# 2000 Environmental Monitoring Program Report

## 1. INTRODUCTION

This report summarizes the monitoring results and activities of the Environmental Monitoring Program at the Idaho National Engineering and Environmental Laboratory (INEEL) for Calendar Year 2000. The purposes of the Environmental Monitoring Program are to monitor effluents and environmental media; to meet applicable permits, rules, and regulations; to assess the impact of INEEL operations on the environment; and to protect public health.

The INEEL is owned by the U.S. Department of Energy (DOE). Various management and operating contractors have been at the INEEL over the years; Bechtel BWXT Idaho, LLC (BBWI) is the current management and operating contractor.

The INEEL was established as the National Reactor Testing Station in 1949 to conduct research and to further develop peaceful uses of atomic energy. The name was changed in 1974 to the Idaho National Engineering Laboratory to include a broader scope of engineering support activities for DOE. In response to the increased role the laboratory currently plays in the environmental cleanup of the DOE complex and technology development, the name was changed in 1997 to the Idaho National Engineering and Environmental Laboratory.

Early monitoring activities focused on evaluating the potential of exposing the general public to release of radioactive materials from INEEL facilities.[1] Radionuclides were the major contaminants of concern because the INEEL was heavily involved in testing nuclear facilities. The Department of Energy and its predecessor agencies sampled and analyzed environmental media that could be affected by atmospheric releases. The United States Geological Survey became involved in environmental surveillance at the INEEL from the beginning of site operations by monitoring groundwater quality in the Snake River Plain Aquifer. The National Oceanic and Atmospheric Administration has also been involved in monitoring atmospheric conditions since the Site's inception. During those early years, management and operating contractors conducted limited sampling of liquid and airborne effluents from facilities to develop waste inventory information.

Environmental monitoring is conducted by the management and operating contractor, the United States Geological Survey, the National Oceanic and Atmospheric Administration, the Stoller Corporation, and the INEEL Oversight Program. The primary emphasis of the management and operating contractor environmental monitoring is on-Site compliance. The United States Geological Survey, the National Oceanic and Atmospheric Administration, and the Stoller Corporation conduct both on-Site and off-Site surveillance, while the INEEL Oversight Program conducts independent verification both on- and off-Site.

### 1.1 Scope

The Environmental Monitoring Program conducts routine compliance monitoring and environmental surveillance at the INEEL. The primary purposes of monitoring and surveillance are to:

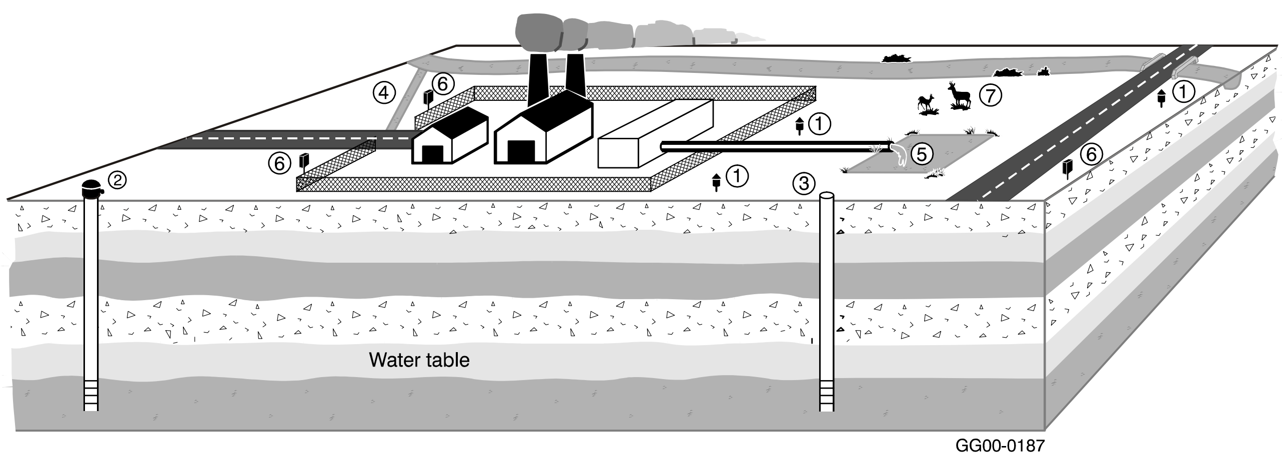
- Evaluate environmental conditions
- Provide and interpret data
- Verify compliance with applicable regulations or standards

- Ensure protection of human health and the environment.

  The Environmental Monitoring Program samples the following media (see Figure 1-1):

- Drinking water
- Liquid effluents
- Groundwater
- Ambient air
- Surface water/storm water runoff
- Soils and biota
- Direct radiation.

The Environmental Monitoring Program evaluates the sampling results and either transmits them directly or sends them to the U.S. Department of Energy Idaho Operations Office for transmittal to the applicable agencies. The results are also summarized annually in this report.




| Key | | | |
|---|---|---|---|
| 1. Ambient air<br>2. Drinking water | 3. Groundwater<br>4. Surface water and storm water runoff | 5. Liquid effluents<br>6. Direct radiation | 7. Soil and biota |

Figure 1-1. Environmental monitoring media sampled.

## 1.2 Program Objectives

The objectives of the Environmental Monitoring Program are to provide, interpret, and report data to ensure compliance with the following:

- Safe Drinking Water Act[2]
- Clean Water Act[3]
- Clean Air Act[4]
- State of Idaho Wastewater Land Application Permit Rules[5]
- State of Idaho Injection Well Permits[6]
- "City of Idaho Falls Industrial Wastewater Acceptance Forms"[7]
- National Pollutant Discharge Elimination System Storm Water Permit[8]
- DOE Order 5400.1 "General Environmental Protection Program"[9]
- DOE Order 5400.5 "Radiation Protection of the Public and the Environment"[10]
- DOE Order 435.1, "Radioactive Waste Management."[11]

These compliance documents provide the objectives of environmental monitoring. The Environmental Monitoring Program internal technical procedures, management control procedures, and program plans provide the details on how to meet the objectives.

### 1.2.1 Environmental Monitoring Objectives

Environmental monitoring is conducted to satisfy the following program objectives:

- Verify and support compliance with applicable federal, state, and local environmental laws, regulations, permits, and orders
- Establish baselines and characterize trends in the physical, chemical, and biological condition of effluent and environmental media
- Identify potential environmental problems and evaluate the need for remedial actions or mitigative measures
- Detect, characterize, and report unplanned releases
- Evaluate the effectiveness of effluent treatment and control and pollution abatement programs
- Determine compliance with commitments made in environmental impact statements, environmental assessments, safety analysis reports, or other official DOE documents.

### 1.2.2 Approach to Meeting Objectives

The general approach to meeting the objectives includes:

- Reviewing current and proposed rules and regulations to determine requirements
- Monitoring drinking water for the protection of the workers, general public, and the environment
- Developing a baseline for effluents and environmental media from historical monitoring data
- Comparing monitoring data from effluents and environmental media to historical data to monitor trends and changes that may indicate loss of process control, unplanned releases, or loss of effectiveness of pollution abatement programs
- Obtaining required permits for effluents
- Monitoring according to effluent permit requirements in terms of parameters, frequency, and methods
- Developing voluntary release criteria or alert levels, where permit criteria are not provided, to define levels of compounds that can be released to the environment or be present in environmental media without creating environmental problems or incurring future remediation liability
- Comparing current monitoring data to release criteria in permits and to other criteria that have been adopted by the program
- Identifying concerns to facility operations and assisting operations managers in resolving issues.

DOE orders provide some guidance on implementation. The DOE guidance is summarized in DOE-EH-0173T, *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance.*[12] The Environmental Monitoring Program follows this technical guide and other regulatory guides.

## 1.3 Quality Assurance/Quality Control

To ensure the effectiveness and reliability of the Environmental Monitoring Program, quality assurance and quality control programs are implemented.

### 1.3.1 Quality Assurance Program

The Quality Assurance Program for the Environmental Monitoring Program:

- Ensures that the sampling methods produce representative samples of environmental media
- Confirms that laboratory analyses are reliable
- Verifies that the quality of reported results is suitable to support decisions based on the environmental monitoring data.

A written quality assurance program plan is prepared for each Environmental Monitoring program. Quality Assurance Program elements are listed below:

- Program plans
- Technical procedures for sampling and conducting field work and analytical procedures
- Corrective action plans
- Chain of custody procedures
- Instrument calibration records
- Data verification/validation
- Internal/external inspection reports
- Personnel qualification/training records
- Records/logbooks
- Analytical reports/data packages
- Statements of work
- Purchasing control.

To further ensure useable data are generated, written program plans and technical procedures document responsibilities and requirements for collecting, analyzing, and processing samples. They also document program design criteria and decision criteria.

### 1.3.2 Quality Control Program

The Quality Control Program consists of submitting quality control samples to the laboratory to measure the amount of uncertainty in analytical data. Results of quality control samples are reviewed as part of the self-assessment program to determine if the monitoring data are meeting program goals. Types of quality control samples, frequency, and tolerance levels are documented in program-specific plans. Types of quality control samples are as follows:

- Blanks/trip blanks
- Field duplicates/replicates
- Splits
- Known standards.

Environmental Monitoring personnel regularly conduct self-assessments to determine whether they are adhering to program requirements and following the internal procedures.

## 1.4 Site Overview

The INEEL is located in southeastern Idaho, roughly equidistant from Salt Lake City, Utah (368 km, 228 mi); Butte, Montana (380 km, 236 mi); and Boise, Idaho (366 km, 228 mi). It is approximately 50 miles west of Idaho Falls, Idaho. Fourteen Idaho counties are located in part or entirely within 80 km (50 mi) of the INEEL (Figure 1-2). The INEEL includes portions of five counties (Bingham, Bonneville, Butte, Clark, and Jefferson).

There are nine primary facility areas and three smaller secondary facilities at the INEEL (Figure 1-2). The nine primary facility areas are:

- Argonne National Laboratory-West
- Auxiliary Reactor Area
- Central Facilities Area
- Idaho Nuclear Technology and Engineering Center
- Naval Reactors Facility
- Power Burst Facility
- Radioactive Waste Management Complex
- Test Area North
- Test Reactor Area.

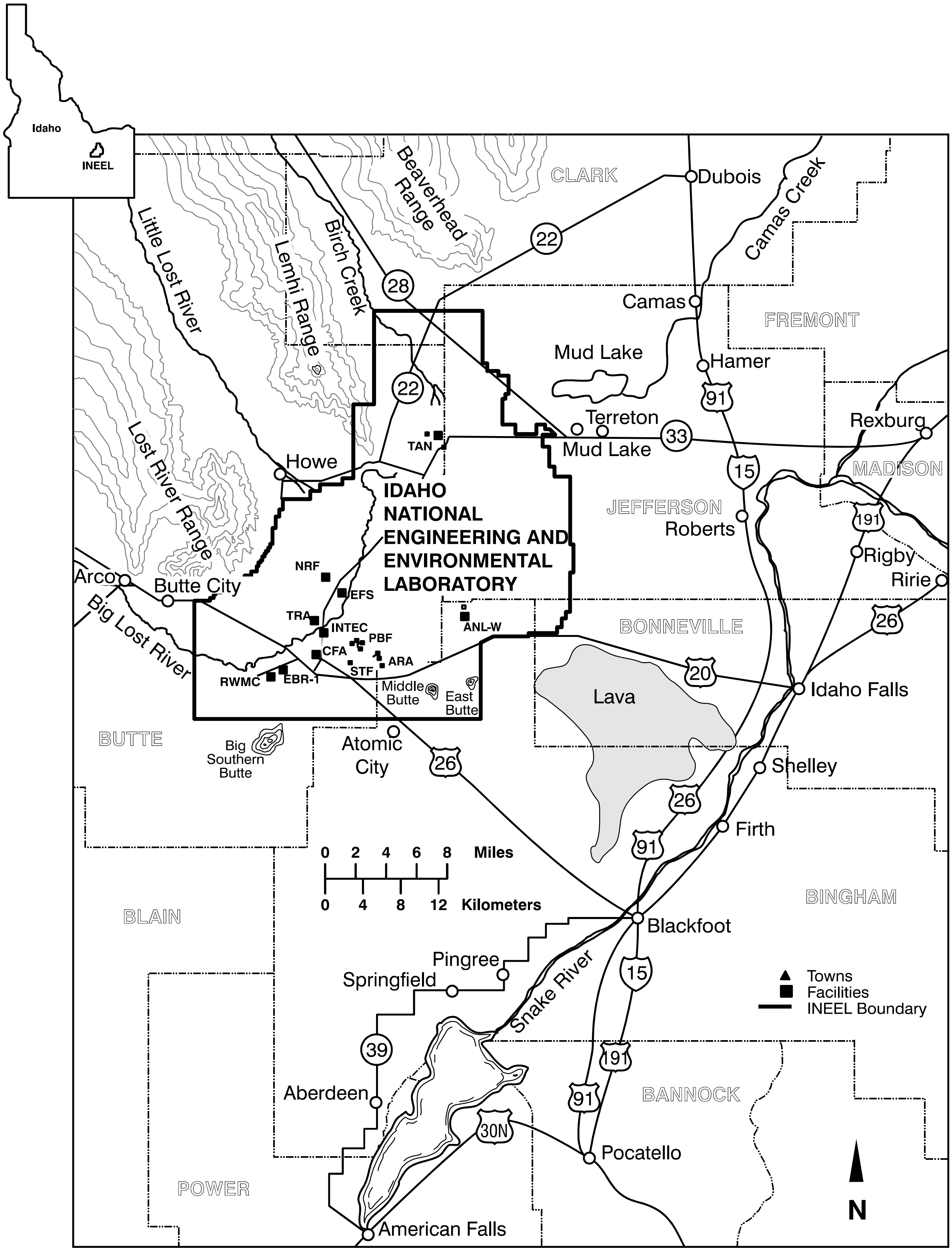



Figure 1-2. Map of Idaho National Engineering and Environmental Laboratory vicinity showing primary and secondary facilities, counties, and cities.

The three secondary facilities are:

- Experimental Breeder Reactor-I
- Experimental Field Station
- Security Training Facility.

There are also administrative, scientific support, and nonnuclear research laboratories in Idaho Falls, Idaho.

The Environmental Monitoring Program conducts surveillance or monitoring at the following locations:

- Nine primary facility areas and three secondary facilities (listed above)
- Outside facility boundaries
- Off-Site locations
- Idaho Falls facilities.

Appendix A includes specific facility maps and monitoring locations.

### 1.4.1 Regional Physical Setting

***1.4.1.1 Physiography.*** The INEEL is located in the north-central part of the Eastern Snake River Plain. The Eastern Snake River Plain is the eastern segment of the Snake River Plain and extends from the Hagerman-Twin Falls area northeast toward the Yellowstone Plateau. The Eastern Snake River Plain is bounded on the northwest and southeast by the north-to-northwest-trending, fault-block mountains of the Basin and Range physiographic province. The southern extremities of the Lost River, Lemhi, and the Beaverhead Ranges extend to the western and northwestern borders of the INEEL. At the base of the mountain ranges, the average elevation is about 1,524 m (5,000 ft) above mean sea level. Individual mountains immediately adjacent to the plain rise to 3,300 m (10,830 ft) above mean sea level.

The surface of the Eastern Snake River Plain is rolling-to-broken and is underlaid by basalt with a thin, discontinuous covering of surficial sediment. Hundreds of extinct volcanic craters and cones are scattered across the surface of the plain. Craters of the Moon National Monument, Big Southern Butte, Twin Buttes, and many small volcanic cones are aligned generally along a broad volcanic ridge trending northeastward from Craters of the Moon toward the Mud Lake basin. Between this volcanic ridge and the northern edge of the plain lies a lower area from which no exterior drainage exists. The INEEL occupies a substantial part of this lower closed topographic basin.

The INEEL is approximately 63 km (39 mi) long in a north-south direction and 58 km (36 mi) wide at its widest point. The INEEL covers approximately 2,307 $km^2$ (890 $mi^2$). The topography of the INEEL, like that of the entire Snake River Plain, is rolling-to-broken. The lowest elevation on the INEEL is the Big Lost River Sinks at 1,455 m (4,774 ft) above mean sea level. The highest elevations are the East Butte, 2,003 m (6,572 ft) above mean sea level, and Middle Butte, 1,948 m (6,391 ft) above mean sea level.

#### *1.4.1.2 Climatology.* 
Physiography affects the climate of the INEEL. The mountains lying west and north of the INEEL deflect moisture-laden air masses upward, which creates an arid to semi-arid climate on the downwind side of the mountains where the INEEL is located. The INEEL climate is characteristically warm and dry in the summer and cold in the winter. The relatively dry air and infrequent low clouds permit intense solar heating of the surface during the day and rapid cooling at night. Meteorological data have been collected at over 45 locations on and near the INEEL since 1949. Thirty meteorological stations are currently operating. The following climatological data are from the National Oceanic and Atmospheric Administration.[13]

The average annual precipitation at the Central Facilities Area (CFA) and Test Area North (TAN) is 22.10 cm (8.70 in.) and 19.94 cm (7.85 in.), respectively. Thunderstorms cause a pronounced precipitation peak in May and June at both CFA and TAN, with an average of 3.1 cm (1.2 in.) at CFA and 3.3 cm (1.3 in.) at TAN for each of these months. The annual average snowfall recorded at CFA is 67.6 cm (26.6 in.), and the water content of melted snow contributes from one-quarter to one-third of the annual precipitation. In 2000, snowfall measured 53 cm (21 in.) and contributed 5.1 cm (2.0 in.) to the total precipitation (16.3 cm [6.42 in.]) at CFA.

Average daily air temperatures during 2000 at the INEEL (CFA) ranged from a low of -15°C (5°F) on January 30 to a high of 26°C (79°F) on July 31. The long-term (1950–2000) average daily air temperature at CFA ranges from -11°C (12°F) during early January to 21°C (70°F) during the latter half of July. The average annual temperature at the INEEL gradually increases over 7 months beginning the first week in January and continues through the third week in July. The temperature then decreases over the next 5 months until the minimum average temperature is again reached in January. A winter thaw has occurred in a number of years in late January. This thaw often was followed by more cold weather until the spring thaw.

Wind speed and direction have been continuously monitored at many stations on and surrounding the INEEL since 1950. Eastern Idaho lies in a region of prevailing westerly winds. The orientation of the bordering mountain ranges and the general northeast trend of the Eastern Snake River Plain strongly influence wind direction at the INEEL. Channeling of these winds within the Eastern Snake River Plain usually produces a west-southwest or southwest wind at most locations on the INEEL. The highest and lowest average wind speeds at CFA occur in April (15.0 km/hr [9.3 mph]) and December (8.2 km/hr [5.1 mph]), respectively.

Local topographic features at TAN result in a greater diversity of wind directions than elsewhere on the INEEL. At the mouth of Birch Creek, the northwest-to-southeast orientation of the Birch Creek valley occasionally channels strong north-northwest winds into the TAN area. At TAN, average wind speeds are highest in April (15.3 km/hr [9.5 mph]) and lowest in December (7.4 km/hr [4.6 mph]). The highest hourly wind speeds occur at several wind directions. Like the rest of the INEEL, west-southwest or southwesterly winds produce the highest hourly wind speeds at TAN. However, strong winds also blow from the northwest and north-northwest.

### 1.4.2 Geology

The INEEL is located on the Eastern Snake River Plain, which is a broad northeast trending structural depression filled with silicic and basaltic volcanic rocks and interlayered sedimentary materials. Basalt vents of the Eastern Snake River Plain form linear arrays of fissure flows, small shields, cones, pit craters, and open cracks. These features define volcanic rift zones where eruptive activity has been concentrated.[14] Individual basalt flows typically range from 3–75 m (10–250 ft) thick.[15,16] Sedimentary interbeds represent quiescent periods between volcanic episodes when the surface was covered by accumulations of windblown, alluvial, and lake bed sediments. The cumulative thickness of subsurface basalt lava flows and interflow sediments range from 120–760 m (400–2,500 ft) or more.[17]

### 1.4.3 Hydrology

***1.4.3.1 Surface Water Hydrology.*** Three surface drainages terminate within the INEEL. The Big Lost River, Little Lost River, and Birch Creek drain mountain watersheds located to the north and west of the INEEL (Figure 1-2). For more than 100 years, flows from the Little Lost River and Birch Creek have been diverted for irrigation. Birch Creek terminates at a playa near the north end of the INEEL, and the Little Lost River terminates at a playa just north of the central northwestern boundary of the INEEL.

The Big Lost River, the major surface water feature on the INEEL, drains more than 3,600 $km^2$ (1,400 $mi^2$) of mountainous area, including parts of the Lost River and the Pioneer Ranges west of the INEEL. The river flows onto the INEEL near the southwestern corner, bends to the northeast, and flows northeastward to the Big Lost River playas.[18] During the 2000 water year (October 1999 through September 2000), flow was recorded in the Big Lost River at the diversion dam near the Radioactive Waste Management Complex. At the diversion dam, water can flow through an engineered channel to the INEEL spreading areas or through culverts to the Big Lost River channel. However, during the 2000 water year, water did not flow to the INEEL spreading areas. A total of 26,643,897 $m^3$ (21,609 acre-ft) of water flowed downstream of the diversion dam in the Big Lost River channel during October through mid-May. Because of infiltration losses in the channel, flow decreased downstream, with 15,772,536 $m^3$ (12,792 acre-ft) reaching the Lincoln Boulevard Bridge and 8,539,758 $m^3$ (6,926 acre-ft) reaching the Big Lost River Sinks.

Local precipitation and surface runoff occasionally affect the INEEL. INEEL facilities, such as the Radioactive Waste Management Complex, experienced flooding caused by local basin runoff in 1962, 1969, and 1982.[1] These events were caused by rapid snow melt combined with heavy rains and were often compounded by frozen soil conditions.

***1.4.3.2 Groundwater Hydrology.*** The Snake River Plain Aquifer is a vast groundwater reservoir that may contain more than 1,200 $km^3$ (1 billion acre-ft) of water. The Snake River Plain Aquifer is composed of basaltic lava flows and interbedded sedimentary deposits. Water is contained in and moves through intercrystalline and intergranular pores, fractures, cavities, interstitial voids, interflow zones, and lava tubes. Openings in the rock units and their degree of interconnection complicate the movement of groundwater in the aquifer. The Snake River Plain Aquifer flows from 1.5 to 6 m/day (5 to 20 ft/day), chiefly to the south-southwest.[19]

Groundwater inflow to the Snake River Plain Aquifer at the INEEL consists mainly of underflow from the northeastern part of the plain and from drainages on the west and north.[19] Most of the groundwater is recharged in the uplands to the northeast, moves southwestward through the Snake River Plain Aquifer, and is discharged from springs along the Snake River near Hagerman. Local precipitation on the plain produces less water. Part of the precipitation evaporates, but part infiltrates into the ground surface and percolates downward to the Snake River Plain Aquifer. At the INEEL, significant recharge is derived from the intermittent flows of the Big Lost River.