-Level Waste and Facilities Disposition Final Environmental Impact Statement." Section 4.7. Idaho Falls, Idaho: DOE, Idaho Operations Office. 2002.
[b] Does not include waste already disposed of at the Radioactive Waste Management Complex or other locations.
[c] Dash indicates no information available.
[d] Waste is shipped offsite before any significant inventory buildup.
[e] A portion of the 65,000 m^3 of transuranic waste retrievably stored at the Radioactive Waste Management Complex may be reclassified as alpha mixed low-level waste. It has been estimated that approximately 40 percent of the 65,000 m^3 is alpha mixed low-level waste, and 60 percent is actually transuranic waste.

NOTE: To convert meters cubed (m^3) to yards cubed (yd^3), multiply by 1.3079; to convert liters (L) to gallons (gal), multiply by 0.264.

of low-level waste are in inventory at INEEL (DOE, 2002a). All on-site-generated low-level waste is stored temporarily at generator facilities until it can be shipped directly to the Radioactive Waste Management Complex for disposal. DOE expects to stop accepting contact-handled and remote-handled low-level wastes at the Radioactive Waste Management Complex in 2020 (DOE, 2002a).

Approximately 65,000 m^3 [85,000 yd^3] of transuranic and alpha-contaminated mixed low-level wastes are retrievably stored, and 60,000 m^3 [78,500 yd^3] of transuranic waste have been buried at the Radioactive Waste Management Complex (DOE, 1995). The Radioactive Waste Management Complex is composed of seven Type II storage modules, each of which can hold up to 4,465 m^3 [5,840 yd^3] of waste in drums or boxes. The total storage capacity is 31, 255 m^3 40,878 yd^3]. The processing capacity of the Advanced Mixed Waste Treatment Facility is 6,500 m^3/yr [8,500 yd^3/yr], and the expected duration of facility operation is 30 years (DOE, 1999). All 65,000 m^3 [85,000 yd^3] of the retrievably stored wastes were considered to be transuranic waste when first stored at INEEL. In 1982, DOE Order 5820.2 changed the definition of transuranic waste. The new definition excluded alpha-emitting waste less than 100×10^{-9} curies/g [3.5×10^{-9} curies/oz] at the time of assay. Because all the waste was initially considered to be transuranic waste, the alpha-emitting wastes were co-mingled in the same containers as the transuranic waste.

DOE has not determined the final disposition of the buried transuranic waste (DOE, 1995). However, DOE currently plans to treat and repackage the retrievably-stored transuranic and alpha-contaminated low-level waste so that all the resulting waste qualifies as transuranic waste. This waste would then be certified and shipped to the Waste Isolation Pilot Plant in New Mexico for final disposition. The Record of Decision from the Waste Isolation Pilot Plant Disposal Phase Final Supplemental Environmental Impact Statement was issued in January 1998 (DOE, 1998), and the first shipments of transuranic waste from the INEEL to the Waste Isolation Pilot Plant occurred in April and August 1999. Since the October 1988 ban by the State of Idaho on shipments of transuranic waste to INEEL, DOE has shipped only small amounts of transuranic waste generated on the site to the Radioactive Waste Management Complex for interim storage.

From 1952 to 1991, DOE processed SNF and irradiated targets at the INTEC. The resulting liquid mixed HLW was stored in the Tank Farm. Mixed transuranic waste/sodium-bearing waste generated from the cleanup of solvent used to recover uranium and from decontamination processes at the INTEC is also stored in the Tank Farm. Although not directly produced from SNF processing, mixed transuranic waste/solid sodium-bearing waste at INEEL has been historically managed as HLW because of some of its physical properties. For purposes of analysis, INEEL has assumed that solid sodium-bearing waste is mixed transuranic waste in prior EISs (DOE, 2002a).

At present, approximately 4,400 m^3 [5,750 yd^3] of HLW calcine are stored at INTEC. INEEL no longer generates liquid mixed HLW because SNF processing has been terminated (DOE, 1995). All liquid mixed HLW produced from past processing has been blended and reprocessed, through calcination, to produce granular calcine. Mixed transuranic waste/solid sodium-bearing waste is generated from incidental activities associated with operations at INTEC (DOE, 1996b). Currently, approximately 3,800,000 L [1,000,000 gal] of mixed transuranic waste/solid sodium-bearing waste are in storage at INTEC, and this amount is expected to be reduced to about 3,028,000 L [800,000 gal] by the time waste processing begins (Barnes, 1999).

3.15 References

Anderson, J.E. “Final Report: Vegetation Studies to Support the NPR Environmental Impact Statement.” Subcontract No. C34–110421. Task Order No. 72. Idaho Falls, Idaho: EG&G Idaho, Inc. 1991.

Anderson, J.E., K.T. Ruppel, J.M. Glennon, K.E. Holte, and R.C. Rope. “Plant Communities, Ethnoecology, and Flora of the Idaho National Engineering Laboratory.” ESRF–005. Idaho Falls, Idaho: Environmental Science and Research Foundation. p. 8. 1996.

Arthur, W.J., J.W. Connelly, D.K. Halford, and T.D. Reynolds. DOE/ID–12099, “Vertebrates of the Idaho National Engineering Laboratory.” Idaho Falls, Idaho: DOE, Idaho Operations Office. 1984.

Arthur, W.J., O.D. Markham, C.R. Groves, B.L. Keller, and D.K. Halford. “Radiation Dose to Small Mammals Inhabiting a Solid Radioactive Waste Disposal Area.” *Journal of Applied Ecology*. Vol. 23. pp. 13–26. 1986.

Barnes, C.M. "Process Assumption Description, Diagrams, and Calculations for P111 (Non-Separations Options, Sodium Bearing Waste Processed)." INEEL–EXT–00323 (EDF–PDS–D–009). Rev. 1. Idaho Falls, Idaho: INEEL. 1999.

Barraclough, J.T., B.D. Lewis, and R.G. Jensen. "Hydrologic Conditions at the Idaho National Engineering Laboratory, Idaho—Emphasis: 1974–1978." U.S. Geological Survey Water Resources Investigations Report 81-526. 1981.

Berenbrock, C. and L.C. Kjelstrom. DOE/ID–22148, "Preliminary Water-Surface Elevations and Boundary of the 100-Year Peak Flow in the Big Lost River at the Idaho National Engineering and Environmental Laboratory, Idaho." U.S. Geological Survey Water Resources Investigations Report 98-4065. 1998.

———. "Estimated 100-Year Peak Flows and Flow Volumes in the Big Lost River and Birch Creek at the Idaho National Engineering Laboratory, Idaho." U.S. Geological Survey Water Resources Investigations Report 96-4163. 1996.

Beyer, W.N. "Evaluating Soil Contamination." Biological Report 90(2). Washington, DC: U.S. Fish and Wildlife Service. 1990.

Bhamidipaty, S. "Plan of Study Big Lost River Diversion System." Walla Walla, Washington: U.S. Department of the Army, Walla Walla District, Corps of Engineers. 1997.

BLM. "Medicine Lodge Resource Management Plan Environmental Impact Statement." Idaho Falls, Idaho: U.S. Department of the Interior, BLM, Idaho Falls District. 1984.

———. "Visual Resource Contrast Rating." *BLM Manual Handbook 8431-1*. Idaho Falls, Idaho: U.S. Department of the Interior, BLM, Idaho Falls District. 1986a.

———. "Final Environmental Impact Statement Eastern Idaho Wilderness Study." Idaho Falls, Idaho: U.S. Department of the Interior, Idaho Falls District. 1986b.

Bowman, A.L. "Seismic and Volcanic Hazard Maps." Engineering Design File SNF–EIS–0001–95. Rev. 2. Idaho Falls, Idaho: LMITCO. 1995.

Cecil, L.D., T.M. Beasley, J.R. Pittman, R.L. Michel, P.W. Kubrik, P. Sharma, U. Fehn, and H.E. Gove. "Water Infiltration Rates in the Unsaturated Zone at the Idaho National Engineering Laboratory Estimated from Chlorine-36 and Tritium Profiles and Neutron Logging." Volume 1: Low Temperature Environments. Proceedings of the 7th International Symposium on Water-Rock Interaction, Park City, Utah, July 13–18, 1992. Rotterdam, Netherlands: A.A. Balkima. pp. 709–714. 1992.

Clawson, K.L., G.E. Start, and N.R. Ricks. DOE/ID–12118, "Climatography of the Idaho National Engineering Laboratory." Idaho Falls, Idaho: U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Environmental Research Laboratories, Air Resources Laboratory, Field Research Division. 1989.

Council on Environmental Quality. "Environmental Justice Guidance Under the National Environmental Policy Act." Washington, DC: Executive Office of the President. 1997.

Craig, T.H., D.K. Halford, and O.D. Markham. "Radionuclide Concentrations in Nestling Raptors Near Nuclear Facilities." *Wilson Bulletin.* Vol. 91. pp. 71–77. 1979.

DOE. DOE/EIS–0287–F, "Idaho High-Level Waste and Facilities Disposition Final Environmental Impact Statement." Idaho Falls, Idaho: DOE, Idaho Operations Office. 2002a.

———. "Idaho National Engineering and Environmental Laboratory Site Treatment Plan." Idaho Falls, Idaho: DOE, Idaho Operations Office. 2002b.

———. DOE/ID–10930, Rev. 0, "Annual INTEC Groundwater Monitoring Report for Group 5—Snake River Plain Aquifer (2001)." Idaho Falls, Idaho: DOE, Operations Office. 2002c.

———. DOE/ID–10967, Rev. 0, "Phase I Monitoring Well and Tracer Study Report for Operable Unit 3-13, Group 4, Perched Water (Draft)." Idaho Falls, Idaho: DOE, Idaho Operations Office. 2002d.

———. DOE/ID–10431, "INEEL Storm Water Pollution Prevention Plan for Industrial Activities." Idaho Falls, Idaho: DOE, Idaho Operations Office. 2001a.

———. "2000 Environmental Monitoring Program Report." INEEL/EXT–01–00447. Idaho Falls, Idaho: DOE, Idaho Operations Office. 2001b.

———. DOE/EIS–0290, "Advanced Mixed Waste Treatment Project Final Environmental Impact Statement." Vol. 1. Idaho Falls, Idaho: DOE, Idaho Operations Office. 1999.

———. "Record of Decision for the Waste Isolation Pilot Plant Disposal Phase Final Supplemental Environmental Impact Statement (WIPP SEIS II), Carlsbad, New Mexico." Washington, DC: DOE. 1998.

———. DOE/ID–10514, "Idaho National Engineering and Environmental Laboratory Comprehensive Facility and Land Use Plan." [Approval Letter: # OPE–OIM–99–028, July 19, 1999] Idaho Falls, Idaho: DOE, Idaho Operations Office. 1997a.

———. "DOE and Contractor Injury and Illness Experience By Year and Quarter 1992 Through 1997 3rd Quarter." Washington, DC: DOE. 1997b.

———. DOE/EM–0334, "Annual Report of Waste Generation and Pollution Prevention Progress." Washington, DC: DOE, Office of Pollution Prevention, Office of Environmental Management. 1997c.

———. DOE/EIS–0200–F, "Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste." Vol. 4 of 5, Appendix I. Washington, DC: DOE, Office of Environmental Management. p. I–38. 1997d.

———. DOE/STD–1023–95. "Change Notice #1—Natural Phenomena Hazards Assessment Criteria." Washington, DC: Office of Environment, Safety, and Health. 1996a.

———. DOE/EM–0290. "The 1996 Baseline Environmental Management Report." Vol. 2. Washington, DC: DOE, Office of Environmental Management. June 1996b.

———. DOE/EIS–0218–F. "Proposed Nuclear Weapons Nonproliferation Policy Concerning Foreign Research Reactor Spent Nuclear Fuel EIS." Vol. 1. Washington, DC: DOE, Office of Environmental Management. 1996c.

———. "Record of Decision for the Final Environmental Impact Statement on a Proposed Nuclear Weapons Nonproliferation Policy Concerning Foreign Research Reactor Spent Nuclear Fuel; Notice." *Federal Register.* Vol. 61, No. 97. p. 25092. May 17, 1996d.

———. DOE/EIS–0203–F. "Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement." Idaho Falls, Idaho: DOE. 1995.

———. DOE/ID–10440. Rev. 1. "Idaho National Engineering Laboratory Long-Term Land Use Future Scenarios." Idaho Falls, Idaho: DOE, Idaho Operations Office. June 1993.

EG&G Idaho, Inc. "Projected INEL Waste Inventories." Engineering Design File, ER&WM–EDF–0015–93. Rev. 6a. Idaho Falls, Idaho: EG&G Idaho, Inc. 1993.

Environmental Science and Research Foundation, Inc. "An Animal of the High Desert—Coyote." Newsletter: Vol. 7. Issue 1. Idaho Falls, Idaho: Environmental Science and Research Foundation, Inc. 2000.

———. "Plant Recovery After a Fire: Does Mother Nature Need Our Help?" Newsletter: Vol. 6, Issue 4. Idaho Falls, Idaho: Environmental Science and Research Foundation, Inc. 1999.

EPA. "Region 9 PRGs Table Users Guide/Technical Background Document." San Francisco, California: EPA Region 9. <http://www.epa.gov/region09/waste/sfund/prg/files/02userguide.pdf> 2002.

———. "Region 4 Waste Management Division Soil Screening Values for Hazardous Waste Sites." Atlanta, Georgia: EPA Region 4. <http://www.epa.gov/region04/waste/ots/epatab4.pdf> 1999.

———. "Final National Pollutant Discharge Elimination System Storm Water Multi-Sector General Permit for Industrial Activities." *Federal Register.* Vol. 60, No. 189. pp. 50803–51319. September 29, 1995.

———. "Integrated Risk Information System (IRIS)—Selected Chemicals Database." Washington, DC: EPA. 1994.

———. "Health Effects Assessment Summary Tables." EPA540–R–93–058. Washington, DC: EPA. 1993.

Evenson, L.M. “Systemic effects of radiation exposure on rodents inhabiting liquid and solid radioactive waste disposal areas.” Master’s Thesis. University of Idaho. Moscow, Idaho. 1981.

FWENC. "Foster Wheeler Environmental Corporation Idaho Spent Fuel Facility Response to NRC Request for Additional Information Related to Environmental Review.” NRC Docket No. 72-25, TAC No. L20768. Letter (March 7) from R.D. Izatt to NRC. FW–NRC–ISF–03–0048. Richland, Washington: FWENC. 2003. [The preceding document is available for public review through the NRC electronic reading room at http://www.nrc.gov/reading-rm/adams.html.]

———. “Environmental Report, Idaho Spent Fuel Facility.” NRC Docket No. 72-25, ISF–FW–RPT–0032. Morris Plains, New Jersey: FWENC. 2001a.

———. “Safety Analysis Report, Idaho Spent Fuel Facility.” NRC Docket No. 72-25, ISF–FW–RPT–0033. Morris Plains, New Jersey: FWENC. 2001b.

———. “License Application, Idaho Spent Fuel Facility.” NRC Docket No. 72-25. ISF–FW–RPT–0127. Morris Plains, New Jersey: FWENC. 2001c.

Gaia Northwest, Inc. “Drinking Water Consumption and Alternative Sources for the Eastern Snake River Plain, Idaho.” Seattle, Washington: Gaia Northwest, Inc. 1988.

Guenzler, R.C. and V. W. Gorman. “The Borah Peak Idaho Earthquake of October 28, 1983—Industrial Facilities and Equipment at INEL.” *Earthquake Spectra*. Vol. 2, No. 1. 1985.

Hackett, W.R. and R.P. Smith. “Quaternary Volcanism, Tectonics, and Sedimentation in the Idaho National Engineering Laboratory Area.” *Field Guide to Geologic Excursions in Utah and Adjacent Areas of Nevada, Idaho, and Wyoming. Geological Society of America Rocky Mountain Section Guidebook*. J.R. Wilson, ed. *Utah Geological Survey Miscellaneous Publication 92-3*. Salt Lake City, Utah: Utah Geological Survey. pp. 1–18. 1992.

Halford, D.K. and O.D. Markham. “Radiation Dosimetry of Small Mammals Inhabiting a Liquid Radioactive Waste Disposal Area.” *Ecology* 59. pp. 1,047–1,054. 1978.

Hoblitt, R.P., C.D. Miller, and W.E. Scott. “Volcanic Hazards with Regard to Siting Nuclear-Power Plants in the Pacific Northwest.” U.S. Geological Survey Open-File Report 87-297. 1987.

Hoff, D.L., R.G. Mitchell, G.C. Bowman, and R. Moore. DOE/ID–12082(89), “The Idaho National Engineering Laboratory Site Environmental Report for Calendar Year 1989.” Idaho Falls, Idaho: DOE, Radiological and Environmental Sciences Laboratory. June 1990.

Idaho Conservation Data Center. *Species with Special Status in Idaho*. Idaho Department of Fish and Game. updated August 1997.

Idaho Department of Environmental Quality. “IDAPA 58, Title 1, Chapter 8, Rules for Public Drinking Water Systems.” Boise, Idaho: Idaho Department of Environmental Quality <http://www.state.id.us/adm/adminrules/rules/idapa58/0108.pdf> 2001a.

———. "IDAPA 58, Title 1, Chapter 17, Wastewater-Land Application Permit Rules." Boise, Idaho: Idaho Department of Environmental Quality. <http://www.state.id.us/adm/adminrules/rules/idapa58/0117.pdf> 2001b.

———. DOE/ID–10660, Rev. 0, "Final Record of Decision, Idaho Nuclear Technology and Engineering Center, Operable Unit 3-13, Idaho National Engineering and Environmental Laboratory, Idaho Falls, Idaho." Idaho Falls, Idaho: Idaho Department of Health and Human Welfare, Division of Environmental Quality, DOE, and EPA. October 1999.

Idaho Department of Water Resources. "Geothermal Investigations in Idaho, Part 9, Potential for Direct Heat Application of Geothermal Resources." *Water Information Bulletin No. 30*. Boise, Idaho: Idaho Department of Water Resources. 1980.

Irving, J.S. "Environmental Resource Document for the Idaho National Engineering Laboratory." EGG–WMO–10279. Idaho Falls, Idaho: EG&G Idaho, Inc. 1993.

Jackson, S.M. "Acceleration Data from 1983 Borah Peak, Idaho, Earthquake Recorded at the Idaho National Engineering Laboratory." Proceedings of Workshop XXVIII on the Borah Peak, Idaho, Earthquake. R.S. Stein and R.C. Buckham, eds. U.S. Geological Survey Open-File Report 85-290. pp. 385–400. 1985.

Jackson, S.M., I.G. Wong, G.S. Carpenter, D.M. Anderson, and S.M. Martin. "Contemporary Seismicity in the Eastern Snake River Plain, Idaho, Based on Microearthquake Monitoring." *Bulletin of the Seismological Society of America*. Vol. 83. pp. 680–695. 1993.

Kaminsky, J.F. "*In-situ* characterization of unsaturated hydraulic properties of surficial sediments adjacent to the radioactive waste management complex, Idaho National Engineering Laboratory, Idaho." Master's thesis, ISU–91–000. Idaho State University. Pocatello, Idaho. 1991.

King, J.J., T.E. Doyle, and S.M. Jackson. "Seismicity of the Eastern Snake River Plain region, Idaho, Prior to the Borah Peak, Idaho, Earthquake: October 1972–October 1983." *Bulletin of the Seismological Society of America*. Vol. 77. pp. 809–818. 1987.

Koslow, K.N. and D.H. Van Haaften. "Flood Routing Analysis for a Failure of Mackay Dam." EGGEP–7184. Idaho Falls, Idaho: EG&G Idaho, Inc. 1986.

Kramber, W.L., R.C. Rope, J. Anderson, J. Giennon, and A. Morse. "Producing a Vegetation Map of the Idaho National Engineering Laboratory Using Landsat Thematic Mapper Data." Proceedings of the American Society for Photogrammetry and Remote Sensing 1992 Annual Meeting, Albuquerque, New Mexico, March 1992. Bethesda, Maryland: American Society for Photogrammetry and Remote Sensing. 1992.

Kuntz, M.A., B. Skipp, M.A. Lanphere, W.E. Scott, K.L. Pierce, G. Dalrymple, L.A. Morgan, D.E. Champion, G.R. Embree, R.P. Smith, W.R. Hackett, and D.W. Rodgers. "Revised Geologic Map of the INEL and Adjoining Areas, Eastern Idaho." *U.S. Geological Survey Open-File Report 990-333*. W.R. Page, compiler. Scale 1:100,000. 1990.

Kuntz, M.A., B. Skipp, M.A. Lanphere, W.E. Scott, K.L. Pierce, G.B. Dalrymple, D.E. Champion, G.F. Embree, W.R. Page, L.A. Morgan, R.P. Smith, W.R. Hackett, and D.W. Rodgers. "Geologic Map of the INEL and the Adjoining Areas, Eastern Idaho." U.S. Geological Survey Miscellaneous Investigations Series, Map 2330. Scale 1:100,000. 1994.

Leonard, P.R. "Estimated Radiological Doses Resulting from Airborne Radionuclides Released by Facilities at the Idaho National Engineering Laboratory." EGG–WTD–10676. Idaho Falls, Idaho: EG&G Idaho, Inc. 1993.

LMITCO. "1998 LMITCO Internal Report, Big Lost River Diversion Dike Foundation Investigation." INEEL/INT–98–0090. Idaho Falls, Idaho: LMITCO. 1998.

———. "1996 LMITCO Environmental Monitoring Program Report for the Idaho National Engineering and Environmental Laboratory." INEEL/EXT–97–0132(96). Idaho Falls, Idaho: LMITCO. 1997.

———. "Executive Summary for Background Dose Equivalent Rates and Surficial Soil Metal and Radionuclide Concentrations for the Idaho National Engineering Laboratory." INEL–94/0250. Rev. 1. Idaho Falls, Idaho: LMITCO. 1996.

———. "Report of 1993/1994 Tank Farm Drilling and Sampling Investigation at the Idaho Chemical Processing Plant." INEL–95/0064. Idaho Falls, Idaho: LMITCO. 1995.

Markham, O.D., R.E. Authenrieth, and R.L. Dickson. "Radionuclides in Pronghorn Resulting from Nuclear Fuel Reprocessing and Worldwide Fallout." *Journal of Wildlife Management.* Vol. 46. pp. 30–42. 1982.

Millard, J.B., F.W. Whicker, and O.D. Markham. "Radionuclide Uptake and Growth of Barn Swallows Nesting by Radioactive Leaching Ponds. *Health Physics.* Vol. 58. pp. 429–439. 1990.

Miller, S.J. DOE/ID–10361, Rev. 1, "Idaho National Engineering Laboratory Management Plan for Cultural Resources (Final Draft)." Idaho Falls, Idaho: DOE, Idaho Operations Office. 1995.

Mitchell, V.E., W.B. Strowd, G.S. Hustedde, and E.H. Bennett. "Mines and Prospects of the Dubois Quadrangle, Idaho." Idaho Bureau of Mines and Geology: Mines and Prospects Map Series, MPM–7. Scale 1:250,000. 1981.

Morris, R.C. "Radioecology of the Idaho National Engineering Laboratory, Draft." Idaho Falls, Idaho: DOE. 1993.

Murphy, R.F. and Y. Murphy. "Northern Shoshone and Bannock." *Handbook of North American Indian*s. Vol. 11. W.C. Sturtevant, gen. ed. Washington, DC: Smithsonian Institution. 1986.

National Park Service. "Cultural Resource Management Guideline." NPS–28. Washington, DC: National Park Service. <http://www.cr.nps.gov/history/online_books/nps28/28contents.htm> (June 11, 1998).

NRC. NUREG–1626, “Final Environmental Impact Statement for the Construction and Operation of an Independent Spent Fuel Storage Installation to Store the Three Mile Island Unit 2 Spent Fuel at the Idaho National Engineering and Environmental Laboratory.” Washington, DC: NRC. March 1998.

Ostenaa, D.A., D.R. Levish, R.E. Klinger, and D.R.H. O’Connell. “Phase 2 Paleohydrolgic and Geomorphic Studies for the Assessment of Flood Risk for the Idaho National Engineering and Environmental Laboratory, Idaho.” Report 99-7. Denver, Colorado: Geophysics, Paleohydrology, and Seismotechonics Group, Technical Service Center, Bureau of Reclamation. 1999.

Pace, B.R. “Cultural Resource Investigations for the Idaho Spent Fuel Facility at the Idaho National Engineering and Environmental Laboratory.” INEEL/EXT–2001–457. Idaho Falls, Idaho: INEEL, Cultural Resource Management Office. 2001.

Ramsdell, J.V. and G.L. Andrews. NUREG/CR–4461, “Tornado Climatology of the Contiguous United States.” Richland, Washington: Pacific Northwest National Laboratory. May 1986.

Patrick, S. and J.E. Anderson. “Fire Ecology of the Idaho National Engineering and Environmental Laboratory.” Annual Technical Report to DOE–ID—Calendar Year 1996. R.C. Morris and R.D. Blew, eds. ESRF–017. Idaho Falls, Idaho: Environmental Science and Research Foundation, Inc. pp. 144–145. 1997.

Pelton, J.R., R.J. Vincent, and N.J. Anderson. “Microearthquakes in the Middle Butte/East Butte Area, Eastern Snake River Plain, Idaho.” *Bulletin of the Seismological Society of America*. Vol. 80. pp. 209–212. 1990.

Peterson, P.M. “1995 Reconciliation of INEL Land.” Idaho Falls, Idaho: DOE, Idaho Operations Office. 1995.

Reynolds, T.D., J.W. Connelly, D.K. Halford, and W.J. Arthur. “Vertebrate Fauna of the Idaho National Environmental Research Park.” *Great Basin Naturalist.* Vol. 46, No. 3. pp. 513–527. 1986.

Ringe, B.L. “Locational analysis and preliminary predictive model for prehistoric cultural resources on the INEL.” Master’s thesis. Idaho State University. Pocatello, Idaho. 1993a.

———. “Locational Analysis and Preliminary Predictive Model for Prehistoric Cultural Resources on the INEL (Draft).” EGG–CS–10706. Idaho Falls, Idaho: EG&G Idaho, Inc. 1993b.

Rodriguez, R.R., A.L. Shafer, J. McCarthy, P. Martian, D.E. Burns, D.E. Raunig, N.A. Burch, and R.L. VanHorn. DOE/ID–10534, “Comprehensive RI/FS for the Idaho Chemical Processing Plant OU3–13 at the INEEL—Part A, RI/BRA Report (Final).” Idaho Falls, Idaho: DOE, Idaho Operations Office. 1997.

Rope, R.C., N.L. Hampton, and K.A. Finely. “Ecological Resources.” Environmental Resource Document for the Idaho National Engineering Laboratory. EGG–WMO–12079. Vols. 1 and 2. Idaho Falls, Idaho: EG&G Idaho, Inc. 1993.

Scott, W.E. “Holocene Rhyodacite Eruptions on the Flanks of South Sister Volcano, Oregon—The Emplacement of Silicic Domes and Lava Flows.” *Geological Society of America Special Paper 212*. J.H. Fink, ed. Boulder, Colorado: Geological Society of America. pp. 35–54. 1987.

Strowd, W.B., V.E. Mitchell, G.S. Hostedde, and R.H. Bennett. “Mines and Prospects of the Idaho Falls Quadrangle, Idaho.” Idaho Bureau of Mines and Geology: Mines and Prospects Map Series, MPM–11. Scale 1:250,000. 1981.

The White House. “Executive Order 12898—Federal Actions to Address Environmental Justice in Minority and Low-Income Populations.” *Federal Register.* Vol. 59. pp. 7629–7633. February 1998.

U.S. Bureau of Labor Statistics. “Local Area Unemployment Statistics.” Washington, DC: U.S. Bureau of Labor Statistics, Local Area Unemployment Statistics Division. 2002.

———. “1990–1996 Annual Average Labor Force Data.” Washington, DC: U.S. Bureau of Labor Statistics, Local Area Unemployment Statistics Division. 1997.

U.S. Bureau of the Census. “1990 Census of Population and Housing.” Washington, DC: U.S. Department of Commerce, Bureau of the Census. 1992.

———. “2000 Census of Population and Housing.” Washington, DC: U.S. Department of Commerce, Bureau of the Census. 2000.

U.S. Department of Commerce. “General Housing Characteristics: 2000.” Census 2000 Summary File (SF1) 100-Percent Data. QT–H1. Washington, DC: Economics and Statistics Division, Bureau of the Census. 2000a.

———. “General Housing Characteristics: 2000.” Census 2000 Summary File (SF1) 100-Percent Data. GCT–H5. Washington, DC: Economics and Statistics Division, Bureau of the Census. 2000b.

U.S. Department of the Interior. "Department of Energy, Idaho National Engineering and Environmental Laboratory Species List Update". Letter (September 3) to R.D. Blew, Environmental Science Research Foundation. Boise, Idaho: U.S. Department of the Interior, U.S. Fish and Wildlife Service. 2002.

Volcanism Working Group. “Assessment of Potential Volcanic Hazards for the New Production Reactor Site at the Idaho National Engineering Laboratory.” EGG–NPR 10624. Idaho Falls, Idaho: EG&G Idaho, Inc. 1990.

Wilhelmson, R.N., K.C, Wright, and D.W. McBride. “Annual Report—1992 Environmental Surveillance for EG&G Idaho Waste Management Facilities at the Idaho National Engineering Laboratory.” EGG–2679(92). Idaho Falls, Idaho: EG&G Idaho, Inc. 1993.

Woodward-Clyde Consultants. “Earthquake Strong Ground Motion Evaluations for the Proposed New Production Reactor at the Idaho National Engineering Laboratory.” EGG–GEO–10304. Idaho Falls, Idaho: EG&G Idaho, Inc. 1992.

———. "Earthquake Strong Ground Motion Estimates for the Idaho National Engineering Laboratory: Final Report." EGG–BG–9350. Idaho Falls, Idaho: EG&G Idaho, Inc. 1990.