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# 2000 Environmental Monitoring Program Report

INEEL
Bechtel BWXT Idaho, LLC
Idaho National Engineering and Environmental Laboratory

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Idaho National Engineering and Environmental Laboratory
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# ABSTRACT

This report describes the Calendar Year 2000 compliance monitoring and environmental surveillance activities of the Idaho National Engineering and Environmental Laboratory management and operating contractor Environmental Monitoring Program. This report includes results of sampling performed by the Drinking Water Program, Liquid Effluent Monitoring Program, Storm Water Monitoring Program, Groundwater Monitoring Program, and Environmental Surveillance Program. This report compares the Calendar Year 2000 results to program-specific regulatory guidelines and past data to evaluate trends. The primary purposes of the monitoring and surveillance activities are to evaluate environmental conditions, to provide and interpret data, to verify compliance with applicable regulations or standards, and to ensure protection of public health and the environment.

Surveillance of environmental media did not identify any previously unknown environmental problems or trends, which would indicate a loss of control or unplanned releases from facility operations. The Idaho National Engineering and Environmental Laboratory complied with permits and applicable regulations, with the exception of those noted in the summary and text. The monitoring and surveillance results demonstrate that the public health and environment were protected.

# SUMMARY

The Environmental Monitoring Program monitors environmental media and facility effluents to assess the effects of the Idaho National Engineering and Environmental Laboratory (INEEL) operations on the environment; to protect public health; and to demonstrate compliance with federal, state, and local regulations. Monitoring data are compared to regulatory criteria to show compliance with regulations and permits and also compared to voluntary protection criteria to assess potential environmental impacts and to ensure protection of public health. Monitoring data from the current year are compared to past monitoring data to identify trends or changes that may indicate loss of control, unplanned releases, or ineffectiveness of pollution prevention programs.

Environmental compliance programs monitor drinking water, storm water, liquid effluents, and groundwater to show compliance with federal, state, and City of Idaho Falls regulations and permits. There were a few instances where permit criteria were exceeded. Corrective action has been taken or is planned to address those situations.

In the past, coliform bacteria were detected in drinking water systems at INEEL facilities as a result of old pipes, stagnant water from buildings and storage tanks where water was seldom used, and biofilm. Water treatment systems for bacteria were installed at all affected INEEL facilities, and as a result, no coliform bacteria were detected in INEEL drinking water systems during 2000.

Groundwater at three locations contained contaminants at or near the drinking water standards. Treatment systems have been installed where necessary, so that water supplied through drinking water distribution systems would meet the drinking water standards.

Liquid effluents from two INEEL Idaho Falls facilities were monitored for compliance with City of Idaho Falls wastewater acceptance forms. All discharges to the sewer system met the discharge limits in the city permits.

Liquid effluent was monitored at the Central Facilities Area, Idaho Nuclear Technology and Engineering Center, and Test Area North, and groundwater was monitored at Idaho Nuclear Technology and Engineering Center and Test Area North for compliance with State of Idaho Wastewater Land Application Permits. Liquid effluents at six additional locations were monitored for characterization and surveillance purposes. All effluent samples taken at the Central Facilities Area Sewage Treatment Plant were in compliance with permit requirements.

Two facilities at the Idaho Nuclear Technology and Engineering Center were monitored under Wastewater Land Application Permits: the Sewage Treatment Plant and the Percolation Ponds. Groundwater sample results from both facilities complied with all permit limits. Total nitrogen concentrations in the Sewage Treatment Plant effluent exceeded the permit limit of 20 mg/L in three monthly samples. As part of the ongoing nitrogen study, an in-depth inventory of nitrogen sources contributing to the Idaho Nuclear Technology and Engineering Center sewage was performed. The study did not identify any new sources. Additional corrective actions are planned, and if these corrective actions do not reduce the

nitrogen to acceptable concentrations, additional operational and plant modifications might be required.

At Test Area North, wastewater effluent and groundwater were monitored for compliance with the Sewage Treatment Plant Wastewater Land Application Permit. All effluent concentrations were within permit limits. Iron, zinc, lead, and total dissolved solids concentrations exceeded the groundwater permit levels in groundwater samples from Test Area North. The elevated iron and zinc concentrations were attributed to galvanic corrosion of the riser pipes. Plans to mitigate the galvanic corrosion are under way.

During 2000, storm water visual inspections were performed at 18 National Pollutant Discharge Elimination System locations. No permit or regulatory limits were exceeded. A required visual inspection was missed at one location. At Test Area North, a small amount of snow melt discharged into Birch Creek from the gravel pit; however, based upon the visual inspections, the water quality was not affected. Because no rainfall or snow melt was discharged down any of the seven injection wells, storm water samples were not collected.

Environmental surveillance programs monitor ambient air, direct radiation, soils, biota, and surface water. Surveillance of environmental media during 2000 did not identify any trends in data that indicated a loss of control or unplanned releases from facility operations.

Ambient air was monitored for radionuclides, particulate matter, nitrogen oxides, and sulfur dioxide. Gross alpha and gross beta radiation from natural background radionuclides are routinely detected in air samples. Cesium-137 and cobalt-60 were the only manmade gamma-emitting radionuclides detected. Cesium-137 was found in samples collected from Experimental Breeder Reactor-I and the Main Gate. Cobalt-60 was detected at the northeast corner of the Subsurface Disposal Area. Cesium-137 and cobalt-60 were detected at the Test Reactor Area. Plutonium-239/240 was detected at the Test Reactor Area and the Rest Area, where strontium-90 was also found. The concentrations of all detected radionuclides were consistent with historical data.

In 2000, wildfires burned approximately 36,000 acres at the INEEL. Air data were evaluated at six air monitors selected based upon proximity to the fire and wind direction to determine the impact of the fire. No manmade radionuclides were detected.

The New Waste Calcining Facility at the Idaho Nuclear Technology and Engineering Center operated only approximately 4 months in 2000. Nitrogen oxide and sulfur dioxide concentrations were well below the Environmental Protection Agency's established ambient air quality standards throughout the year.

Surface water runoff was collected during all quarters of 2000 at the Radioactive Waste Management Complex. Cesium-137 and cobalt-60 were the only manmade, gamma-emitting radionuclides detected. Cesium-137 is commonly detected in environmental samples collected at the Radioactive Waste Management Complex and is usually at or near background concentrations. Americium-241 and plutonium-239/240 were detected at concentrations consistent with those typically

seen in waters collected from areas with high volumes of suspended particulates and were comparable to historical concentrations for that area.

Surface water runoff was also sampled at the Waste Experimental Reduction Facility seepage basins. Cesium-137 was detected at concentrations comparable to historical concentrations and other monitoring results from water samples collected at the INEEL.

Soil samples were collected from the Radioactive Waste Management Complex. Cesium-137, americium-241, plutonium-239/240, and strontium-90 were detected and were consistent with historical concentrations at the Radioactive Waste Management Complex.

Soil samples were collected from outside the Argonne National Laboratory-West. Cesium-137, plutonium-239/240, americium-241, and strontium-90 were detected in concentrations consistent with past analyses.

Direct radiation exposures measured by thermoluminescent dosimeters at both off- and on-Site locations and soil surveys on-Site were consistent with historical data.

Results from the Environmental Monitoring Program demonstrate that the public health and environment were protected, and with few exceptions, sampling results were in compliance with requirements.

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# ACRONYMS

| | |
|---|---|
| Am | americium |
| ANL-W | Argonne National Laboratory-West |
| ARA | Auxiliary Reactor Area |
| BBWI | Bechtel BWXT Idaho, LLC |
| BOD | biochemical oxygen demand |
| cc | cubic centimeter |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act |
| CFA | Central Facilities Area |
| cfm | cubic feet per minute |
| CFR | Code of Federal Regulations |
| CN | cyanide |
| CPP | Chemical Processing Plant |
| Cs | cesium |
| CTF | Contained Test Facility |
| DCG | Derived Concentration Guide |
| DOE | U.S. Department of Energy |
| EBR-I | Experimental Breeder Reactor-I |
| EFS | Experimental Field Station |
| EPA | Environmental Protection Agency |
| g | gram |
| GPRS | global positioning radiometric scanner |
| IDAPA | Idaho Administrative Procedures Act |
| IFF | Idaho Falls Facilities |
| INEEL | Idaho National Engineering and Environmental Laboratory |
| INTEC | Idaho Nuclear Technology and Engineering Center |
| IRC | INEEL Research Center |
| keV | kilo-electron-volt |
| L | liter |
| m | meter |
| MCL | maximum contaminant level |
| mg | milligram |
| mL | milliliter |
| mR | milliroentgen |
| mrem | millirem |
| MWSF | Mixed Waste Storage Facility |
| NA | not applicable |
| ND | nondetect |
| $NH_3N$ | ammonia |
| NNN | nitrate + nitrite as nitrogen |

| | |
|---|---|
| OMRE | Organic-Moderated Reactor Experiment |
| PBF | Power Burst Facility |
| pCi | picocurie |
| $PM_{10}$ | particulate matter $\leq 10$ $\mu$m |
| ppb | parts per billion |
| Pu | plutonium |
| RCRA | Resource Conservation and Recovery Act |
| RWMC | Radioactive Waste Management Complex |
| SDA | Subsurface Disposal Area |
| SMC | Specific Manufacturing Capability |
| SPERT | Special Power Excursion Reactor Test |
| Sr | strontium |
| STF | Security Training Facility |
| STP | Sewage Treatment Plant |
| SWEPP | Stored Waste Examination Pilot Plant |
| TAN | Test Area North |
| TCE | trichloroethylene |
| TDS | total dissolved solids |
| TKN | total Kjeldahl nitrogen |
| TLD | thermoluminescent dosimeter |
| TRA | Test Reactor Area |
| TSA | Transuranic Storage Area |
| TSF | Technical Support Facility |
| TSS | total suspended solids |
| USGS | United States Geological Survey |
| VANB | Van Buren Boulevard |
| WCB | Willow Creek Building |
| WERF | Waste Experimental Reduction Facility |
| WMF | Waste Management Facility |
| WRRTF | Water Reactor Research Test Facility |

# 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:

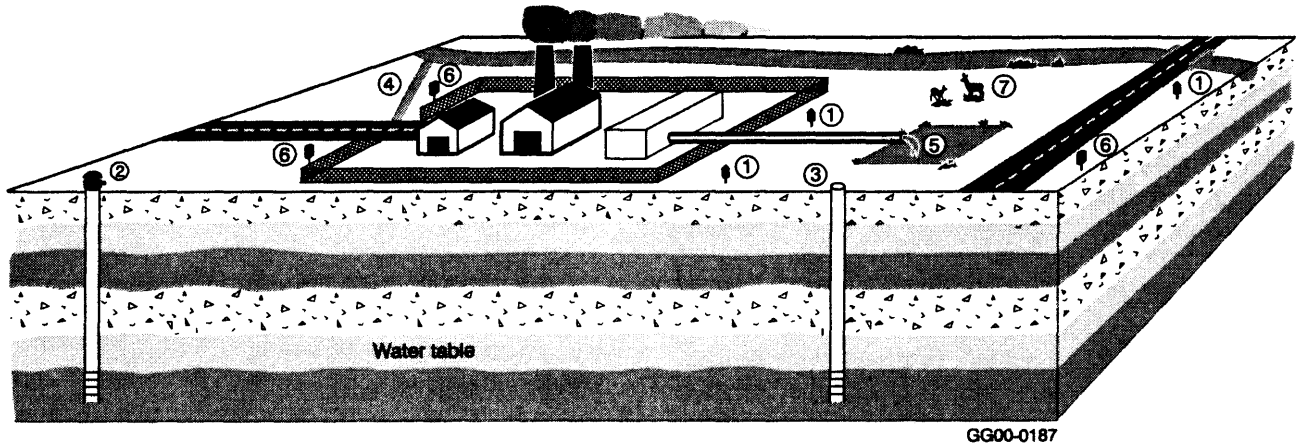
- Evaluate environmental conditions
- Provide and interpret data
- Verify compliance with applicable regulations or standards

- 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.

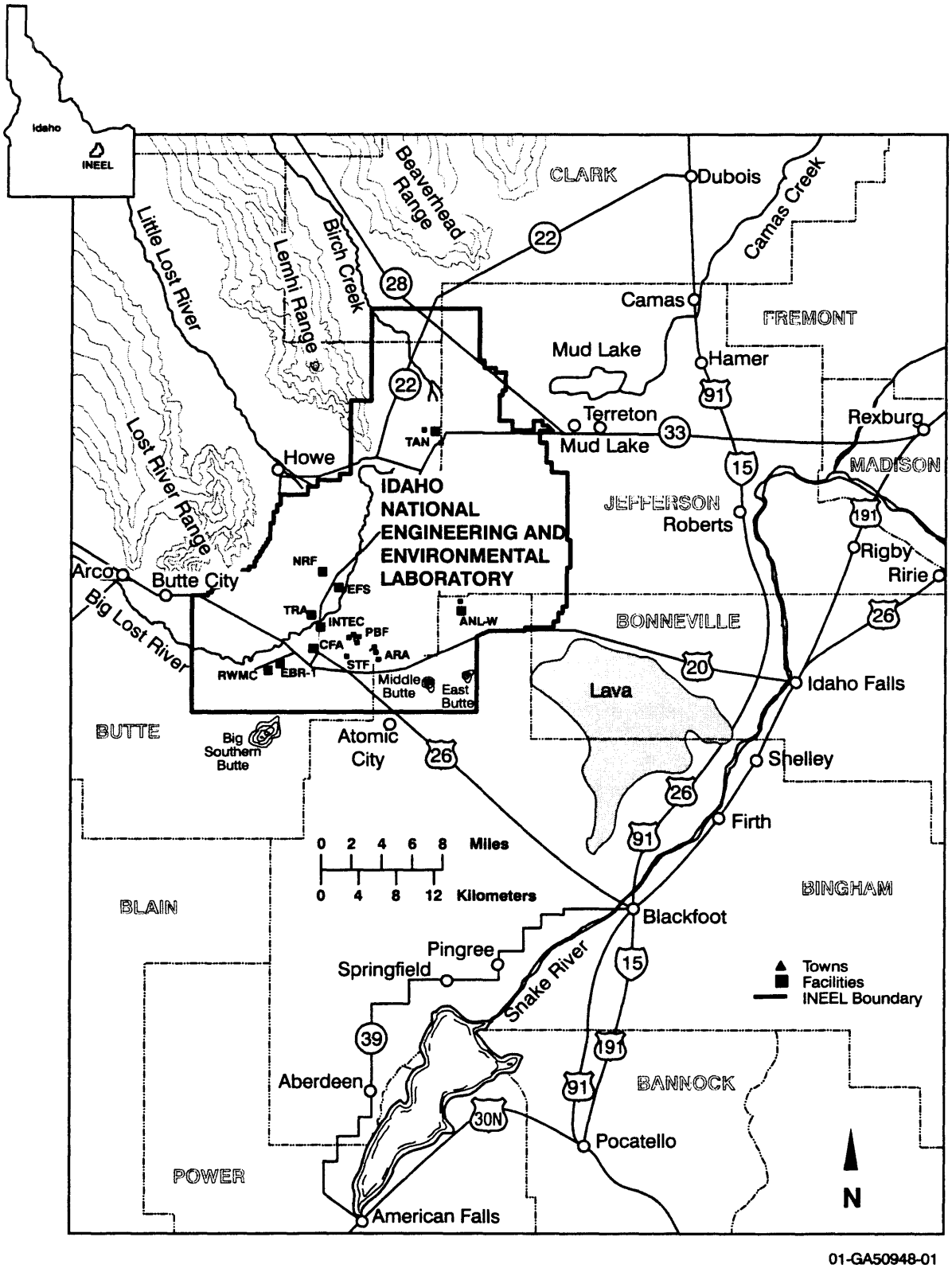



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Figure 1-2. Map of Idaho National Engineering and Environmental Laboratory vicinity showing primary and secondary facilities, counties, and cities.

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.

# 2. COMPLIANCE MONITORING PROGRAM

This section presents the results of the Compliance Monitoring Program at the INEEL. The Compliance Monitoring Program samples drinking water, liquid effluents, storm water, and groundwater to show compliance with federal, state, and local regulations and permits. Section 2.1 presents the Drinking Water Monitoring Program results, Section 2.2 presents the Liquid Effluent Monitoring Program results, Section 2.3 presents the Storm Water Monitoring Program results, and Section 2.4 presents the Groundwater Monitoring Program results.

## 2.1 Drinking Water Program

In 1988, a centralized drinking water program was established for most INEEL facilities. Argonne National Laboratory-West and the Naval Reactors Facility are the only two facilities that are not included in the INEEL Drinking Water Program. Argonne National Laboratory-West is managed by DOE-Chicago, and the Naval Reactors Facility is managed by the Department of Defense.

The Drinking Water Program was established to monitor production and drinking water wells, which are multiple-use wells for industrial use, fire safety, and drinking water. According to the "Idaho Regulations for Public Drinking Water Systems" (Idaho Administrative Procedures Act [IDAPA] 58.01.08),[20] INEEL drinking water systems are classified as either nontransient or transient, noncommunity water systems. The transient, noncommunity water systems are at the Experimental Breeder Reactor (EBR)-I, the Gun Range, and the Main Gate. The rest of the water systems at the INEEL are classified as nontransient, noncommunity water systems, which have more stringent requirements than transient, noncommunity water systems.

Because groundwater supplies the drinking water at the INEEL, information on groundwater quality was used to help develop the Drinking Water Program. The United States Geological Survey (USGS) and the management and operating contractor monitor and characterize groundwater quality at the INEEL. Three groundwater contaminants have impacted INEEL drinking water systems: tritium at Central Facilities Area (CFA), carbon tetrachloride at Radioactive Waste Management Complex (RWMC), and trichloroethylene at Test Area North/Technical Support Facility (TAN/TSF).

### 2.1.1 Program Design Basis

The Drinking Water Program monitors drinking water to ensure it is safe for consumption and to demonstrate that it meets federal and state regulations (that is, maximum contaminant levels [MCLs] are not exceeded). The Safe Drinking Water Act[2] establishes the overall requirements for the Drinking Water Program.

As required by the State of Idaho, the Drinking Water Program uses Environmental Protection Agency-approved (or equivalent) analytical methods to analyze drinking water in compliance with IDAPA 58.01.08[20] and 40 Code of Federal Regulations (CFR) 141–143.[21]

Currently, the Drinking Water Program monitors 10 water systems, which include 17 wells. Drinking water parameters are regulated by the State of Idaho under authority of the Safe Drinking Water Act. Parameters with primary maximum contaminant levels must be monitored at least once every compliance period, which is 3 years. Parameters with secondary maximum contaminant levels are monitored every 3 years based on a recommendation by the Environmental Protection Agency. The 3-year compliance periods for the Drinking Water Program are 1999–2001, 2002–2004, and so on. Many parameters require more frequent sampling during an initial period to establish a baseline, and subsequent monitoring frequency is determined from the baseline.

Because of known contaminants, the Drinking Water Program monitors more frequently than required. For example, the program monitors for bacteriological analyses more frequently because of historical problems with bacteriological contaminants. These detections were possibly caused by biofilm on older water lines and stagnant water, and resampling results were normally in compliance with the maximum contaminant level. Table 2-1 lists the 2000 Drinking Water Program monitoring locations, parameters, and frequencies.

Table 2-1. 2000 drinking water monitoring locations, parameters, and frequencies.

| Facility | Sample Point | Parameters | Sample Frequency |
|---|---|---|---|
| CFA | Selected buildings | Bacteriological | 2 quarterly[a]<br>3 monthly[b] |
| | | Total trihalomethanes | 1 quarterly[b] |
| | 1603 | Nitrate | 1 annually[a] |
| | 1603 | Metals, inorganics, organics[c] and secondary drinking water standards | 1, as required every 3 years |
| | Wells #1 and #2 and 1603 | Gross alpha, beta, Sr-90, tritium, and radon[d] | 1 sample each, quarterly |
| CTF | Selected buildings | Bacteriological | 1 quarterly[a]<br>2 monthly[b] |
| | | Total trihalomethanes | 1 quarterly[b] |
| | 614, point-of-entry to distribution system after treatment | Nitrate | 1 annually[a] |
| | 614 and Wells #1 and #2 | Gross alpha, beta, tritium, radon[d] | 1 quarterly |
| | 614 | Metals, inorganics, organics,[c] and secondary drinking water standards | 1, as required every 3 years |
| EBR-I | Selected buildings | Bacteriological | 1 quarterly[a]<br>1, May, June, July, August, and September[b] |
| | 601, point-of-entry to distribution system after treatment | Nitrate | 1 annually[a] |
| | | Gross alpha, beta, radon,[d] and tritium | 1 quarterly |
| | 601 | Metal, inorganics, organics,[c] and secondary drinking water standards | 1, as required every 3 years |

Table 2-1. (continued).

| Facility | Sample Point | Parameters | Sample Frequency |
|---|---|---|---|
| Gun Range | Selected buildings | Bacteriological | 1 quarterly[a]<br>1 monthly[b] |
| | | Total trihalomethanes | 1 quarterly[b] |
| | 608, point-of-entry to distribution system after treatment | Nitrate | 1 annually[a] |
| | | Gross alpha, beta, radon,[d] and tritium | 1 quarterly |
| | 608 | Metals, inorganics, organics,[c] and secondary drinking water standards | 1, as required every 3 years |
| INTEC | Selected buildings | Bacteriological | 2 quarterly[a]<br>3 monthly[b] |
| | | Total trihalomethanes | 1 quarterly[b] |
| | 614, point-of-entry to distribution system after treatment | Nitrate | 1 annually[a] |
| | 614 and Wells #1 and #5 | Gross alpha, beta, radon,[d] tritium, and Sr-90 | 1 sample each, quarterly |
| | 614 | Metals, inorganics, organics,[c] and secondary drinking water standards | 1, as required every 3 years |
| Main Gate | Selected buildings | Bacteriological | 1 quarterly[a]<br>1 monthly[b] |
| | 603, point-of-entry to distribution system after treatment | Nitrate | 1 annually[a] |
| | 603 and Well | Gross alpha, beta, radon,[d] and tritium | 1 quarterly |
| | | Metals, inorganics, organics,[c] and secondary drinking water standards | 1, as required every 3 years |
| PBF | Selected buildings | Bacteriological | 1 quarterly[a]<br>2 monthly[b] |
| | | Total trihalomethanes | 1 quarterly[b] |
| | 638, point-of-entry to distribution system after treatment | Nitrate | 1 annually[a] |
| | 638 and Wells #1 and #2 | Gross alpha, beta, radon,[d] and tritium | 1 quarterly |
| | 638 | Metals, inorganics, organics,[c] and secondary drinking water standards | 1, as required every 3 years |

Table 2-1. (continued).

| Facility | Sample Point | Parameters | Sample Frequency |
|---|---|---|---|
| RWMC | Selected buildings | Bacteriological | 1 quarterly[a]<br>3 monthly[b] |
| | 604, point-of-entry to distribution system after treatment | Nitrate | 1 annually[a] |
| | 604 | Metals, inorganics, organics,[c] and secondary drinking water standards | 1, as required every 3 years |
| | 603 Well and 604, point-of-entry to distribution system after treatment | Gross alpha, beta, radon,[d] and tritium | 1 quarterly |
| TRA | Selected buildings | Bacteriological | 1 quarterly[a]<br>3 monthly[b] |
| | | Total trihalomethanes | 1 quarterly[b] |
| | 608, point-of-entry to distribution system after treatment | Nitrate | 1 annually[a] |
| | 608 and Wells #1, #3, and #4 | Gross alpha, beta, radon,[d] and tritium | 1 quarterly |
| | 608 | Metals, inorganics, organics,[c] and secondary drinking water standards | 1, as required every 3 years |
| TSF | Selected buildings | Bacteriological | 1 quarterly[a]<br>2 monthly[b] |
| | | Total trihalomethanes | 1 quarterly[b] |
| | 610, point-of-entry to distribution system after treatment | Nitrate | 1 annually[a] |
| | 610 #1 and #2 Wells | Gross alpha, beta, radon,[d] and tritium | 1 quarterly |
| | 610 | Metals, inorganics, organics,[c] and secondary drinking water standards | 1, as required every 3 years |

a. Compliance samples (required by regulations).

b. Surveillance samples (required by Program Plan).

c. Waivers for reduced monitoring of some organic parameters (e.g., dioxin) were obtained from the State of Idaho.

d. Radon sampled for special study in 2000.

### 2.1.2 Data Summary and Assessment by Facility

During 2000, 604 routine samples and 96 quality control samples were collected and analyzed from Central Facilities Area (CFA), Experimental Breeder Reactor-I (EBR-I), Gun Range, Idaho Nuclear Technology and Engineering Center (INTEC), Main Gate, Power Burst Facility (PBF), Radioactive Waste Management Complex (RWMC), Test Area North (TAN; Contained Test Facility [CTF] and Technical Support Facility [TSF]), and Test Reactor Area (TRA). In addition to the routine sampling, the Drinking Water Program also collects nonroutine samples. For example, a nonroutine sample is collected after a water main breaks and is repaired to determine if the water is acceptable for use before it is put back into service. The Drinking Water Program received 74 requests for nonroutine sampling.

Analytical results of interest in 2000 are presented in Table 2-2 and are discussed in the following subsections. EBR-I, Gun Range, INTEC, Main Gate, PBF, TAN/CTF, and TRA were well below drinking water limits for all regulatory parameters and are therefore not discussed.

Table 2-2. Monitored parameters of interest in 2000.

| Parameter[a] | Location | Results (4-Quarter Average) | MCL |
|---|---|---|---|
| Trichloroethylene | TSF #1 Well | 3.65 µg/L[b] | NA[c] |
| | TSF Distribution | 0.97 µg/L[d] | 5 µg/L |
| Tritium | CFA Distribution | 11,126 pCi/L | 20,000 pCi/L |
| | CFA #1 Well | 11,673 pCi/L[e] | NA[c] |
| | CFA #2 Well | 10,028 pCi/L | NA[c] |
| Carbon tetrachloride | RWMC Well | 4.33 µg/L | NA[c] |
| | RWMC Distribution | 2.33 µg/L | 5 µg/L |

a. These parameters are known contaminants that the Drinking Water Program is tracking. See specific sections for details.

b. Sampled only twice during the year for surveillance purposes (not required by regulations to be sampled). The compliance point is after the sparger system (air stripping process); the compliance result is 0.97 µg/L for the four-quarter average.

c. NA—Maximum contaminant level (MCL) is not applicable to the well concentration.

d. Result is based on a 3-quarter average. No volatile organic samples were collected during the third quarter of 2000 because no laboratory contract was in place.

e. Result is based on a 3-quarter average. No second quarter result was available for this location because of maintenance and repair.

***2.1.2.1 Central Facilities Area.*** The CFA water system serves over 1,000 people daily. Since the early 1950s, wastewater containing tritium has been disposed to the Snake River Plain Aquifer at TRA and INTEC (Figure 1-1) through injection wells and infiltration ponds. These wastewaters migrated south-southwest and are the suspected source of tritium contamination in the CFA water supply wells. The practice of disposing of wastewater through injection wells and infiltration ponds was discontinued.

In 2000, water samples were collected quarterly from CFA #1 Well (at CFA-651), CFA #2 Well (at CFA-642), and CFA-1603 (point of entry to the distribution system) for compliance purposes. Since December 1991, the mean tritium concentration has been below the maximum contaminant level at all three locations. In general, tritium concentrations in groundwater have been decreasing due to changes in disposal rates, disposal techniques, recharge conditions, and radioactive decay.

***2.1.2.2 Radioactive Waste Management Complex.*** Various solid and liquid radioactive and chemical wastes, including transuranic wastes, have been disposed at the RWMC. The RWMC contains pits, trenches, and vaults where radioactive and organic wastes were disposed belowgrade, as well as placed abovegrade and covered on a large pad. During an INEEL-wide characterization program conducted by USGS, carbon tetrachloride and other volatile organic compounds were detected in groundwater samples taken at the RWMC.[22] Review of waste disposal records indicated an estimated 334,600 L (88,400 gal) of organic chemical wastes (including carbon tetrachloride, trichloroethylene, tetrachloroethylene, toluene, benzene, 1,1,1-trichloroethane, and lubricating oil) were disposed at the RWMC before 1970. High vapor-phase concentrations (up to 2,700 parts per million vapor phase) of volatile organic compounds were measured in the unsaturated zone above the water table. Groundwater models predict that volatile organic compound concentrations will continue to increase in the groundwater at the RWMC.

The RWMC production well is located in WMF-603 and supplies all of the drinking water for over 150 people at the RWMC. The well was put into service in 1974. Water samples were collected at the wellhead and from the point of entry to the distribution system, which is the point of compliance, at WMF-604.

Since monitoring began at RWMC in 1988, there has been an upward trend in carbon tetrachloride concentrations (Figure 2-1). In October 1995, the carbon tetrachloride concentrations increased to 5.48 μg/L at the well. This was the first time the concentrations exceeded the maximum contaminant level of 5.0 μg/L. However, the maximum contaminant level for carbon tetrachloride is based on a four-quarter average and applies to the distribution system. The distribution system is the point from which water is first consumed at RWMC and is the compliance point. Table 2-3 presents the carbon tetrachloride concentrations at the RWMC drinking water well and distribution system for 2000. The mean concentration at the well for 2000 was 4.33 μg/L, and the maximum concentration was 4.8 μg/L. The mean concentration at the distribution system was 2.33 μg/L, and the maximum concentration was 2.9 μg/L.

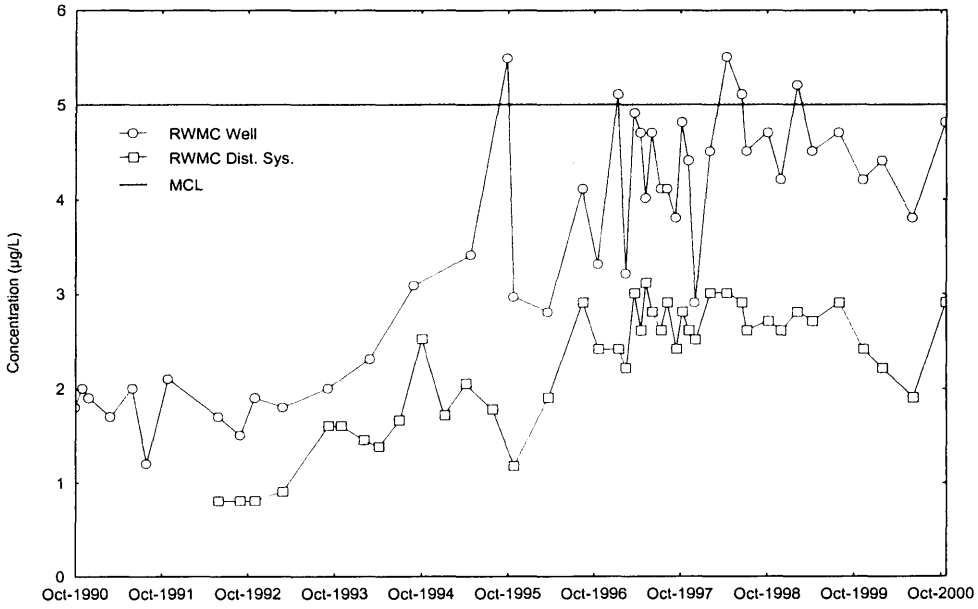



Figure 2-1. Carbon tetrachloride concentrations in Radioactive Waste Management Complex drinking water well and distribution system.

Table 2-3. Carbon tetrachloride concentrations in Radioactive Waste Management Complex drinking water well and distribution system (2000).

| Location | Number of Samples[a] | Carbon Tetrachloride Concentration (μg/L) | | | |
|---|---|---|---|---|---|
| | | Minimum | Maximum | Mean | MCL |
| RWMC WMF-603 Well | 3 | 3.8 | 4.8 | 4.33 | NA[b] |
| RWMC WMF-604 Distribution | 3 | 1.9 | 2.9 | 2.33 | 5.0 |

a. No samples were collected during the second quarter of 2000 because no laboratory was available to perform the analysis. The problem was resolved, and sampling resumed during the third quarter.

b. NA—Not applicable. MCL applies to the distribution system only.

***2.1.2.3 Test Area North/Technical Support Facility.*** In 1987, trichloroethylene was detected at both TSF #1 and #2 Wells, which supply drinking water to approximately 100 employees at TSF daily. The inactive TSF injection well (TSF-05) is believed to be the principal source of trichloroethylene contamination at the TSF. Bottled water was provided until 1988 when a sparger system (air stripping process) was installed in the water storage tank to volatilize the trichloroethylene to levels below the maximum contaminant level.

During the third quarter of 1997, TSF #1 Well was taken off line, and TSF #2 Well was put on line as the main supply well because the trichloroethylene concentration of TSF #2 was below the maximum contaminant level of 5.0 μg/L. Therefore, by using TSF #2 Well, no treatment (sparger air stripping system) is required. TSF #1 Well is used as a backup to TSF #2 Well. If TSF #1 Well must be used, the sparger system must be activated to treat the water.

Table 2-4 presents the trichloroethylene concentrations at TSF #1 Well and the distribution system. Regulations do not require sampling of TSF #1 Well; however, samples were collected to monitor trichloroethylene concentrations. The distribution system is the compliance point. TSF #2 Well was not sampled during 2000 because it was not required by regulations. The mean concentration of trichloroethylene at the distribution system for 2000 was 0.97 μg/L, which is well below the MCL. Figure 2-2 illustrates the concentrations of trichloroethylene in both TSF wells and the distribution system from 1990 through 2000. Past distribution system sample exceedances are attributed to preventive maintenance activities interrupting operation of the sparger system. The decreasing concentration at TSF #1 Well is attributed to the plume shifting in response to reduced pumping at TSF #1 Well.

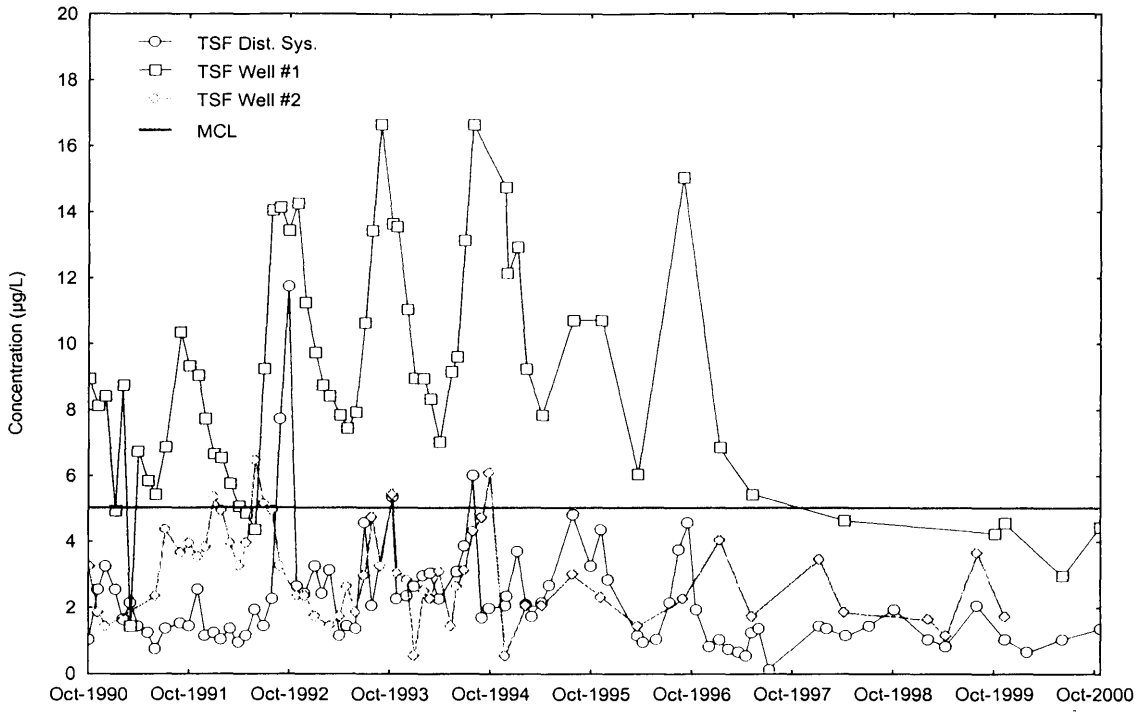
Table 2-4. Trichloroethylene concentrations at Technical Support Facility #1 Well and distribution system (2000).

| Location | Number of Samples[a] | Trichloroethylene (μg/L) | | | |
|---|---|---|---|---|---|
| | | Minimum | Maximum | Mean | MCL |
| TSF #1 Well (612)[b] | 2 | 2.9 | 4.4 | 3.65 | NA[c] |
| TSF Distribution (610) | 3 | 0.6 | 1.3 | 0.97 | 5.0 |

a. No samples were collected during the second quarter of 2000 because no laboratory was available to perform the analysis. The problem was resolved, and sampling resumed during the third quarter.

b. Regulations do not require sampling at this well.

c. NA— Not applicable. MCL applies to the distribution system only.




NOTE: During 2000, Well #2 was not sampled because it was not required by regulations.

Figure 2-2. Trichloroethylene concentrations in Technical Support Facility drinking water wells and distribution system.

### 2.1.3 Special Studies

The EPA has proposed new radon standards, which are expected to be effective in 2002. The EPA is considering one of two MCLs: 300 pCi/L in drinking water or 4,000 pCi/L for indoor air in conjunction with drinking water. The EPA recommended that radon be sampled before the new standards are effective. Therefore, The Drinking Water Program sampled for radon quarterly at all wells and distribution systems in Calendar Year 2000 in anticipation of the proposed radon standards, to establish baseline levels, and to assess the need for treatment equipment if 2000 radon levels exceed the proposed limit. Those wells or distribution systems that approached or exceeded the proposed maximum contaminant level of 300 pCi/L in drinking water are shown in Table 2-5.

Table 2-5. Radon results in 2000.

| Location | Results (4-Quarter Average) (pCi/L) | Proposed MCL[a] (pCi/L) |
|---|---|---|
| CFA #1 Well | 304 | 300/4,000 |
| CFA #2 Well | 348[b] | 300/4,000 |
| CFA Distribution | 180 | 300/4,000 |
| PBF #1 Well | 228 | 300/4,000 |

a. Two proposed MCLs: 300 pCi/L is for drinking water, and 4,000 pCi/L is for indoor air in conjunction with drinking water.

b. Result is based on a 3-quarter average.

### 2.1.4 Quality Assurance/Quality Control

***2.1.4.1 Data Accuracy, Precision, and Completeness.*** The Drinking Water Program is required to take compliance samples at a frequency and type specified in the regulations. Programmatic quality assurance/quality control goals have been established for accuracy, precision, and completeness.[23] Data accuracy is assessed by using field blind spike results. Precision is assessed by calculating the relative percent difference determined from duplicate samples. Completeness is assessed by comparing the number of samples required for compliance to the number of compliance samples collected.

The Drinking Water Program's accuracy goal is all blind spike percent recoveries must fall within their standards range. For the bacteriological analyses, the goal cannot be quantitatively assessed since a numerical result is not provided. All results (absent or present) from the bacteriological blind spikes agreed with the manufactures' specifications. One blind spike submitted with nitrate analyses performed during the year was within the performance acceptance limits set by the manufacturer. Sixteen blind spikes were submitted for radiological analysis: four each for gross alpha, gross beta, strontium-90, and tritium. Based on an in-house evaluation, all of the blind spikes fell within their expected range. However, the laboratory did not report results for one of the strontium-90 blind spikes due to a laboratory error.

The Drinking Water Program's precision goal states that the relative percent difference determined from duplicates must be 35% or less for 90% of all duplicates. During 2000, duplicate samples were taken and analyzed for one total trihalomethane pair and six radiological pairs of samples. The relative percent difference was not calculated for one pair of radiological samples because both results were less-than-detected. For the remaining six pairs of duplicate samples, all relative percent differences were less than 35%, except for one calculated from a pair of radiological samples. As a result, the precision goal of 90% of all duplicates having relative percent differences of less than 35% was not met. Corrective actions are specified in the *Drinking Water Program Plan* to address programmatic quality control problems and have been implemented by program personnel to address this issue.

The Drinking Water Program's completeness goal is to collect, analyze, and verify 100% of all compliance samples. This goal was met during 2000 for all analysis types except for organics. Second quarter organics samples could not be collected because no laboratory was available to perform the analysis. The problem was resolved, and sampling resumed during the third quarter.

In addition to goals for accuracy, precision, and completeness, the Drinking Water Program requires that 10% of the samples collected for each analysis type be quality assurance/quality control samples to include duplicates, field blanks, trip blanks, blind spikes, and splits. This goal was met in 2000 for all four analysis types (organic, inorganic, radiological, and bacteriological) required to be sampled during the year.

Additional quality assurance/quality control samples were taken during 2000 as trip blanks and splits. However, no performance criteria have been established for these types of samples. Performance criterion does exist for field blanks for the Drinking Water Program (i.e., they must be less than 10% of the maximum contaminant level). However, no field blanks were taken during 2000.

***2.1.4.2 Data Validation and Sampling Issues.*** During 2000, none of the results were rejected as unusable during data validation. Two additional issues that possibly impacted the sample results were discovered.

One volatile organic compound sample taken in June was improperly preserved. The logbook indicated that the sample was collected from a nonchlorinated system; however, it was collected from a chlorinated system. Because the sample was not a compliance sample and the results were consistent with

past historical results, the positive detections were "J" flagged, indicating that they were usable. Programmatic procedures addressing sampling and logbook documentation were reviewed to ensure that similar logbook errors did not impact future sampling results.

During July, two samples were switched at the laboratory during tritium analysis. One sample was from a water system with a history of tritium, and the other sample was from a water system with no history of tritium. Because the initial results from the laboratory were not consistent with historical results, the laboratory was contacted, and the laboratory confirmed the two samples were mistakenly switched. The laboratory reanalyzed the samples, and the reanalyzed results were comparable to historical results for both water systems. Project personnel contacted the laboratory to prevent similar laboratory errors from occurring in the future.

No other sampling or validation issues were identified during the year.

## 2.2 Liquid Effluent Monitoring Program

The Liquid Effluent Monitoring Program monitors for nonradioactive and radioactive parameters in liquid waste effluents generated within selected facilities at the INEEL. This program ensures that liquid effluent samples provide representative data to demonstrate compliance with permits and regulations.

### 2.2.1 Program Design Basis

The Liquid Effluent Monitoring Program was instituted at the INEEL in 1986, and radiological monitoring of selected effluent streams was added to the program in 1992. Effluent monitoring for compliance with various permits was added as permits were obtained.

INEEL Idaho Falls facilities are required to comply with the applicable regulations in Chapter 1, Section 8, of the Municipal Code of the City of Idaho Falls.[24] The City of Idaho Falls is authorized by the Clean Water Act to set pretreatment standards for nondomestic discharges to the publicly-owned treatment works.[25] Industrial Wastewater Acceptance Forms[7] are obtained for facilities that dispose process liquid effluent through the City of Idaho Falls sewer system. The forms contain requirements that apply to all management and operating contractor and Department of Energy Idaho Operations Office-operated facilities that discharge to the city sewer system. Forms include general requirements applicable to all facilities and specific monitoring requirements for the INEEL Research Center (IRC) and the Willow Creek Building (WCB) due to the nature of activities at these two facilities.

The State of Idaho regulation IDAPA 58.01.02, "Water Quality Standards and Wastewater Treatment Requirements,"[26] regulates liquid effluent discharges. Much of the wastewater discharged at the INEEL is to the ground surface through infiltration ponds or sprinkler irrigation systems. Discharge of wastewater to the land surface must be permitted under IDAPA 58.01.17, "Wastewater Land Application Permit Rules."[5] The management and operating contractor operates five facilities that require Wastewater Land Application Permits at the INEEL. The following four of the five facilities have been issued Wastewater Land Application Permits:

- CFA Sewage Treatment Plant (STP)
- INTEC Percolation Ponds
- INTEC STP

- TAN/TSF STP.

A Wastewater Land Application Permit application has been submitted to the Idaho Division of Environmental Quality for the TRA Cold Waste Pond. An application had also been submitted for Water Reactor Research Test Facility (WRRTF) process and sewage ponds. However, the WRRTF has since been shutdown, and the permit is no longer required.

The Wastewater Land Application Permits originally issued for the CFA STP, the INTEC Percolation Ponds, and the INTEC STP have expired. Permit extensions were received during Calendar Year 2000 for the CFA STP and the INTEC Percolation Ponds. A renewal application was submitted for the INTEC STP in March 2000, but notification to continue operation was not received before the end of the calendar year. Also during Calendar Year 2000, the Idaho Division of Environmental Quality approved plans and specifications to construct two new Percolation Ponds at INTEC to replace the current ponds. The new Percolation Ponds are expected to be completed by December 2003.

The Wastewater Land Application Permits generally require compliance with the Idaho groundwater quality standards[27] in specified downgradient groundwater monitoring wells. Annual discharge volume and application rates and effluent quality limits are specified in the permits.

The *2000 Annual Wastewater Land Application Permit Performance Reports for the Idaho National Engineering Laboratory*[28] for permitted wastewater land application facilities were submitted to the Idaho Division of Environmental Quality. As required by State of Idaho Wastewater Land Application Permits, the reports describe site conditions for the four permitted facilities. These reports contain:

- Permit-required monitoring data
- Status of special compliance conditions
- Discussions of environmental impacts by the facilities.

Parameters monitored by the Liquid Effluent Monitoring Program are reviewed periodically to comply with new permits, regulations, orders, and codes and to reflect the changing processes at the INEEL. Sampling frequency and type are determined by considering the purpose for obtaining the data. Sampling locations are chosen where the samples most closely represent the released effluent when practical. Effluent discharges regulated by a permit are monitored as the permit requires.

The sampling design was based on an approach developed to evaluate effluent sampling locations, frequencies, and parameters based on risk.[29,30] Risk is defined as the statistical probability of exceeding a release limit (both regulatory limits and environmental risk-based limits). The sampling design differentiates between streams requiring characterization monitoring and those requiring surveillance monitoring. The objectives of characterization monitoring are to provide data from which risk can be quantified and to establish baseline conditions for measuring change. Streams requiring characterization monitoring did not have sufficient historical data to quantify risk. Sites requiring surveillance monitoring were determined from historical data to have a potential risk of exceeding a limit or potential impact to the environment.

Table 2-6 lists effluent streams that were sampled by Effluent Monitoring Program personnel during 2000 and the parameters and frequency of monitoring for each stream. The specific date during the period was randomly selected. Monitoring for permit-required parameters was conducted according to the frequencies specified in permits for applicable streams. INTEC Percolation Pond monitoring is performed by INTEC Operations; therefore, it is not included in Table 2-6.

Twenty-four-hour composite samplers were used at all accessible locations. Grab samples were collected at certain areas because of inaccessibility to the effluent stream or the nature of the discharge. The Industrial Wastewater Acceptance agreements with the City of Idaho Falls and the Wastewater Land Application Permits require that pollutants be analyzed using methods listed in 40 CFR 136, "Guidelines Establishing Test Procedures for the Analysis of Pollutants."[31]

### 2.2.2 Data Summary and Assessment by Facility

During 2000, 13 effluent discharge points were routinely monitored for nonradiological parameters and 5 for radiological parameters at the following five areas:

- CFA
- INTEC
- Idaho Falls
- TAN
- TRA.

Four hundred seventy effluent samples (defined as types of analyses performed) were collected.

To assess the data for trends or changes that might indicate loss of process control or unplanned release, current monitoring data are compared to statistical control limits. (Refer to Appendix B for the calculation of these limits). These statistical control limits are not regulatory limits, rather they are comparison limits used to monitor a given effluent for changes from expected levels. If a parameter concentration exceeds the upper statistical control limit, there is less than a 1% chance that the exceedance was due to random fluctuations. The effluent to the CFA Sewage Treatment Plant (Section 2.2.2.1), INTEC Sewage Treatment Plant (Section 2.2.2.2), and TAN/TSF effluent to the Disposal Pond (Section 2.2.2.4) were the only locations for which parameters repeatedly exceeded the upper statistical control limits. All other exceedances of the upper statistical control limits were infrequent occurrences and did not indicate a trend or identify a regulatory issue, and therefore, are not discussed.

Measurement results were compared to regulatory limits. Regulatory limits include Resource Conservation and Recovery Act toxicity characteristic hazardous waste limits and applicable permit limits. Any detections above regulatory limits were addressed with facility representatives and regulatory agencies, and if required, actions were taken based upon those reviews. All results were below Resource Conservation and Recovery Act toxicity characteristic hazardous waste limits and City of Idaho Falls limits. With the exception of three total nitrogen monthly results at the INTEC Sewage Treatment Plant, which exceeded the Wastewater Land Application Permit limit, all results were within regulatory limits.

Table 2-6. 2000 effluent monitoring locations, parameters, and frequencies.

| Location | Discharge Description | Type of Monitoring | Parameters[a] | Frequency |
|---|---|---|---|---|
| CFA-LS1, Sewage Treatment Plant Lift Station | Untreated wastewater from all sanitary sewer drains throughout CFA | Wastewater Land Application Permit | Wastewater Land Application Permit parameters[b] | Monthly |
| CFA-STF, Sewage Treatment Plant effluent pump pit | Treated wastewater from the CFA Sewage Treatment Plant lagoons prior to land application | Wastewater Land Application Permit | Wastewater Land Application Permit parameters | Monthly (when pivot operating) |
| | | Characterization | Cl, F, $SO_4$, total dissolved solids (TDS), metals,[c] and radiological parameters[d] | Quarterly (when pivot operating) |
| CFA-696,[e] Transportation Complex oil and water separator | Water from floor drains and vehicle maintenance areas in the Transportation Complex | Surveillance | Total oil and grease | Quarterly |
| CPP-769, influent to Sewage Treatment Plant | Untreated wastewater from sanitary sewer drain throughout INTEC | Wastewater Land Application Permit | Wastewater Land Application Permit parameters | Monthly |
| | | Characterization | NNN, $NH_3N$, TKN, BOD, and alkalinity | Weekly nitrogen study upon request |
| CPP-771,[e] effluent from Cell No. 2 | Treated wastewater from aeration lagoons | Characterization | NNN, $NH_3$ N, TKN, BOD, and alkalinity | Weekly nitrogen study upon request |
| CPP-773, Sewage Treatment Plant effluent to Rapid Infiltration Trenches | Treated wastewater from the INTEC lagoons prior to the infiltration trenches | Wastewater Land Application Permit | Wastewater Land Application Permit parameters | Monthly |
| | | Characterization | Metals[c] and radiological parameters<br>NNN, $NH_3$ N, TKN, BOD, and alkalinity | Quarterly<br>Weekly nitrogen study upon request |
| TRA-608,[e,f] effluent from Reverse Osmosis Unit | Water treatment process at the TRA demineralizer facility | Characterization | Metals,[c] Cl, F, $SO_4$, TDS, and NNN | Quarterly |
| | | | Radiological parameters | Quarterly |
| TRA-764, effluent to Cold Waste Pond | Nonradioactive, nonsanitary drains throughout TRA | Surveillance | Metals,[c] Cl, F, $SO_4$, TDS, and radiological parameters | Quarterly |

Table 2-6. (continued).

| Location | Discharge Description | Type of Monitoring | Parameters[a] | Frequency |
|---|---|---|---|---|
| TAN-655, effluent to Sewage Treatment Plant pond | Combination of process water from TAN-607 and treated sewage | Wastewater Land Application Permit | Wastewater Land Application Permit parameters | Monthly |
| | | Surveillance | Radiological parameters | Quarterly and upon request |
| | | | NNN, $NH_3N$, and TKN | Special study upon request |
| WRRTF-1,[c] Sewage Lagoon sump | Treated effluent from the sanitary system at WRRTF | Surveillance | Metals,[c] Cl, F, $SO_4$, TSS, TDS, BOD, NNN, TKN, and P | Annually |
| WRRTF-2,[c] process pond sump pit | Nonsanitary, nonradioactive sources at WRRTF | Surveillance | Metals,[c] Cl, F, $SO_4$, TSS, TDS, and NNN | Semiannually |
| IFF-603B, IRC east access port | Sewage and laboratory discharges from IRC and the Research Office Building | Industrial Wastewater Acceptance Form | Metals,[g] and CN | Semiannually |
| IFF-616, WCB effluent | Sanitary sewage and wastewater from WCB | Industrial Wastewater Acceptance Form | Metals,[g] and CN | Semiannually |
| Live Fire Range | Floor wash water from firing range | Surveillance | Total Pb | On request |

a. All locations are sampled for field parameters including pH, specific conductance, and temperature.

b. Wastewater Land Application Permit parameters are specified in the individual permits.

c. Metals include the following target analyte list: antimony, arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, thallium, and zinc.

d. Radiological parameters include gross alpha, gross beta, and gamma spectrometry.

e. These samples were grab samples. Other samples were 24-hour composites.

f. Sampling at TRA-608 was discontinued after the 3rd quarter 2000 sampling.

g. Required metals include arsenic, cadmium, chromium, copper, lead, mercury, nickel, silver, and zinc.

Additionally, annual average concentrations in discharges to land application facilities were compared to calculated risk-based release levels. Release levels were developed for disposal of wastewater to land application facilities (percolation ponds or sprinkler irrigation sites).[32,33] Release levels were developed to ensure that long-term use of the ponds for wastewater disposal would not result in accumulation of contaminants that potentially become an unacceptable risk to human health or result in degradation of groundwater quality in excess of Wastewater Land Application Permit limits. Gross alpha and gross beta concentrations were compared to the Derived Concentration Guide for the most restrictive alpha- and beta-emitting radionuclides (plutonium-239 and strontium-90, respectively). During 2000, the sulfate and total dissolved solids risk-based release levels were exceeded at the TRA cold waste pond and are discussed in Section 2.2.2.3. No other risk-based release levels were exceeded at any other facilities.

Historical and 2000 summary statistical data for effluent streams are in Environmental Monitoring Program files. In 2000, concentrations were below corresponding limits at the following facilities: CFA-LSI, CFA-696, TRA-608, WRRTF-1, WRRTF-2, IFF-603B, IFF-616 and are therefore not discussed. The following sections discuss only the effluent streams and parameters that exceeded the applicable limits in 2000. Effluent monitoring of the INTEC Percolation Ponds (CPP-797) is conducted by INTEC Operations. Therefore, results are not included in this report.

***2.2.2.1 Effluent from the CFA Sewage Treatment Plant.*** The CFA Sewage Treatment Plant treats water from sanitary sewage drains throughout CFA (Figure A-4). Wastewater is derived from restrooms, showers, and the cafeteria, a significant portion of which is comprised of noncontact cooling water from air conditioners and heating systems which dilutes the wastewater effluent.

The STP consists of:

- 1-acre partial-mix, aerated lagoon (Lagoon No. 1)
- 9-acre facultative lagoon (Lagoon No. 2)
- 0.5-acre polishing pond (Lagoon No. 3)
- Sprinkler pivot irrigation system, which applies wastewater on up to 73.5 acres of native desert rangeland.

A 400-gallon-per-minute pump applies wastewater from the lagoons to the land through a computerized center pivot system. The permit limits wastewater application to 25 acre-in./acre/year from March 15 through November 15 and limits leaching losses to 3 in./year.

During 2000, five effluent samples (including one duplicate sample) were taken from the pump pit (prior to the pivot) during the months of normal pivot operation. Effluent concentrations repeatedly exceeded the upper statistical control limits for the following parameters: conductivity (4 samples), total phosphorus (5 samples), and total Kjeldahl nitrogen (TKN) (5 samples). In addition, biochemical oxygen demand (BOD) results exceeded the associated upper statistical control limit and represented the highest BOD concentrations reported to date. These upper statistical control limit exceedances indicated concentrations that are significantly higher than what would be expected based on historical data. However, calculated loading rates for both total nitrogen (of which TKN is a main component) and total phosphorus remained much lower than projected in the initial permit application and do not indicate a negative impact to the application area. While removal efficiencies calculated for both total nitrogen and BOD were at lower-than-projected levels, treatment in the lagoons is still sufficient to produce a good quality effluent for land application. These parameters will continue to be monitored for continued increasing trends.

#### 2.2.2.2 *Idaho Nuclear Technology and Engineering Center Sewage Treatment Plant.*

The INTEC Sewage Treatment Plant treats and disposes of sanitary and other related wastes at INTEC. It consists of:

- Two aerated lagoons
- Two quiescent, facultative stabilization lagoons
- Four rapid infiltration trenches
- Six weir boxes (control stations) that control the flow of the sewage through the lagoons and trenches.

Automatic, flow-proportional composite samplers are located at control stations CPP-769 (influent) and CPP-773 (effluent) (Figure A-8). The Wastewater Land Application Permit for the Sewage Treatment Plant sets the following limits for effluent prior to the infiltration trenches (CPP-773):

- Total suspended solids (TSS) of 100 mg/L averaged monthly
- Total nitrogen (nitrate + nitrite + TKN) of 20 mg/L averaged monthly
- Flow to rapid infiltration trenches of 30 million gallons annually.

December 2000 permit-required samples were not taken for either the influent or effluent. The effluent sample could not be taken due to construction activities in support of the scheduled shear gate replacement project. Failure to obtain the December influent sample is considered a permit noncompliance and required notification to the Idaho Division of Environmental Quality.[34] However, no environmental consequences were anticipated from the failure to collect the December influent sample.

For Calendar Year 2000, the INTEC Sewage Treatment Plant (CPP-773) effluent did not exceed the monthly average of 100 mg/L for TSS. The flow limit set forth in the permit was not exceeded during the 2000 permit year, which ran from November 1999 through October 2000. However, the total nitrogen limit of 20 mg/L was exceeded 3 months during Calendar Year 2000. The 2000 total nitrogen annual average concentration was 15.6 mg/L. Total nitrogen concentrations in the effluent exceeded the permit limit for the first time in December 1997. Although elevated nitrogen concentrations occur during warmer months, the highest total nitrogen concentrations typically occur during colder months, when biological activity of microorganisms decreases from the colder temperatures. Figure 2-3 shows influent and effluent total nitrogen concentrations from September 1995 through December 2000. Since the 1999 annual report was published, additional information was received from the analytical laboratory about the December 1999 influent result originally reported as 196 mg/L. As a result of this information and further validation of the associated data package, the result was rejected and is considered unusable. Figure 2-3 reflects this change.

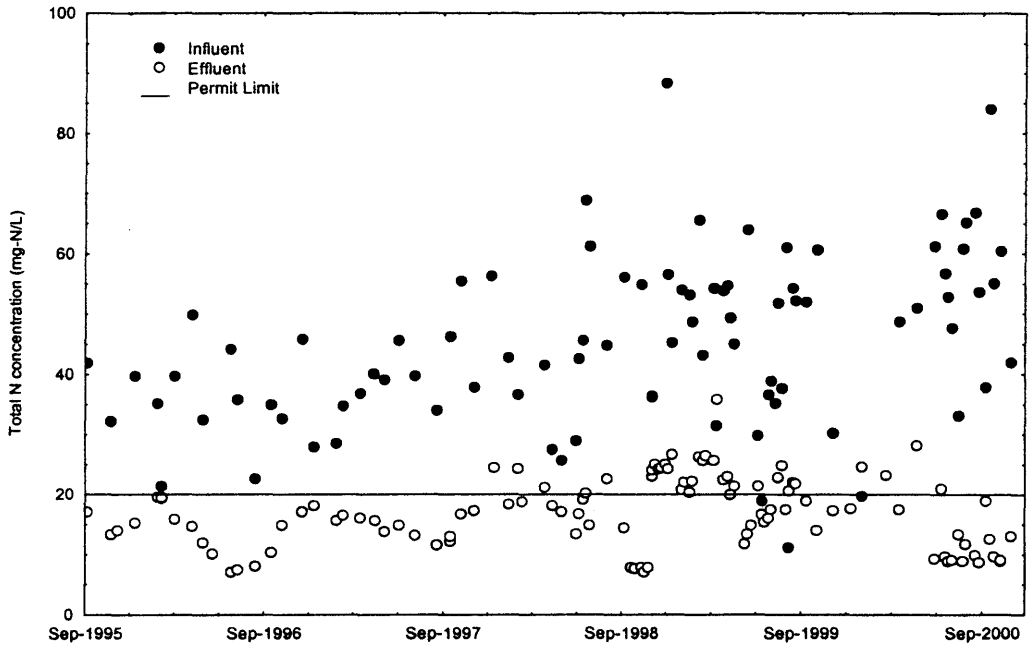



Figure 2-3. Total nitrogen concentrations at the Idaho Nuclear Technology and Engineering Center Sewage Treatment Plant from 1995 through 2000.

To better understand the removal of nitrogen during wastewater treatment, extra samples were taken as part of a nitrogen study. Additional monthly samples were collected for nitrogen (more than required by the permit) beginning in June 1998 and continued through most of 2000. The additional samples were collected from the influent (CPP-769), effluent from Cell No. 2 (CPP-771), and effluent (CPP-773) and analyzed for total Kjeldahl nitrogen (TKN), nitrate + nitrite as nitrogen (NNN), and ammonia ($NH_3N$).

From the sample results (Table 2-7), it was determined that as the wastewater enters the lagoon system, it is mainly composed of TKN (a form of nitrogen). The majority of the TKN is in the form of ammonia. The aerators in lagoon Cell Nos. 1 and 2 reduce the ammonia concentration from that found in the influent through the process of air stripping. Comparing the nitrogen concentrations from CPP-771 with the concentrations from the effluent shows little additional nitrogen removal is taking place in lagoon Cell Nos. 3 and 4. The majority of the total nitrogen in these two cells is still in the form of ammonia. During June 2000, aeration was increased to these two cells by operating both blowers simultaneously. Preliminary results from samples taken at control structure CPP-771 (effluent from Cell No. 2) indicate that operating both blowers may have increased ammonia removal. Blower operation was discontinued temporarily in November 2000 during the replacement of the shear gates. It is expected that the shear gate replacement will improve flow control. Additionally, two surface aerators will be installed, and testing will be performed during 2001 to determine their effectiveness in stripping additional ammonia from the wastewater.

Table 2-7. Idaho Nuclear Technology and Engineering Center Sewage Treatment Plant average[a] nitrogen concentrations.

| | | CPP-769 | | | CPP-771 | | | CPP-773 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Parameter | Units | 1998 | 1999 | 2000 | 1998 | 1999 | 2000 | 1998 | 1999 | 2000 |
| Ammonia as N | mg/L | 36.14 | 33.99 | 42.92 | 14.86 | 19.38 | 12.44 | 14.98 | 14.57 | 11.63 |
| Nitrate + nitrite as N | mg/L | 0.14 | 0.11 | 0.06 | 0.97 | 1.75 | 3.07 | 0.75 | 1.80 | 1.41 |
| Total Kjeldahl nitrogen | mg/L | 44.57 | 46.27 | 47.23 | 16.46 | 22.05 | 15.59 | 16.67 | 17.99 | 14.24 |
| Total nitrogen | mg/L | 44.71 | 46.38 | 47.28 | 17.41 | 23.81 | 18.67 | 18.12 | 19.80 | 15.65 |

a. Calendar year averages are based on monthly averages of all data for a given month.

The 2000 annual effluent average decreased from the past several years. This decrease could be due to the increased aeration or other measures already implemented (such as bacterial reseeding in 1999).

Nineteen samples were taken during the year for both the influent and effluent, including the additional samples taken for the nitrogen study. Influent (CPP-769) concentrations repeatedly exceeded the upper statistical control limits for the following parameters: BOD (10 samples), ammonia (4 samples), TKN (4 samples), and TSS (10 samples). Effluent (CPP-773) concentrations exceeded the upper statistical control limit for TSS (14 samples). These concentrations were significantly higher than expected based on historical data, and all of these parameters showed increasing trends over time. However, TSS concentrations were well below the permit limit. Increases in TSS for both the influent and effluent do not appear to be related to the number of employees assigned to INTEC, as population levels have decreased since 1995. Levels of TSS, although elevated, remain below the permit limit of 100 mg/L, and both BOD and TSS are being treated efficiently by the lagoon system, based on the relatively high removal efficiencies.

Most of the maintenance and operational corrective actions have been completed. These corrective actions will be evaluated to determine the effectiveness in reducing nitrogen concentrations. During Calendar Year 2000, a waste stream evaluation was performed to attempt to locate unauthorized industrial wastewater sources that could be contributing to the nitrogen exceedances. The study did not identify any previously unidentified sources.[35] Additional operational and plant modifications could be required if planned corrective actions do not reduce the nitrogen to acceptable concentrations.

***2.2.2.3 Effluent to the Cold Waste Pond (TRA-764).*** Effluent to the Cold Waste Pond (TRA-764) is from nonradioactive, cold waste drains within TRA (Figure A-15). The cold drains are located throughout TRA, including laboratories and craft shops. Maintenance cleaning waste, floor, and yard drains are examples of intermittent TRA discharges that might alter water quality parameters during normal operations. The largest volume of wastewater received by the Cold Waste Pond is secondary cooling water from the Advanced Test Reactor when it is in operation. Chemicals used in cooling tower water are primarily commercial corrosion inhibitors and sulfuric acid to control pH. The cold waste effluents collect at the cold well sump and sampling station, and are pumped out to the Cold Waste Pond, which is located outside the TRA fence. A radiation monitor and alarm on the cooling tower system prevents accidental discharges of radiologically contaminated cooling water.

In 2000, all comparison limits were met, except for sulfate and total dissolved solids. The 2000 annual average sulfate concentration barely exceeded the risk-based release level (280.1 mg/L vs. 280 mg/L).[30] The historical average (285.63 mg/L), based on all data through 1999, also exceeded the risk-based level. Both the 2000 average total dissolved solids concentration (715 mg/L) and the historical

average (581 mg/L) exceeded the risk-based release level of 560 mg/L. Concentrations of total dissolved solids and sulfate in samples collected during reactor operation differ significantly from those collected during reactor outages. These differences are due to the discharge of approximately 80–120 gallons per minute of secondary cooling water containing four to five times the normal raw water hardness, as well as corrosion inhibitors and sulfuric acid. This discharge occurs when the reactor is operating and during the first day of the outage and results in concentrations two to three times that discharged during outages. The average concentrations slightly exceed the concentrations predicted to degrade groundwater quality above drinking water standards.

***2.2.2.4 Effluent to the TAN/TSF Disposal Pond (TAN-655).*** The TSF sewage or sanitary wastewater consists primarily of spent water containing wastes from rest rooms, sinks, and showers. The wastewater goes to the TAN-623 Sewage Treatment Plant, and then to the TAN-655 lift station, which pumps to the Disposal Pond (Figure A-15).

The process water drain system collects wastewater from various TAN facilities. The process wastewater consists of effluent, such as steam condensate; water softener and demineralizer discharges; and cooling water, heating, ventilating, air conditioning, and air scrubber discharges. The process wastewater is transported directly to the TAN-655 lift station where it is mixed with treated sanitary wastewater before being pumped to the Disposal Pond.

The Wastewater Land Application Permit for the TAN/TSF Sewage Treatment Plant sets concentration limits for TSS and total nitrogen (measured at the effluent to the Disposal Pond) and requires that the effluent be sampled and analyzed monthly for several parameters.

Monthly TSS and total nitrogen concentrations were below the permit limits throughout the year. During Calendar Year 2000, 16 samples were taken at TAN-655, including duplicate samples and additional May samples. Effluent concentrations repeatedly exceeded the upper statistical control limits for the following parameters: BOD (13 samples), chloride (7 samples), ammonia (15 samples), TKN (10 samples), total phosphorus (7 samples), sulfate (4 samples), TDS (6 samples), and sodium (7 samples). These concentrations were significantly higher than expected based on historical data. In addition, all of these parameters, except sulfate, showed increasing trends over time when all permit data are considered. Increasing trends in ammonia and TKN could cause the Wastewater Land Application Permit limit of total nitrogen to be exceeded if concentrations continue to increase. However, both ammonia and TKN concentrations peaked in March and decreased during the remainder of the year. These parameters will continue to be monitored, and sampling will be increased, as required. Elevated sodium, chloride, and TDS concentrations are likely the result of effluents from demineralizer regeneration, boiler blowdown, and water softening. TDS concentrations appear to increase during the winter months, which could be attributed to reduced plant efficiency and possibly to boiler operations. A review of TAN utilities chemical use records identified an increase in salt use (for water softening) in 1999 and 2000. Salt usage is expected to decrease with the installation of a new water softener system. These parameters will continue to be monitored to determine the impact of the expected decrease in salt usage.

### 2.2.3 Special Studies

The CFA Sewage Treatment Plant was built in 1994 to treat wastewater in pretreatment lagoons followed by land application via a pivot irrigation system. The Wastewater Land Application Permit for the CFA Sewage Treatment Plant requires annual soil sampling inside the application area. These results are reported in the Annual Wastewater Land Application Permit Site Performance Reports.[28] Besides permit-required soil sampling, additional soil and soil pore-water sampling was initiated in 1997 as part of a special study. The primary objectives of this study are to evaluate the effects additional nitrogen and

salt loading have on the overall soil profile in a native sagebrush steppe environment (one of three plant communities in the application area) and to determine the implications on the area's long-term ecological health. This study was designed to measure soil chemistry for the same constituents as those required for the Wastewater Land Application Permit (except phosphorous) inside the application area and compare them to similar measurements made immediately outside the application area in the same plant community. Lysimeters were also installed to extract soil pore-water at the same locations and depth intervals as the soil samples.

Sampling locations were chosen based on their proximity to the Environmental Science and Research Foundation's neutron probe access tubes. A cluster of three lysimeters (placed at 30-cm [12-in.], 60-cm [24-in.], and 90-cm [35-in.] depths) was placed adjacent to five neutron probes within the application area and five neutron probes in an adjacent control area during the summer of 1997. Soil pore-water sampling began at these locations in the spring of 1998 and continued in the spring of 1999. Soil pore-water sampling was not conducted in 2000, but soil samples were collected at the same depths in May 2000 and again in November 2000 in conjunction with the Wastewater Land Application Permit required sampling.

Soluble salts (as measured by electrical conductivity) were elevated inside the application area compared to the control area for the past 4 years in the surface interval (Figure 2-4). However, soil salinity levels are still in the range of those taken before wastewater application and are considered to have a negligible effect on plant growth. Sodium adsorption ratio levels were also elevated in the 0-12 in. interval of the application area when compared to the control area (Figure 2-5). Soils with high SARs can cause reduced infiltration Soils with electrical conductivity below 2 mmhos/cm and sodium adsorption ratio below 15 are generally classified as not having salinity or sodium problems.[36] As Figures 2-4 and 2-5 show, electrical conductivity and sodium adsorption ratio have been below those levels, indicating no salinity or sodium problems in the application area soils.

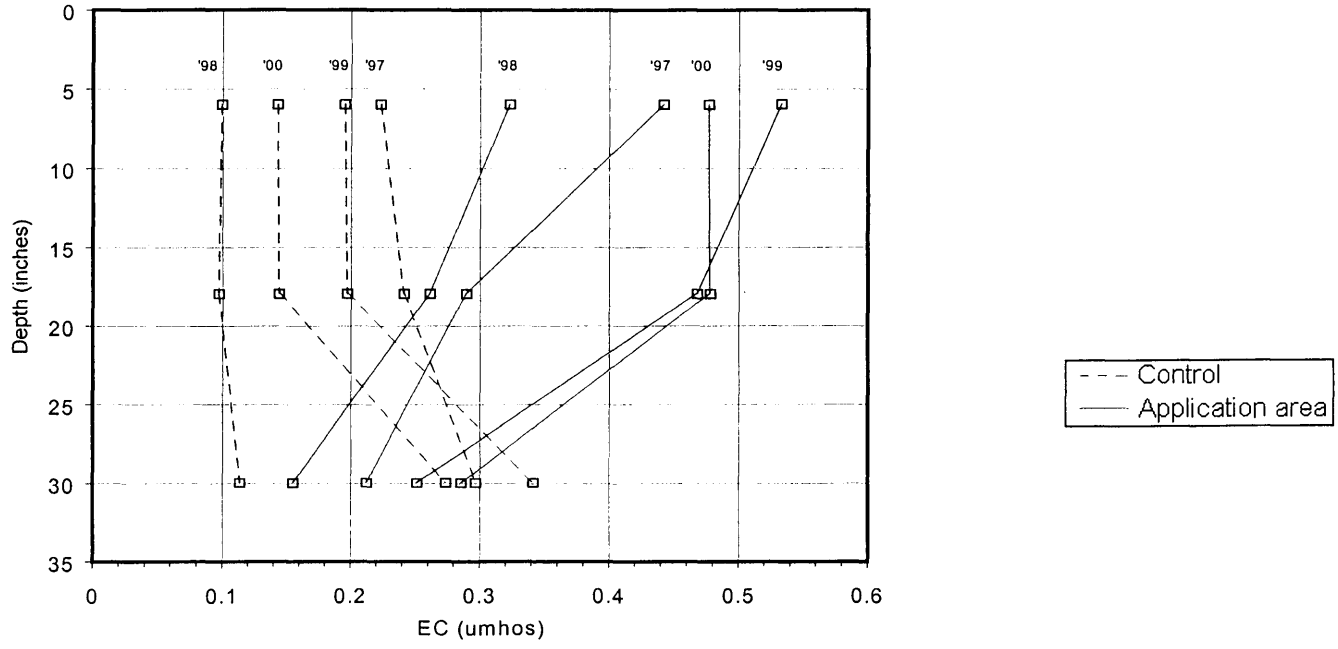



Figure 2-4. Electrical conductivity vs. soil depth (fall sampling).

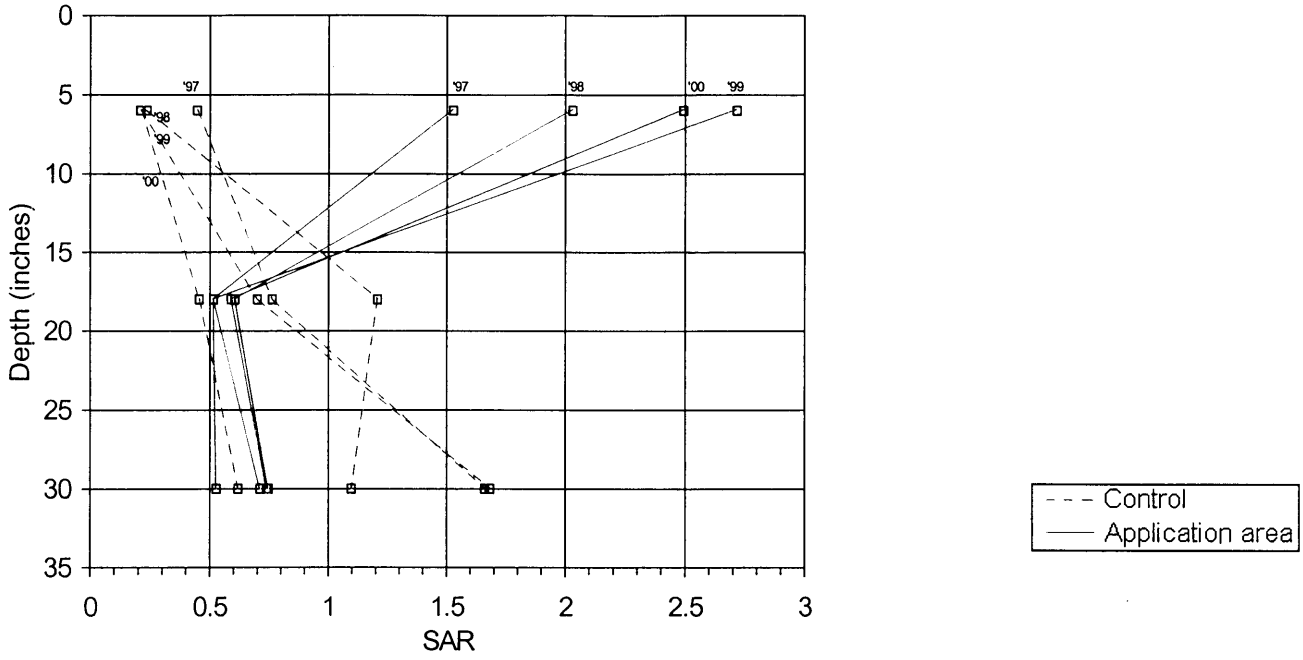



Figure 2-5. Sodium adsorption ratio vs. soil depth (fall sampling).

Ammonium, nitrate as nitrogen, and TKN concentrations in the soil have remained very low. It is possible that increased nutrients and water available to the plants as a result of wastewater application are actually stimulating plant growth, resulting in rapid utilization of plant-available nitrogen and ammonium.

Percent organic matter in the application area remains similar to that of the control area. Significant changes in the percentage of organic matter within the application area are not expected for several years until plant matter from several growing seasons is incorporated into the soil profile. Soil pH appears to be unaffected by wastewater application.

### 2.2.4 Quality Assurance/Quality Control

***2.2.4.1 Data Accuracy, Precision, and Completeness.*** To assess the conformance of the analytical data for the Liquid Effluent Monitoring Program to programmatic quality assurance/quality control objectives, goals for accuracy, precision, and completeness have been established.[37] Accuracy is assessed by submitting field blind spike samples and is measured in terms of percent recovery. Precision is measured by calculating the relative percent difference between duplicate samples. Completeness is measured by comparing the number of samples required for compliance with the wastewater permits to the number of compliance samples collected.

Quarterly field blind spikes (or standards) are required to assess the analytical data accuracy. However in 2000, issues with past data and concerns with the number of laboratories used for analysis resulted in a total of twelve sets of blind standards being submitted. Blind standard sample solutions are purchased from a National Institute of Standards and Testing-certified supplier. The samples are prepared by the supplier of the standards using bottles supplied by the Liquid Effluent Monitoring Program. The supplier ships the prepared standards back to Liquid Effluent Monitoring Program personnel, who repackage, relabel, and ship them to the analytical laboratory with regular field samples. The standard

labeling and sample numbering schemes are used so that there is no indication to the analytical laboratory that the samples are quality control samples.

Of the twelve blind standard sets submitted during the year, five reported at least one parameter that fell outside the performance acceptance limits recommended by the supplier of the standards. Of the 42 individual parameters and six metal suites submitted for analysis as blind standards, 13 parameters (including 3 individual metals parameters) were outside the performance acceptance limits. One of the three laboratories reported all results within the performance acceptance limits on the three blind standard sets submitted. Neither of the remaining two laboratories routinely missed the limits on any individual parameter.

Failure of the blind spike results for any parameter could impact the results reported for the associated monitoring samples. The concern is that the actual results could be biased in the same direction as the blind spike results and could result in an exceedance of a permit limit. In all but one case, either no permit limit existed or the blind spike result was higher than the performance acceptance limit (which could result in the actual concentration being less than that reported). For one of the fourth-quarter submittals, the blind spike result for TKN was below the associated performance acceptance limit and could have resulted in the actual TKN concentration being higher than what was reported (6.64 mg/L). The Wastewater Land Application Permit for the effluent to the TAN Disposal Pond sets a concentration limit for total nitrogen, of which TKN is a component, at 20 mg/L as measured at TAN-655. The December total nitrogen (8.04 mg/L) based on the reported TKN result was well below the permit limit and could more than double and still be within the permit limit. To estimate the impact of the low bias in the TKN blind spike sample, the reported blind spike result (1.02 mg/L) was compared to the certified value for the TKN standard (1.48 mg/L) and was approximately 69% of the certified value. If it is assumed that the reported concentration of TKN in the associated TAN-655 sample were also low by the same percent, then the value could be closer to 11.2 mg/L and the resulting total nitrogen could then be closer to 12.6 mg/L, still well within the permit limit.

Collection of duplicate samples is required approximately once per year per sampling location to assess data precision. The precision goal is to achieve less than or equal to 35% relative percent difference between any pair of duplicate samples. For metals, all of the duplicate pairs had relative percent differences less than 35%. For inorganics, 89% of the duplicate pairs had relative percent differences less than 35%. Of the five pairs that exceeded the 35% relative percent difference, one had concentrations that were below detection limits. No duplicate pairs of radiological samples were taken. In many instances, the effluent samples collected were either nondetected for various analytes or contained analytes at concentrations less than five times the method detection limit. When analyte concentration is less than five times the method detection limit, quantification of the analyte becomes less certain.

The goal for completeness is to collect 100% of all required compliance samples. However, during 2000 this goal was not met. December 2000 permit-required samples were not taken for either the influent (CPP-769) or effluent (CPP-773) to the INTEC STP. The effluent sample could not be taken due to scheduled construction activities, and the influent sample was not taken because of a miscommunication. Failure to obtain the December influent sample was considered a noncompliance and required Idaho Department of Environmental Quality notification. No environmental consequences were anticipated from the failure to collect the December influent sample, and steps were taken to correct impacts to future sample collection.

***2.2.4.2 Data Validation and Sampling Issues.*** During 2000, nine results (eight BOD and one TSS) were rejected as unusable during data validation because the laboratory exceeded the holding time. Five of these nine results were compliance-required samples from four different compliance points.

In addition, all eight results from one sampling event were rejected as unusable because the sample was not representative of the monitored effluent. The compositor at that location malfunctioned and collected too little sample volume and collected a large amount of sediment. This sample event was not a required compliance sample.

No other sampling or validation issues were identified during the year.

## 2.3 Storm Water Monitoring Program

The Environmental Protection Agency National Pollutant Discharge Elimination System rules for the point source discharges of storm water to waters of the U.S. require permits for discharges from industrial activities.[8] For regulatory purposes, waters of the U.S. at the INEEL include:

- Big Lost River
- Little Lost River
- Birch Creek
- Spreading areas
- Playas
- Tributaries.

Together the above comprise the Big Lost River System (Figure 2-6).

A Storm Water Monitoring Program was implemented in 1993 when storm water permits initially applied to the INEEL. The program was modified as permits changed, data were evaluated, and needs were identified. In 1997, monitoring of storm water that enters deep injection wells was transferred from the United States Geological Survey to the management and operating contractor. On September 30, 1998, the Environmental Protection Agency issued the "Final Modification of the National Pollutant Discharge Elimination System Storm Water Multi-Sector General Permit for Industrial Activities."[8] The INEEL implemented the analytical monitoring requirements of the permit starting January 1, 1999, and ending September 30, 1999. Visual monitoring was implemented starting October 1, 1998, and continues to be performed quarterly. The permit requires analytical monitoring in year 4 of the permit (1999) and from the coal pile when there is a discharge to the Big Lost River System. But storm water did not discharge to the Big Lost River System; therefore, during 2000, all storm water monitoring were visual examinations only. The *INEEL Storm Water Pollution Prevention Plan for Industrial Activities*[38] was revised to meet the requirements of the Storm Water Industrial Permit. The *INEEL Storm Water Pollution Prevention Plan for Industrial Activities* applies to certain industrial facilities and includes:

- Pollution prevention teams
- Descriptions of potential sources of pollution

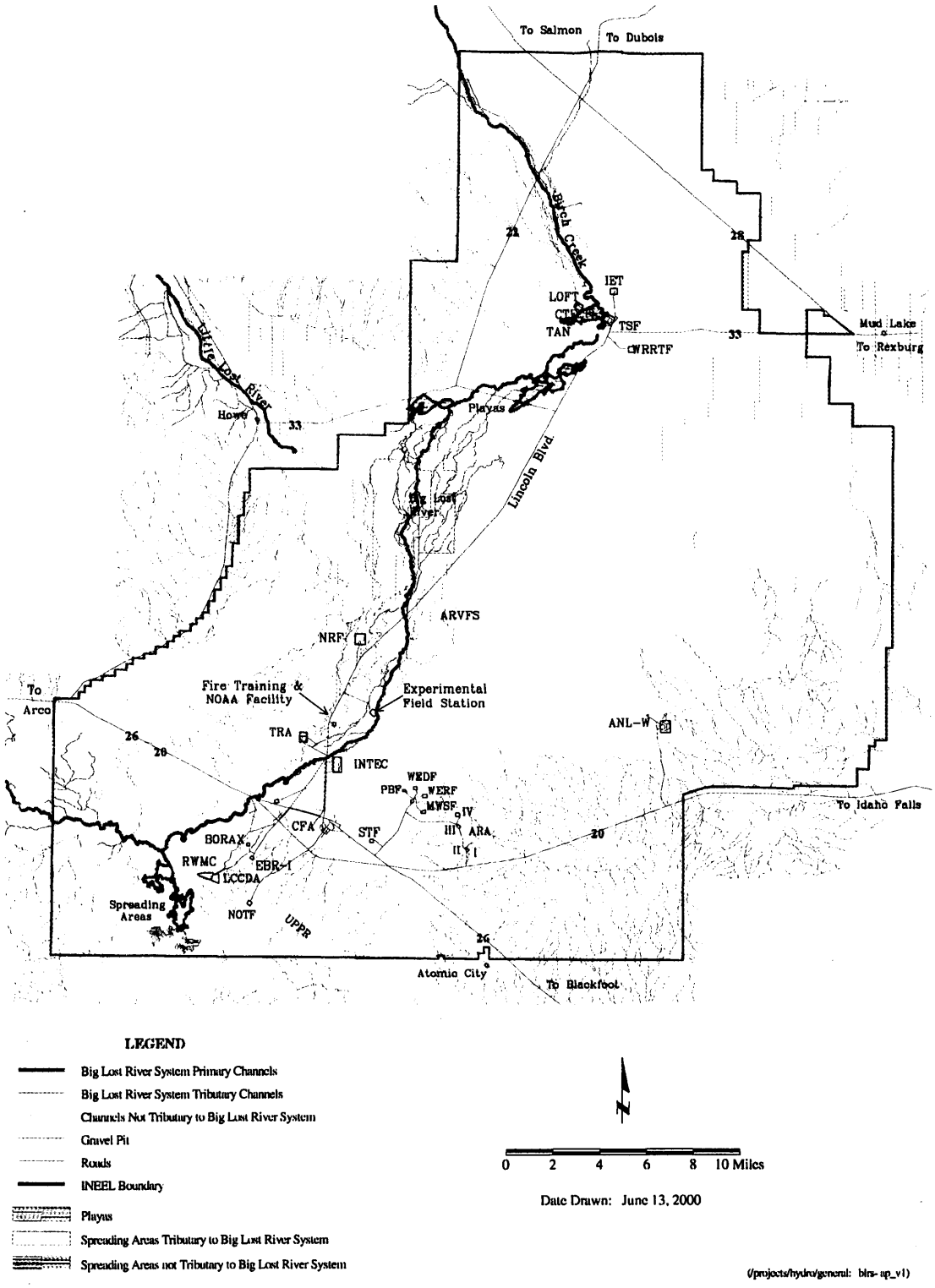



Figure 2-6. Big Lost River System.

- Measures and controls
- Evaluation requirements
- Monitoring requirements and data.

Practices to minimize storm water pollution are evaluated annually, and the *Storm Water Pollution Prevention Plan for Industrial Activities* is revised accordingly.

### 2.3.1 Program Design Basis

The Storm Water Monitoring Program meets the Storm Water Industrial Permit[8] requirements by conducting permit-required monitoring. In addition, the program monitors storm water to deep injection wells to comply with State of Idaho Injection Well Permits.[6] Storm Water Industrial Permit-required data are submitted to the Environmental Protection Agency in a Discharge Monitoring Report.[39] Additionally, Storm Water Industrial Permit visual data are included, and analytical data are summarized in the annual revisions of the *INEEL Storm Water Pollution Prevention Plan for Industrial Activities*. Data for storm water discharged to deep injection wells are reported to the Idaho Department of Water Resources.

For 2000, a total of 34 sites (Table 2-8) at five INEEL areas (Appendix A) were designated as storm water monitoring locations based upon drainage patterns and proximity to potential sources of pollutants. Twenty-seven locations met the conditions for quarterly visual monitoring required by the Storm Water Industrial Permit when discharges occur to the Big Lost River System. The Storm Water Industrial Permit requires visual examinations of storm water for obvious indications of storm water pollution. In addition, visual examinations were conducted for surveillance purposes at some locations whether or not storm water discharged to the Big Lost River System. At permit-specified locations, storm water is collected for laboratory analysis when storm water discharged to the Big Lost River System during year 4 of the permit only (1999) and annually from discharges from the coal pile to the Big Lost River System.

The Storm Water Industrial Permit requires that samples be collected and visually examined from rain storms that accumulated at least 0.25 cm (0.1 in.) of precipitation preceded by at least 72 hours without measurable precipitation (0.1 in) to allow pollutants to build up and then be flushed from the drainage basin. Because of unique meteorological conditions, not all sites may have storm water discharge from storms that meet the permit requirements every quarter. Therefore, additional samples may be collected from snow melt or from storms that do not meet permit requirements.

The storm duration, amount, and duration between the storm event sampled and the end of the previous storm are recorded for all precipitation events. In addition, if a storm results in a discharge to the Big Lost River System and analytical samples are required at that location, total discharge volume is estimated as required by the Storm Water Industrial Permit.

Seven deep injection wells are monitored when storm water discharges to those wells as required by the "Injection Well Permits."[6] Injection well sample data are compared to primary drinking water maximum contaminant levels from 40 CFR 141.[21] No analytical samples were required for 2000 because there was no discharge down any permitted injection well.

Table 2-8. 2000 storm water monitoring locations and frequencies.

| Site ID | Site Description | Parameters[a] | Number of Sampling Events | |
|---|---|---|---|---|
| | | | Analytical[b] | Visual[c] |
| CFA-MP-2 | CFA Landfill #3 east side | Total suspended solids, iron, visual | 0 | 0[f] |
| CFA-MP-3[d] | CFA Disposal Well near junction of Lincoln and Wyoming | Drinking water metals, organics, inorganics, coliform, and radiological parameters | 0 | 0 |
| CPP-MP-1 | East Perimeter Road at culvert to retention basin | CN, chemical oxygen demand, ammonia-N, total recoverable metals,[e] total suspended solids, NNN, visual | 0 | 4 |
| CPP-MP-2 | South side of coal pile at discharge to ditch | pH, total suspended solids, visual | 0 | 4 |
| CPP-MP-3 | INTEC Ash Pit | Total suspended solids, iron, visual | 0 | 3 |
| PBF-MP-2[d] | SPERT Disposal 1 | Drinking water metals, drinking water organics, inorganics, coliform, radiological parameters | 0 | 0 |
| PBF-MP-3[d] | SPERT Disposal 2 | Drinking water metals, drinking water organics, inorganics, coliform, radiological parameters | 0 | 0 |
| PBF-MP-4[d] | SPERT Disposal 3 | Drinking water metals, drinking water organics, inorganics, coliform, radiological parameters | 0 | 0 |
| WMC-MP-2 | Outflow from the SDA at the sump by Culvert C-12 | Total suspended solids, iron, NNN, zinc, visual | 0 | 0[f] |
| WMC-MP-1 | East culvert off Ops. Area | CN, chemical oxygen demand, ammonia, total suspended solids, metals,[e] dissolved magnesium, NNN, visual | 0 | 6 |
| WMC-MP-4 | West culvert off Ops. Area | CN, chemical oxygen demand, ammonia, metals, total suspended solids, dissolved magnesium, NNN, visual | 0 | 7 |
| WMC-MP-C13 | North side of road in culvert just prior to entering SDA | Visual inspection only | 0 | 0[f] |
| WMC-MP-C26 | Culvert C-26 north of TSA | Visual inspection only | 0 | 1 |
| WMC-MP-C15 | Culvert C-15 north of TSA | Visual inspection only | 0 | 1 |
| WMC-MP-C23 | Culvert C-23 north of TSA | Visual inspection only | 0 | 0[g] |
| WMC-MP-C18 | Culvert C-18 north of TSA | Visual inspection only | 0 | 1 |
| WMC-MP-C17 | Culvert C-17 north of TSA | Visual inspection only | 0 | 1 |
| WMC-MP-C33 | Culvert C-33 north of TSA | Visual inspection only | 0 | 1 |
| WMC-MP-C40 | Culvert C-40 south of WMF-636 | Visual inspection only | 0 | 1 |
| WMC-MP-C41 | Culvert C-41 southwest of WMF-636 | Visual inspection only | 0 | 3 |

Table 2-8. (continued).

| Site ID | Site Description | Parameters[a] | Number of Sampling Events | |
|---|---|---|---|---|
| | | | Analytical[b] | Visual[c] |
| WMC-MP-C25 | Culvert C-25 northwest corner of TSA | Visual inspection only | 0 | 4 |
| SMC-MP-1 | West side of Specific Manufacturing Capability (SMC) on Taylor Creek Road | Visual inspection only | 0 | 4 |
| SMC-MP-2 | North side of SMC | Visual inspection only | 0 | 4 |
| CTF-MP-1 | South of SMC 631 off of Snake Ave. | Visual inspection only | 0 | 3 |
| TSF-MP-1[d] | TAN Drainage Disposal 1, corner of Lincoln and Nile | Drinking water metals, drinking water organics, inorganics, coliform, radiological parameters | 0 | 0 |
| TSF-MP-2[d] | TAN Drainage Disposal 2, discharge to basin TAN-782 | Drinking water metals, drinking water organics, inorganics, coliform, radiological parameters | 0 | 0 |
| TSF-MP-3[d] | TAN Drainage Disposal 3, basin northwest of TSF | Drinking water metals, drinking water organics, inorganics, coliform, radiological parameters | 0 | 0 |
| TAN-MP-1 | T-28 N. Borrow Source inflow | NNN, total suspended solids, visual | 0 | 2 |
| TAN-MP-2 | T-28 N. Borrow Source outflow | NNN, total suspended solids, visual | 0 | 2 |
| TGP-MP-11 | T-28 S. Borrow Source | NNN, total suspended solids, visual | 0 | 0[f] |
| RGP-MP-11 | T-12 Borrow Source | NNN, total suspended solids, visual | 0 | 0[f] |
| BGP-MP-11 | Adams Blvd. Borrow Source | NNN, total suspended solids, visual | 0 | 0[f] |
| LGP-MP-11 | Lincoln Blvd. Borrow Source | NNN, total suspended solids, visual | 0 | 0[f] |
| TRP-MP-11 | Monroe Blvd. Borrow Source | NNN, total suspended solids, visual | 0 | 0[f] |

a. All locations are sampled for field parameters including pH, electrical conductivity, and temperature, except those requiring visual inspections only.

b. As specified by the permit, no analytical samples were required for 2000.

c. Visual examination includes a description of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other indicators of storm water pollution.

d. Injection well permit monitoring.

e. Metals are: silver, arsenic, cadmium, iron, mercury, manganese, lead, selenium.

f. No discharge available; therefore, no visual examination performed.

g. Visual examination inadvertently missed.

### 2.3.2 Data Summary and Assessment

No analytical monitoring was performed during 2000. Only the coal pile required analytical monitoring, but no storm water discharged from the coal pile to the Big Lost River System. Therefore, an analytical sample was not collected. Fifty-two storm water visual examinations were performed at 18 locations. Twenty-six of the 52 storm water visual examinations were performed on water discharged to the Big Lost River System from the RWMC monitoring points in compliance with the Storm Water Industrial Permit. During 2000, no rainfall, snow melt, or discharge down injection wells was observed at 16 monitoring points, including all seven injection wells, and nine storm water monitoring locations; therefore, no visual examinations were performed or analytical samples taken (injection wells only) at those locations.

Visual examinations of storm water samples indicate that a small amount of suspended solids is usually present and is normal due to high winds blowing dust onto facilities; therefore, no corrective actions are required.

An unusual odor at location WMC-MP-4 was noted during visual examinations on July 20 and October 10, 2000; however, it was determined that recent paving activity in the area caused the odor. No other obvious indicators of storm water pollution were observed.

### 2.3.3 Quality Assurance/Quality Control

The completeness goal is to collect 100% of all compliance samples. However, during 2000 this goal was not met. Location WMC-MP-C23 was inadvertently overlooked during visual examinations performed on October 10, 2000, and a subsequent storm did not occur during the quarter. However, water quality was not degraded during the October storm because there were no exposed pollutants in the drainage area to Culvert #23, and if there were a discharge to the drainage channel, the storm water would have remained in the drainage channel, evaporated, and infiltrated. Therefore, the storm water did not commingle with water in the Big Lost River, which is more than 4 miles from the RWMC facility.

No analytical samples were collected in 2000; therefore, no quality control samples were submitted. Visual examination reports were checked for accuracy against logbook entries prior to submittal to the industrial storm water coordinator.

## 2.4 Groundwater Monitoring Program

Groundwater Monitoring Program personnel collect all routine groundwater samples required by the Wastewater Land Application Permits, Remedial Investigation/Feasibility Studies, and Records of Decision for INEEL facilities managed by the management and operating contractor. This section summarizes the results from the 2000 groundwater monitoring activities conducted to demonstrate compliance with INEEL Wastewater Land Application Permits. Results from the groundwater monitoring activities supporting Remedial Investigation/Feasibility Studies and Records of Decision are summarized in reports prepared and published by the respective Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Waste Area Groups.

### 2.4.1 Program Design Basis

The sampling locations, frequency, and analyses to be performed for all Wastewater Land Application Permit groundwater monitoring activities were negotiated with the State of Idaho during the approval stages of the respective Wastewater Land Application Permit. Monitoring wells were selected based on the hydrogeology of the area to best determine the impact to the subsurface and the Snake River

Plain Aquifer by liquid effluent discharges to the percolation ponds. Sampling frequency was established based on the amount of historical data available for the specific monitoring wells, and analytical parameters were chosen to match the contaminants commonly found in the liquid effluent of the respective ponds. Contaminant concentrations in the monitoring wells are compared to the primary constituent standards and the secondary constituent standards, specified in IDAPA 58.01.11, "Ground Water Quality Rule."[27] These standards replace the previous maximum allowable concentrations and secondary maximum contaminant levels specified in the groundwater quality standards.[26] An exception to the primary constituent standards and the secondary constituent standards is made in the INTEC Percolation Pond Wastewater Land Application Permit, where specific limits are established for total dissolved solids and chloride levels. Table 2-9 lists the monitoring wells sampled during 2000, the sampling frequency, and the analyses performed.

### 2.4.2 Data Summary and Assessment by Facility

The following sections discuss parameters of interest in groundwater at the INTEC Percolation Ponds, the INTEC Sewage Treatment Plant, and the TAN/TSF Sewage Treatment Plant.

***2.4.2.1 Idaho Nuclear Technology and Engineering Center Percolation Ponds Monitoring Wells.*** During the 2000 reporting period, groundwater samples were collected at the INTEC Percolation Pond Wastewater Land Application Permit monitoring wells in April and October (see Figure A-8 for well locations). The 2000 analytical results were very similar to those of the previous years: no permit levels were exceeded in the compliance wells; the chloride, total dissolved solids, and sodium concentrations remained elevated downgradient of the Percolation Ponds; and concentrations were nondetectable for most of the remaining analytical parameters. Chloride, sodium, and total dissolved solids concentrations continue to be elevated in USGS-112 and USGS-113 compared to the upgradient well (USGS-048) for the Percolation Ponds. These elevated concentrations are the result of the continued water softening and treatment processes at INTEC, which introduce total dissolved solids, chloride, and sodium into the Service Waste System and eventually to the Percolation Ponds. Groundwater concentrations for total dissolved solids, chloride, and sodium in USGS-112 and USGS-113 are generally expected to follow the decreasing trends exhibited by the Percolation Ponds' effluent (measured at CPP-797), with the exception of lower concentrations due to mixing in the aquifer, and a time lag and dampening effect from the 137-m (450-ft) vadose zone. Significant decreasing trends in concentrations of these parameters were not evident in the groundwater. The trends in the compliance wells will continue to be evaluated as more data become available. Figures 2-7 and 2-8 show the chloride and total dissolved solids concentrations for the Percolation Ponds' effluent, USGS-112, and USGS-113.

Iron concentrations increased but were below the secondary constituent standard limits in all of the monitoring wells. As in previous years, USGS-112 exhibited the highest iron concentrations of the four monitoring wells. However, the iron concentrations in USGS-112 are not believed to be the result of Percolation Ponds operation because concentrations increased in wells both upgradient and downgradient of the Percolation Ponds over the past few years. In addition, the iron concentrations in the Percolation Ponds' effluent are well below those in USGS-112. Based on a 1999 study[40] of wells of similar ages at TAN, corrosion of the riser pipes is suspected to cause the increased iron concentrations.

Table 2-9. 2000 Groundwater Monitoring Program sampling locations for INEEL Wastewater Land Application Permit facilities.

| Permit | Monitoring Well | Well Description | Sampling Frequency | Analysis Parameters |
|---|---|---|---|---|
| INTEC Percolation Ponds Wastewater Land Application Permit | USGS-121 | Facility background aquifer well upgradient of INTEC | Semiannually in April and October | Total Kjeldahl nitrogen, chloride, total dissolved solids, sodium, nitrate-nitrogen, nitrite-nitrogen, arsenic, cadmium, chromium, mercury, selenium, silver, fluoride, iron, manganese, copper, aluminum, pH |
| | USGS-048 | Surveillance aquifer well upgradient of Percolation Ponds | | |
| | USGS-112 | Point of compliance aquifer well | | |
| | USGS-113 | Point of compliance aquifer well | | |
| INTEC Sewage Treatment Plant Wastewater Land Application Permit | USGS-121 | Facility background aquifer well upgradient of INTEC | Semiannually in April and October | Total Kjeldahl nitrogen, ammonium-nitrogen, nitrate-nitrogen, nitrite-nitrogen, biochemical oxygen demand, fecal coliform, total coliform, total phosphorous, chloride, total dissolved solids |
| | ICPP-MON-PW-024 | Surveillance perched water well adjacent to infiltration trenches | | |
| | USGS-052 | Point of compliance aquifer well | | |
| TAN/TSF Sewage Treatment Plant Wastewater Land Application Permit | TANT-MON-A-001 | Facility background aquifer well upgradient of TAN | Semiannually in April and October | Total Kjeldahl nitrogen, ammonium-nitrogen, nitrate-nitrogen, nitrite-nitrogen, biochemical oxygen demand, fecal coliform, total coliform, total phosphorous, chloride, total dissolved solids, arsenic, barium, chromium, fluoride, lead, iron, manganese, mercury, selenium, sodium, sulfate, zinc |
| | TANT-MON-A-002 | Point of compliance aquifer well | | |
| | TAN-10A | Point of compliance aquifer well | | |
| | TAN-13A | Point of compliance aquifer well | | |

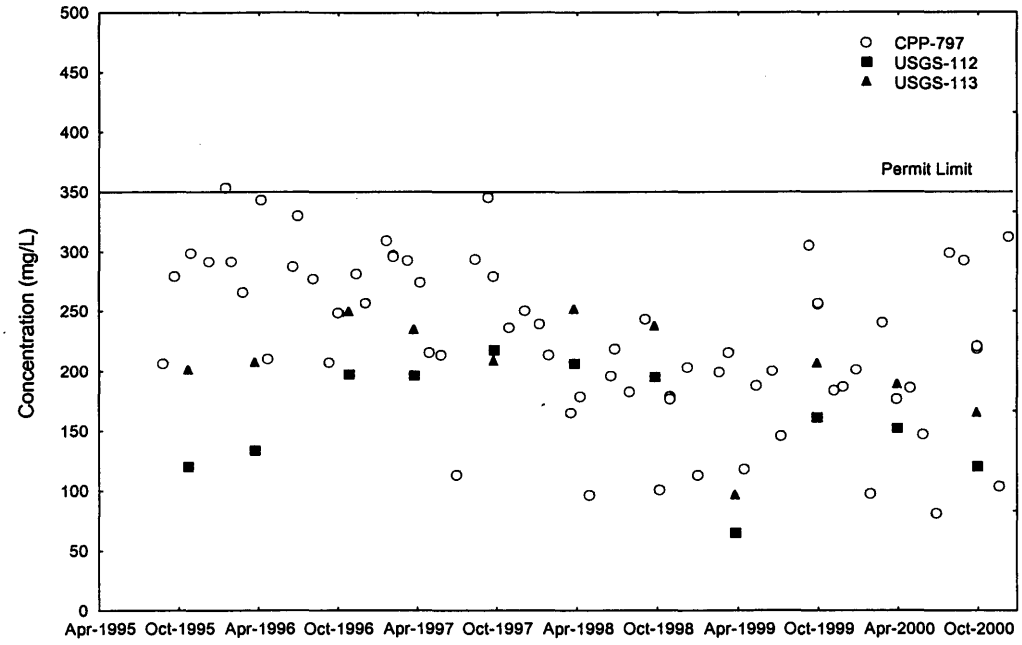



Figure 2-7. Chloride concentrations from Idaho Nuclear Technology and Engineering Center Percolation Ponds wells and effluent (CPP-797).

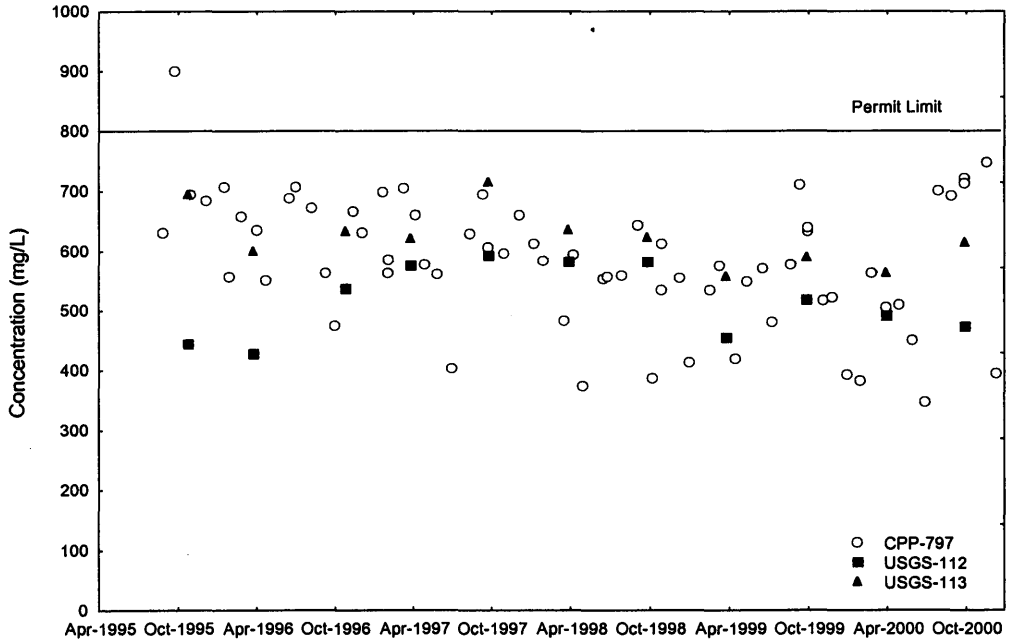



Figure 2-8. Total dissolved solids concentrations from Idaho Nuclear Technology and Engineering Center Percolation Ponds wells and effluent (CPP-797).

***2.4.2.2 Idaho Nuclear Technology and Engineering Center Sewage Treatment Plant Monitoring Wells.*** Groundwater samples were collected at the three monitoring wells specified by the INTEC Sewage Treatment Plant Wastewater Land Application Permit in April and October (see Figure A-8 for well locations). All groundwater samples collected from USGS-052 (representing the point of compliance) met permit limits during 2000. Similar to previous years, chloride, total dissolved solids, and nitrate concentrations were only slightly elevated in USGS-052 compared to the facility upgradient well, and concentrations were largely nondetectable for the remaining analytical parameters.

Results for ICPP-MON-PW-024, a perched water well completed approximately 21 m (70 ft) below the surface of the infiltration trenches, were largely unchanged from 1999. Unlike USGS-052, ICPP-MON-PW-024 is used as an indicator of soil treatment efficiency rather than as a point of compliance. Total dissolved solids and chloride in the perched water approximate that of the effluent, while total coliform concentrations are less than the effluent. Total nitrogen (the sum of total Kjeldahl nitrogen, nitrate as nitrogen, and nitrite as nitrogen) is also present in the perched water at reduced concentrations. This reduction (Figure 2-9) may be partly due to the increased trench rotation frequency that was implemented in March 1997. This increased trench rotation frequency will continue, and contaminant trends in the perched water and aquifer will be observed and tracked.

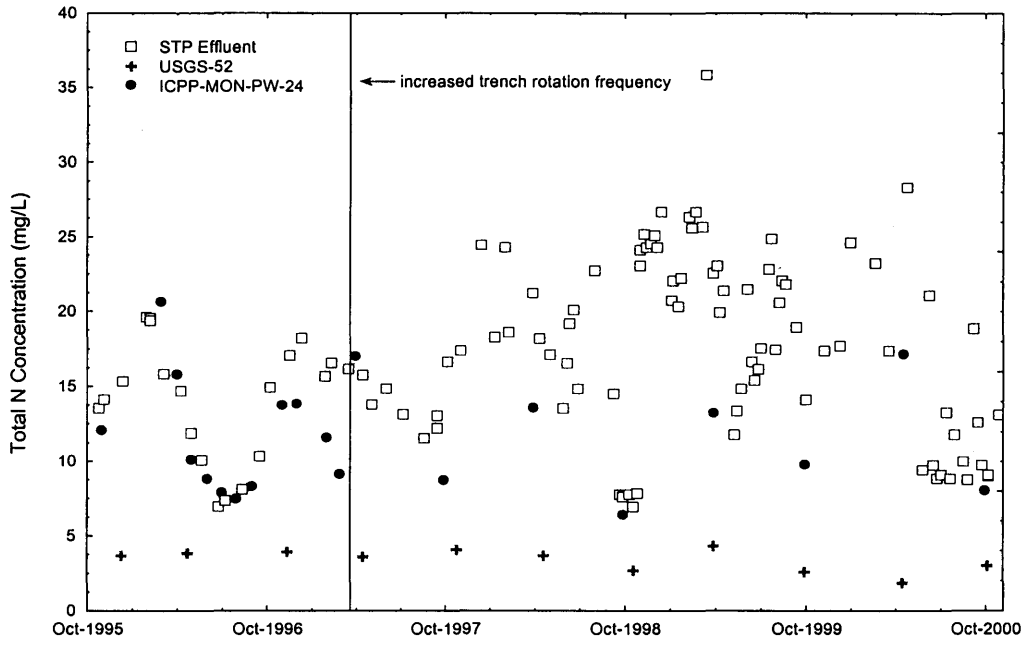



Figure 2-9. Total nitrogen concentrations in Sewage Treatment Plant effluent, ICPP-MON-PW-024, and USGS-052.

#### 2.4.2.3 *Test Area North/Technical Support Facility Sewage Treatment Plant Monitoring Wells.*

Groundwater samples were collected at the TAN Sewage Treatment Plant Wastewater Land Application Permit monitoring wells in April and October (see Figure A-15 for well locations). Total coliform was absent in the 2000 sampling except for the presence of *citrobacter* reported in upgradient well TANT-MON-A-001 for April 2000 (40 col/100 mL). This coliform bacteria is a relatively free-living bacteria found in natural water bodies and soils. This, coupled with its detection in a well upgradient of the Disposal Pond, indicates that the Disposal Pond is unrelated to the detection of coliform in the groundwater.

Total dissolved solids concentrations exceeded the permit limit (500 mg/L) in TAN-10A in October. Iron concentrations exceeded the permit limit (0.3 mg/L) in TAN-13A in April and October, in TANT-MON-A-002 in April, and in TAN-10A in October. Zinc and lead concentrations also exceeded the permit limit in TAN-13A in October. The elevated iron concentrations are believed to be the result of galvanic corrosion of the riser pipes. Zinc concentrations also increased in all four wells during the same period. Galvanic corrosion problems were confirmed during a corrosion evaluation[40] performed late in 1999 on several TAN monitoring wells of similar construction and age. Plans to mitigate the galvanic corrosion are underway.

Of the three monitoring wells used as points of compliance for the TAN Sewage Treatment Plant Wastewater Land Application Permit, TAN-10A had the highest contaminant concentrations compared to the upgradient background monitoring well. It is difficult to establish a strong relationship between the water quality in TAN-10A and the Disposal Pond. First, injectate from a former injection well (located close to TAN-10A and used for disposal of numerous waste streams) is still present in the groundwater and continues to substantially impact groundwater quality. Second, groundwater remediation now underway near the former injection well significantly influences local hydraulic gradients and contaminant concentrations.

### 2.4.3 Quality Assurance/Quality Control

The groundwater sampling activities associated with Wastewater Land Application Permit compliance sampling follow established procedures and analytical methodologies.

During 2000, 234 groundwater samples, which yielded 482 parameter results, were collected from the INTEC and TAN Wastewater Land Application Permit monitoring wells. In addition, 69 quality control samples were collected. One hundred percent of the samples required for permit compliance were collected (meeting project data completeness goals), and only two parameter results (less than 1% of the total) were rejected as unusable during data validation due to laboratory errors.

Quality assurance/quality control practices used by the Environmental Monitoring Program assess and enhance the reliability and validity of field and laboratory measurements conducted to support Environmental Monitoring Programs. Therefore, field quality control samples were collected or prepared during the sampling activity in addition to regular groundwater samples. All analyses were performed by certified laboratories. Because TAN and INTEC are regarded as separate sites, quality control samples (duplicate samples, field blanks, and equipment blanks) were prepared for each site. One duplicate groundwater sample was collected for every 20 samples collected or, at a minimum, 5% of the total number of samples collected. Duplicates were collected using the same sampling techniques and preservation requirements as regular groundwater samples. Field blanks were collected at the same frequency as the duplicate samples, and were prepared by pouring deionized water into the prepared bottles at the sampling site. Equipment blanks (rinsates) were collected from the sample port manifold after decontamination and before subsequent use, also using deionized water.

Duplicate samples are collected to assess the potential for any bias introduced by analytical laboratories. Duplicates have precision goals within 35%, as determined by the relative percent difference measured between the paired samples. For all duplicate analyses, 54 out of 57 total pairs (95%) had relative percent differences less than 35%. This high percentage of acceptable duplicate results indicates little problem with laboratory contamination and good overall precision. Of the three pairs that exceeded the 35% relative percent difference, all concentrations were below detection limits or less than five times the method detection limit. Quantification of the analyte becomes less certain at these levels.

Field blanks and equipment blanks are collected to assess the potential introduction of contaminants during sampling and decontamination activities. For most chemical constituents, results above two times the method detection limit are identified as suspected contamination. Results from the field blanks and rinsates did not indicate field contamination or improper decontamination procedures.

Results from the duplicate, field blank, and rinsate samples indicate that field sampling procedures, decontamination procedures, and laboratory procedures have been used effectively to produce high quality data.

# 3. ENVIRONMENTAL SURVEILLANCE PROGRAM

This section presents the Environmental Surveillance Program results at the INEEL. The Environmental Surveillance Program monitors air, surface water runoff, soil, biota, and direct radiation to comply with applicable DOE Orders and other requirements. Section 3.1 presents the air surveillance results, including the results from the wildfires in 2000 (Section 3.1.3), Section 3.2 presents the surface water runoff surveillance results, Section 3.3 presents the soil surveillance results, Section 3.4 presents the biota surveillance results, and Section 3.5 presents the direct radiation surveillance results.

The overall Environmental Surveillance Program is divided between two distinct programs: the Site Surveillance Program and the Waste Management Surveillance Program. The management and operating contractor conducts the Site Environmental Surveillance Program at INEEL facilities and selected off-Site locations. This surveillance is conducted in conjunction with the off-Site monitoring contractor (S. M. Stoller). The off-Site monitoring contractor and the management and operating contractor monitoring comprise the overall INEEL Environmental Surveillance Program.

The management and operating contractor also conducts environmental surveillance in and around waste management facilities (Radioactive Waste Management Complex [RWMC], Waste Experimental Reduction Facility [WERF] and Test Area North [TAN]) for compliance with DOE Order 435.1.[11] The basis for the Waste Management Surveillance Program differs from the Site Surveillance Program in that it is more facility- or source-specific.

The Environmental Surveillance Program section of this report is presented by media, with separate subsections for waste management surveillance and site surveillance. These activities are listed in Tables 3-1 and 3-2, respectively. Approximately 3,500 samples were collected and analyzed in 2000.

The Environmental Surveillance Program emphasizes measurement of airborne radionuclides because of the importance of the air transport pathway. Site surveillance data are used to monitor potential trends in radioactivity in the environment at the INEEL in order to assess possible impact on-Site and off-Site.

Soils are sampled to determine if long-term deposition of airborne materials released from the INEEL has resulted in a buildup of radionuclides in the environment. Food chain surveillance and off-Site air and soil measurements are conducted by the off-Site monitoring contractor. The off-Site contractor compiles the Annual Site Environmental Report,[41] which provides additional information and dose calculations.

The analytical results reported in the following surveillance sections are those that are greater than two times the analytical uncertainty. Analytical uncertainties reported in text and tables are the 2-sigma uncertainty for the radiological analyses.

Table 3-1. Summary of waste management surveillance activities.

| Facility | Media | Description | Frequency of Analyses | Type of Analyses |
|---|---|---|---|---|
| RWMC | | | | |
| Subsurface Disposal Area (SDA) | **Air** | | | |
| | • $PM_{10}$ | 8 air monitors operated at 0.113 $m^3$/min (includes 1 control and 1 replicate) | Semimonthly<br>Semimonthly<br>Monthly<br>Quarterly | Gross alpha<br>Gross beta<br>Gamma spectrometry<br>Radiochemistry[a] |
| | • Suspended particulate | 1 air monitor operated at 0.113 $m^3$/min | Semimonthly<br>Semimonthly<br>Monthly<br>Quarterly | Gross alpha<br>Gross beta<br>Gamma spectrometry<br>Radiochemistry[a] |
| | • Atmospheric moisture | 1 monitor at 110 cc/min | 4–13 weeks | Tritium |
| | **Surface Water** | One 4-L sample from Subsurface Disposal Area and control location | Quarterly, depending on precipitation | Gross alpha<br>Gross beta<br>Gamma spectrometry<br>Radiochemistry[a,b,c] |
| | **Direct Radiation** | | | |
| | • Surface gamma activity | GPRS[d] detector system | Semiannually | External radiation levels |
| | • Ionizing radiation | 4 TLD[e] packets and 7 background communities | Semiannually | External radiation levels |
| | **Soil** | 5 surface locations in each of 5 major areas (plus 2 control areas) | Triennially | Gamma spectrometry<br>Radiochemistry[a] |
| | **Vegetation** | 3 composites in each of 5 major areas (plus 2 control areas)[c] | Annually, species sampled varies each year as determined by availability | Gamma spectrometry<br>Radiochemistry[a] |
| | **Visual Inspection** | Tour Subsurface Disposal Area and Transuranic Storage Area | Monthly | Results reported for any required corrective action |
| Stored Waste Examination Pilot Plant (SWEPP) | **Air** | | | |
| | • $PM_{10}$ | 7 air monitors operated at 0.113 $m^3$/min (includes 1 control) | Semimonthly<br>Semimonthly<br>Monthly<br>Quarterly | Gross alpha<br>Gross beta<br>Gamma spectrometry<br>Radiochemistry[a] |
| | • Suspended particulate | 2 air monitors operated at 0.113 $m^3$/min | Semimonthly<br>Semimonthly<br>Monthly<br>Quarterly | Gross alpha<br>Gross beta<br>Gamma spectrometry<br>Radiochemistry[a] |
| | **Surface Water** | One 4-L sample from TSA-1, TSA-2, TSA-3, TSA-4, and control locations | Quarterly, depending on precipitation | Gross alpha<br>Gross beta<br>Gamma spectrometry<br>Radiochemistry[a] |
| | **Soil** | 9 locations sampled (plus 1 control area) | Triennially | Gamma spectrometry<br>Radiochemistry[a] |

Table 3-1. (continued).

| Facility | Media | Description | Frequency of Analyses | Type of Analyses |
|---|---|---|---|---|
| Waste Experimental Reduction Facility (WERF) | **Air** | | | |
| | • $PM_{10}$ | 4 air monitors operated at 0.113 $m^3$/min (includes 1 control) | Semimonthly<br>Semimonthly<br>Monthly | Gross alpha<br>Gross beta<br>Gamma spectrometry |
| | • Suspended particulate | 1 air monitor operated at 0.113 $m^3$/min | Semimonthly<br>Semimonthly<br>Monthly | Gross alpha<br>Gross beta<br>Gamma spectrometry |
| | • Ionizing radiation | 11 TLD packets and 7 background communities | Semiannually | External radiation levels |
| | **Soil** | | | |
| | • Surface soils | 15 surface locations | Triennially[f] | Gamma spectrometry |
| | • Seepage basins | 3 locations | Annually | Gamma spectrometry |
| | **Surface Water** | One 4-L sample from seepage basins | Quarterly, depending on precipitation | Gamma spectrometry |
| | **Vegetation** | 11 locations (includes 3 controls) | Triennially | Gamma spectrometry |
| Mixed Waste Storage Facility (MWSF) | **Air** | | | |
| | • $PM_{10}$ | 1 air monitor operated at 0.113 $m^3$/min | Semimonthly<br>Semimonthly<br>Monthly | Gross alpha<br>Gross beta<br>Gamma spectrometry |
| Test Area North (TAN) | **Air** | | | |
| | • Suspended particulate | 5 air monitors operated at 0.113 $m^3$/min | Semimonthly<br>Semimonthly<br>Monthly<br>Quarterly | Gross alpha<br>Gross beta<br>Gamma spectrometry<br>Radiochemistry |
| Organic Moderated Reactor Experiment (OMRE) | **Direct Radiation** | | | |
| | Surface gamma activity | GPRS detector system | Annually | External radiation levels |

a. Analysis for americium-241, plutonium-238, plutonium-239/240, uranium-234, uranium-235, uranium 238, and strontium-90.

b. Samples for radiochemical analyses usually collected during second quarter only.

c. Exact number of samples may vary due to availability.

d. GPRS—Global positioning radiometric scanner.

e. TLD—thermoluminescent dosimetry.

f. Sampling frequency may vary if air radioactivity levels increase.

Table 3-2. Summary of site surveillance activities.

| Sample Type | Analyses | Collection Frequency | Locations: Distant Communities | Locations: INEEL (On-Site) |
|---|---|---|---|---|
| **Air—low volume (particulate)** | Gross alpha | Weekly | Blackfoot, Craters of the Moon, Idaho Falls, Rexburg | ANL-W, ARA, CFA, EBR-I, TAN, TRA, RWMC, INTEC, EFS, Van Buren, PBF, NRF |
| | Gross beta | Weekly | Blackfoot, Craters of the Moon, Idaho Falls, Rexburg | ANL-W, ARA, CFA, EBR-I, TAN, TRA, RWMC, INTEC, EFS, Van Buren, PBF, NRF |
| | Gamma spectrometry | Quarterly | Blackfoot, Craters of the Moon, Idaho Falls, Rexburg | ANL-W, ARA, CFA, EBR-I, TAN, TRA, RWMC, INTEC, EFS, Van Buren, PBF, NRF |
| | Radiochemistry[a] | Quarterly | Blackfoot, Craters of the Moon, Idaho Falls, Rexburg | ANL-W, ARA, CFA, EBR-I, TAN, TRA, RWMC, INTEC, EFS, Van Buren, PBF, NRF |
| | Particulate | Quarterly | Blackfoot, Craters of the Moon, Idaho Falls, Rexburg | ANL-W, ARA, CFA, EBR-I, TAN, TRA, RWMC, INTEC, EFS, Van Buren, PBF, NRF |
| **Air—low volume (cartridge)** | I-131 (gamma screen) | Weekly | Blackfoot, Craters of the Moon, Idaho Falls, Rexburg | ANL-W, ARA, CFA, EBR-I, TAN, TRA, RWMC, INTEC, EFS, Van Buren, PBF, NRF |
| **Air—nitrogen oxide** | Nitrogen oxide | Continuously | NA[b] | EFS, Van Buren |
| **Air—sulfur dioxide** | Sulfur dioxide | Continuously | NA | Van Buren |
| **Air—moisture** | Tritium | 4 to 13 weeks | Craters of the Moon, Idaho Falls | EFS, Van Buren |
| **Soil** | Gamma spectrometry | Annually | NA | Each major facility[c] once every 7 years |
| | Radiochemistry | Annually | NA | Each major facility once every 7 years |
| **Direct radiation** | TLD[d] | Semiannually | Aberdeen, Arco, Atomic City, Blackfoot, Craters of the Moon, Howe, Idaho Falls, Minidoka, Monteview, Mud Lake, Reno Ranch, Rexburg, Roberts | ANL-W, ARA, CFA, EBR- I, TAN, TRA, RWMC, INTEC, EFS, Van Buren, PBF, NRF |
| | Surface surveys | Annually | NA | Each perimeter of the major facilities every 3 years |

a. Radiochemistry—americium-241, plutonium-238, plutonium-239/240, and strontium-90 are included.

b. NA—not applicable.

c. Major facilities include ANL-W, ARA, CFA, INTEC, NRF, PBF, RWMC, TAN, and TRA.

d. TLD—thermoluminescent dosimetry.

## 3.1 Air Surveillance

The Waste Management Surveillance Program collects particulate material on 102 mm (4-inch) membrane filters using two types of air monitors: particulate matter with a nominal size of 10 $\mu$m ($PM_{10}$) and total suspended particulate air monitors. While the $PM_{10}$ monitors are designed to only admit respirable particles with a 50% cutpoint of 10 microns in diameter, the suspended particulate air monitors admit larger particles. The $PM_{10}$ monitors the respirable size fraction of particulate materials, which is also the range of particle sizes that can be suspended in air for long periods and is therefore readily transported to off-Site locations by wind. Filters are collected and analyzed semimonthly for gross alpha and gross beta, and monthly composites of each location are analyzed quantitatively for gamma-emitting radionuclides. Filters from each sample location are also composited quarterly and are analyzed for specific alpha- and beta-emitting radionuclides. Appendix B presents the approach used for data analysis of these samples.

The Site Surveillance Program collects filters from a network of low-volume air monitors weekly. Air flows at an average of about 57 L/min (2 cfm) through a set of filters consisting of a 5-cm (2-inch) 1.2-$\mu$m pore membrane filter followed by a charcoal cartridge. These filters are analyzed weekly for gross alpha and gross beta and are composited quarterly by location. The composite samples are analyzed using gamma spectrometry and specific radiochemical methods for alpha- and beta-emitting radionuclides. In addition to the particulate filter samples, charcoal cartridges are collected and analyzed weekly using gamma spectrometry.

There is no requirement to monitor the dust burden at the INEEL, but it is monitored to provide comparison information to other monitoring programs and to the U.S. Department of Energy Idaho Operations Office. The suspended particulate dust burden is monitored with the same low-volume filters used to collect the radioactive particulate samples.

Nitrogen oxides are monitored at Van Buren Boulevard (VANB) and Experimental Field Station (EFS) following an Environmental Protection Agency-equivalent method to implement the *Ambient Nitrogen Dioxide Monitoring Plan for the INEL.*[42] This monitoring fulfills one of the conditions specified in the "Permit to Construct, Idaho Chemical Processing Plant Nitrogen Oxide Sources."[43]

Sulfur dioxide measurements are recorded to confirm that the INEEL does not release significant amounts of sulfur dioxide with respect to national ambient air quality standards. Sulfur dioxide is monitored at the VANB location.

Samplers for tritium in water vapor in the atmosphere are located at the EFS and VANB locations (Figure A-1). Air passes through a column of molecular sieve. The molecular sieve adsorbs water vapor in the air; columns are changed when the molecular sieve adsorbs sufficient moisture to obtain a sample. Tritium concentrations are then determined by liquid scintillation counting of the water extracted from the molecular sieve columns.

### 3.1.1 Data Summary and Assessment for Waste Management Surveillance

Gross alpha and gross beta data provide initial detection of significant changes in airborne radioactivity. The gross alpha and gross beta data are also used as a criteria to screen samples for immediate gamma and radiochemical analyses for specific radionuclide identification. Specific radionuclide concentrations are compared to applicable Derived Concentration Guides for the public (Appendix D).

Figures 3-1 and 3-2 summarize the 1999 and 2000 gross alpha and gross beta concentrations by facility and monitor type and illustrate short-term changes in concentrations. Tables 3-3 and 3-4 summarize corresponding 1999 and 2000 concentrations.

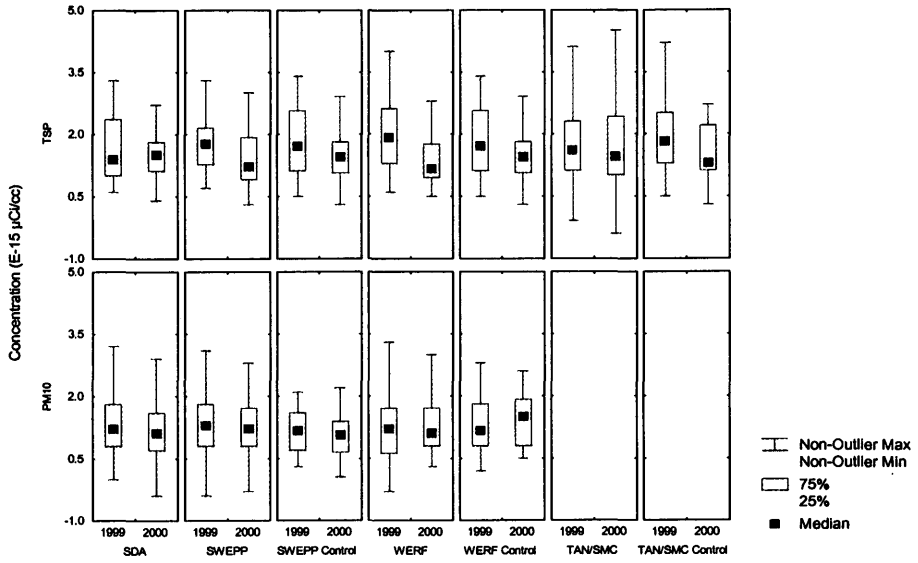



Figure 3-1. Gross alpha concentrations by year, facility, and monitor type.

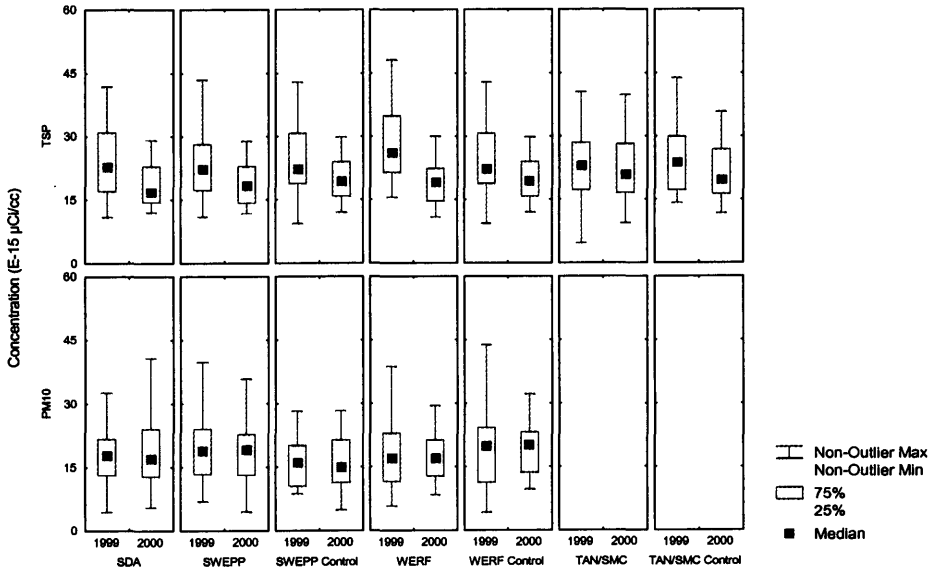



Figure 3-2. Gross beta concentrations by year, facility, and monitor type.

Table 3-3. Summary statistics for gross alpha concentrations (4-in. filters).

| Monitor Type | Facility | Year | Number of Samples | Mean (E-15 μCi/cc) | Median (E-15 μCi/cc) | Minimum (E-15 μCi/cc) | Maximum (E-15 μCi/cc) |
|---|---|---|---|---|---|---|---|
| Suspended particulate | Subsurface Disposal Area (SDA) | 1999 | 24 | 1.7 | 1.4 | 0.6 | 4.5 |
| | | 2000 | 24 | 1.5 | 1.5 | 0.4 | 3.1 |
| | SWEPP | 1999 | 48 | 1.8 | 1.8 | 0.7 | 4.1 |
| | | 2000 | 48 | 1.4 | 1.2 | 0.3 | 3.0 |
| | Control[a] | 1999 | 24 | 1.8 | 1.7 | 0.5 | 3.4 |
| | | 2000 | 24 | 1.5 | 1.5 | 0.3 | 3.0 |
| | WERF | 1999 | 23 | 2.0 | 1.9 | 0.6 | 4.0 |
| | | 2000 | 24 | 1.4 | 1.2 | 0.5 | 3.1 |
| | TAN/SMC | 1999 | 93 | 1.7 | 1.6 | -0.09 | 4.1 |
| | | 2000 | 88 | 1.7 | 1.5 | -0.4 | 4.5 |
| | Control[b] | 1999 | 24 | 2.0 | 1.8 | 0.5 | 4.2 |
| | | 2000 | 23 | 1.6 | 1.3 | 0.3 | 4.0 |
| $PM_{10}$ | SDA | 1999 | 129 | 1.4 | 1.2 | 0.0 | 4.4 |
| | | 2000 | 139 | 1.3 | 1.1 | -0.4 | 5.8 |
| | SWEPP | 1999 | 138 | 1.4 | 1.3 | -1.0 | 5.3 |
| | | 2000 | 138 | 1.4 | 1.2 | -1.2 | 7.1 |
| | Control[c] | 1999 | 24 | 1.1 | 1.2 | 0.3 | 2.1 |
| | | 2000 | 24 | 1.0 | 1.1 | 0.05 | 2.2 |
| | WERF | 1999 | 59 | 1.2 | 1.2 | -0.3 | 3.3 |
| | | 2000 | 65 | 1.3 | 1.1 | 0.3 | 3.6 |
| | Control[d] | 1999 | 20 | 1.4 | 1.2 | 0.2 | 2.8 |
| | | 2000 | 23 | 1.4 | 1.5 | 0.5 | 2.6 |

a. SDA/SWEPP/WERF.

b. TAN/SMC.

c. SDA/SWEPP.

d. WERF.

Table 3-4. Summary statistics for gross beta concentrations (4-in. filters).

| Monitor Type | Facility | Year | Number of Samples | Mean (E-15 µCi/cc) | Median (E-15 µCi/cc) | Minimum (E-15 µCi/cc) | Maximum (E-15 µCi/cc) |
|---|---|---|---|---|---|---|---|
| Suspended particulate | SDA | 1999 | 24 | 24.2 | 22.6 | 10.9 | 41.8 |
| | | 2000 | 24 | 20.1 | 16.6 | 11.9 | 47.7 |
| | SWEPP | 1999 | 48 | 23.6 | 22.2 | 10.9 | 43.4 |
| | | 2000 | 48 | 19.8 | 18.3 | 11.6 | 50.9 |
| | Control[a] | 1999 | 24 | 24.4 | 22.2 | 9.3 | 42.8 |
| | | 2000 | 24 | 21.0 | 19.2 | 11.9 | 43.7 |
| | WERF | 1999 | 23 | 27.6 | 26.0 | 15.5 | 48.1 |
| | | 2000 | 24 | 20.5 | 18.9 | 10.8 | 43.4 |
| | TAN/SMC | 1999 | 93 | 24.4 | 23.0 | 4.6 | 70.8 |
| | | 2000 | 88 | 23.6 | 20.9 | 9.3 | 57.6 |
| | Control[b] | 1999 | 24 | 26.3 | 23.8 | 14.1 | 75.1 |
| | | 2000 | 23 | 23.5 | 19.4 | 11.6 | 52.5 |
| $PM_{10}$ | SDA | 1999 | 129 | 18.5 | 17.8 | 4.3 | 44.1 |
| | | 2000 | 139 | 19.4 | 16.9 | 5.4 | 47.9 |
| | SWEPP | 1999 | 138 | 20.1 | 18.6 | 6.9 | 61.7 |
| | | 2000 | 138 | 21.1 | 18.9 | 4.4 | 87.7 |
| | Control[c] | 1999 | 24 | 16.5 | 15.9 | 8.7 | 37.0 |
| | | 2000 | 24 | 17.6 | 14.9 | 4.8 | 43.2 |
| | WERF | 1999 | 59 | 17.7 | 16.9 | 5.7 | 38.6 |
| | | 2000 | 65 | 19.1 | 16.8 | 8.3 | 44.8 |
| | Control[d] | 1999 | 20 | 19.2 | 19.8 | 4.2 | 43.7 |
| | | 2000 | 23 | 20.0 | 20.1 | 9.6 | 46.3 |

a. SDA/SWEPP/WERF.

b. TAN/SMC.

c. SDA/SWEPP.

d. WERF.

During 2000, as with past gross alpha concentrations, the facility groupings varied very little (Figure 3-1). From 1999 to 2000, for the suspended particulate monitors, the median concentrations decreased slightly for all facility grouping, except the SDA, where the median concentration slightly increased. For the $PM_{10}$ monitors, the median concentrations decreased for all groupings, except for the WERF control group, which slightly increased. To test for statistical significance of the variations in medians of gross alpha concentrations from 1999 to 2000, the Kruskal-Wallis significance test was performed on data from each facility grouping. The changes in median concentrations from 1999 to 2000 for the gross alpha $PM_{10}$ monitors at SWEPP and WERF were statistically significant at the 0.05 level. For the remaining facility/monitor type groupings, the changes in gross alpha median concentrations from 1999 and 2000 were not significant.

Variability among facility groupings during 2000 for median gross beta concentrations is graphically presented in Figure 3-2. Median gross beta concentrations from suspended particulate

monitors for all facility groupings decreased from 1999 to 2000. Median gross beta concentrations from $PM_{10}$ monitors decreased for all groupings, except for SWEPP and the WERF control location, which slightly increased. For suspended particulate monitors, these changes were significant at the 0.05 level for SWEPP and WERF, while for $PM_{10}$ monitors, none of the changes were significant.

Quarterly averages of RWMC and WERF gross beta concentrations (cesium-137 equivalent) since 1990 are shown in Figures 3-3 and 3-4, respectively, which show a continued seasonal trend.

Cesium-137 and cobalt-60 were the only manmade, gamma emitting radionuclides detected in 2000. Cesium-137 was detected in two samples collected in July at EBR-I and the Main Gate (both are control locations). The maximum concentration was 7.0 ± 2.0 E-16 microcuries per cubic centimeter (μCi/cc), which is near the stated detection limit and represent 0.0002% of the Derived Concentration Guide. Cobalt-60 was detected in three samples (monitors SDA 2 and SDA 4.2) at the northeast corner of the SDA. The maximum concentration was 19.0 ± 2.0 E-16 μCi/cc, which is 0.0007% of the Derived Concentration Guide.

No manmade alpha and beta-emitting radionuclides were above the laboratory-stated detection limits for 2000.

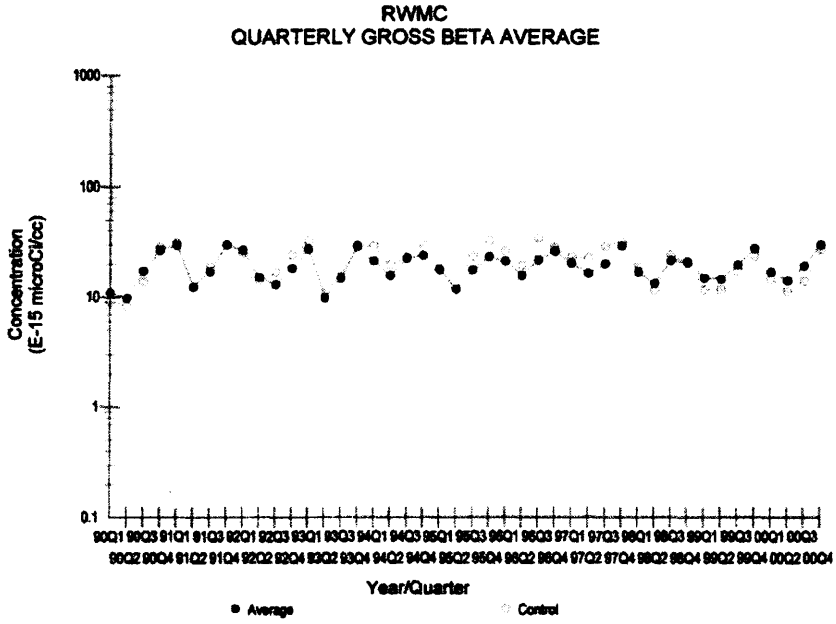



Figure 3-3. Quarterly average of gross beta air concentrations (cesium-137 equivalent) measured at Radioactive Waste Management Complex for the past 10 years.

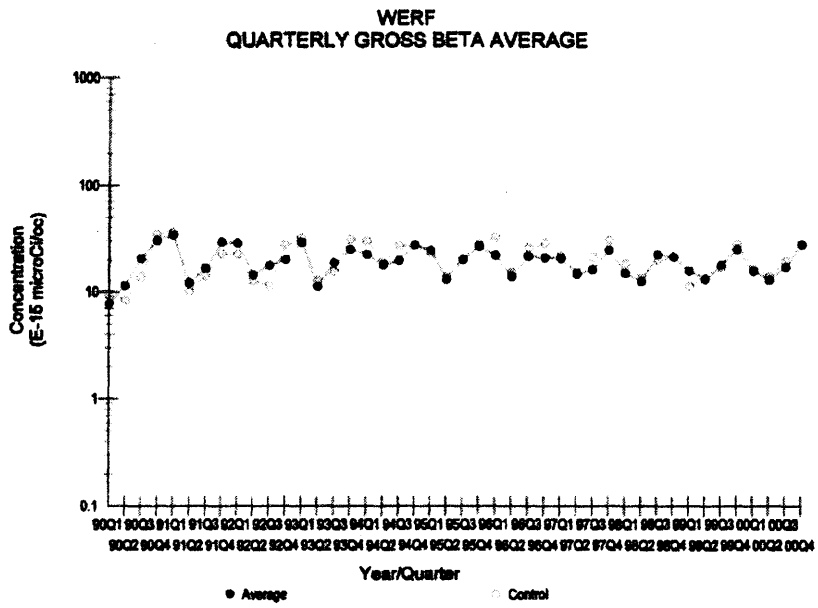



Figure 3-4. Quarterly average of gross beta air concentrations (cesium-137 equivalent) measured at Waste Experimental Reduction Facility for the past 10 years.

### 3.1.2 Data Summary and Assessment for Site Surveillance

Table 3-5 presents the maximum gross alpha concentration for each location. During 2000, most maximum concentrations occurred during the third quarter as a result of natural activity being released and concentrated due to fires in the area. Gross alpha concentrations for the remaining quarters were, in general, typical of those measured previously. The mean gross alpha concentrations are shown in Table 3-6 and also reflect a slight increase in the third quarter.

The highest mean concentrations of gross beta were detected in the third quarter of 2000 (Table 3-7). The maximum quarterly average gross beta concentration was 48 E-15 $\mu$Ci/cc at the Argonne National Laboratory-West (ANL-W) and represents 0.5% of the Derived Concentration Guide for strontium-90 (most restrictive).

Cesium-137 and cobalt-60 were the only gamma-emitting radionuclides detected in the quarterly composite of 5-cm (2-in.) low-volume filter samples during 2000. These samples were collected from Test Reactor Area (TRA) in the third quarter. The concentrations were $0.44 \pm 0.1$ E-15 $\mu$Ci/cc and $0.86 \pm 0.11$ E-15 $\mu$Ci/cc respectively. Cobalt-60 is a radionuclide that has been commonly detected around TRA in surface soils. Cobalt-60 detections at TRA are more likely from the resuspension of these soils. No iodine-131 was detected in 2000.

Plutonium-239/240 was also detected by radiochemical analysis at the Rest Area, TRA, and TRA Location B (Table 3-8). The maximum Pu-239/240 concentration was at the TRA Location B during the third quarter and was $0.02 \pm 0.008$ E-15 $\mu$Ci/cc, which represents 0.1% of the Derived Concentration Guide. Strontium-90 was also detected at the Rest Area. The concentration was $0.11 \pm 0.04$ E-15 $\mu$Ci/cc and represents 0.001% of the Derived Concentration Guide. The Rest Area location was added in

August 2000 to better monitor the burned area (Section 3.1.3 discusses the fire). At these locations, the particulate loading was extremely high because high winds resuspended soil after the areas were burned.

The 2000 annual mean suspended particulate concentrations are shown in Table 3-9, and the 2000 maximum quarterly suspended particulate concentrations are shown in Figure 3-5. Higher suspended particulate concentrations were found at the locations near the burned areas, in particular the Rest Area and TRA. The largest source of airborne particulates on the INEEL in 2000 was resuspended dust from wildfire-burned areas.

No tritium concentrations were above the laboratory-stated detection limits.

Ambient nitrogen dioxide concentrations were obtained continuously at the stations at the intersection of Van Buren Boulevard and U.S. Highway 20/26 and the EFS (Figure A-1). The New Waste Calcining Facility at INTEC, the largest single source of nitrogen dioxide on the INEEL, operated from March 7 to June 29, 2000. The mean nitrogen dioxide concentrations for 2000 at VANB and EFS were 2.2 $\mu g/m^3$ (1.2 parts per billion [ppb]) and 7.6 $\mu g/m^3$ (4.1 ppb), respectively. These were significantly lower than the Environmental Protection Agency national primary ambient air quality standard of 100 $\mu g/m^3$ (53 ppb).

Ambient sulfur dioxide was continuously monitored at VANB during 2000 (Figure A-1). The mean sulfur dioxide concentration was 0.3 $\mu g/m^3$ (0.13 ppb), or 0.4% of the annual primary air quality standard. The maximum daily concentration of 13.3 $\mu g/m^3$ (1.5 ppb) was 3.7% of the primary standard for a 24-hour period. The maximum recorded three-hour average of 7.5 $\mu g/m^3$ (2.8 ppb) was 0.6% of the secondary standard.

Table 3-5. Maximum gross alpha concentrations for 2000 per location.

| Location | Date | Maximum Concentration[a] (E-15 $\mu$Ci/cc) |
|---|---|---|
| ANL-W | 08/30 | 10.0 ± 1.2 |
| ARA | 08/02 | 3.7 ± 1.3 |
| CFA | 08/02 | 7.1 ± 1.9 |
| EBR-I | 08/02 | 3.4 ± 1.5 |
| EFS | 07/26–07/31[c] | 12.0 ± 3.0 |
| INTEC | 08/02 | 8.0 ± 5.0 |
| NRF | 08/23 | 4.6 ± 1.4 |
| PBF | 08/02 | 5.5 ± 1.4 |
| Rest Area[b] | 10/04 | 3.6 ± 1.6 |
| RWMC | 07/26–07/31[c] | 3.5 ± 1.2 |
| TAN | 08/09 | 2.6 ± 0.8 |
| TRA | 07/26–07/31[c] | 5.0 ± 3.0 |
| VANB | 07/26–07/31[c] | 10.0 ± 4.0 |
| Off-Site | 03/29 | 5.2 ± 1.6 |

a. Uncertainties shown are the associated 2 sigma.

b. Rest Area (new monitor) in place beginning 8/23.

c. Wildfires 7/26 to 7/29.

Table 3-6. Mean gross alpha concentrations for 2000 per location.

| Location | 1st Quarter Concentration (E-15 µCi/cc) | 2nd Quarter Concentration (E-15 µCi/cc) | 3rd Quarter Concentration (E-15 µCi/cc) | 4th Quarter Concentration (E-15 µCi/cc) | Annual Mean Concentration (E-15 µCi/cc) | % of DCG[a] |
|---|---|---|---|---|---|---|
| ANL-W | 0.26 | 0.7 | 1.9 | 0.4 | 0.8 | 3.9 |
| ARA | -0.2 | 0.8 | 1.0 | 0.5 | 0.5 | 2.5 |
| CFA | 0.4 | 0.3 | 2.1 | 1.4 | 1.1 | 5.5 |
| EBR-I | -0.06 | 0.7 | 1.3 | 0.5 | 0.6 | 3.0 |
| EFS | 0.7 | 0.5 | 2.4 | 0.5 | 1.0 | 5.1 |
| INTEC | -0.2 | -0.4 | 1.7 | 0.1 | 0.3 | 1.5 |
| NRF | -0.3 | 0.8 | 1.7 | 0.7 | 0.7 | 3.6 |
| PBF | 0.5 | 0.7 | 2.0 | 0.3 | 0.9 | 4.5 |
| Rest Area | —[b] | —[b] | 1.4 | 1.1 | 1.3 | 6.5 |
| RWMC | -0.06 | 0.6 | 0.9 | 0.8 | 0.6 | 3.0 |
| TAN | 0.6 | 0.8 | 1.1 | 0.3 | 0.7 | 3.5 |
| TRA | -0.09 | 0.6 | 1.9 | 1.5 | 1.0 | 5.0 |
| VANB | 0.03 | 0.7 | 1.8 | 0.8 | 0.8 | 4.0 |
| Off-Site | 0.6 | 1.1 | 1.5 | 1.0 | 1.0 | 5.0 |

a. DCG—Derived Concentration Guide.

b. Rest Area (new monitor) in place beginning 8/23/00.

Table 3-7. Mean gross beta concentrations for 2000 per location.

| Location | 1st Quarter Concentration (E-15 μCi/cc) | 2nd Quarter Concentration (E-15 μCi/cc) | 3rd Quarter Concentration (E-15 μCi/cc) | 4th Quarter Concentration (E-15 μCi/cc) | Annual Mean Concentration (E-15 μCi/cc) | % of DCG[a] |
|---|---|---|---|---|---|---|
| ANL-W | 20 | 19 | 48 | 30 | 29 | 0.3 |
| ARA | 18 | 19 | 26 | 31 | 24 | 0.3 |
| CFA | 25 | 19 | 28 | 34 | 27 | 0.3 |
| INTEC | 22 | 18 | 28 | 26 | 24 | 0.3 |
| EBR-I | 21 | 18 | 25 | 32 | 24 | 0.3 |
| EFS | 26 | 21 | 30 | 33 | 28 | 0.3 |
| NRF | 23 | 19 | 29 | 33 | 26 | 0.3 |
| PBF | 17 | 18 | 23 | 30 | 22 | 0.2 |
| Rest Area | —[b] | —[b] | 31 | 27 | 29 | 0.3 |
| RWMC | 16 | 15 | 21 | 24 | 19 | 0.2 |
| TAN | 19 | 17 | 23 | 31 | 23 | 0.3 |
| TRA | 21 | 19 | 29 | 36 | 26 | 0.3 |
| VANB | 22 | 18 | 30 | 33 | 26 | 0.3 |
| Off-Site | 20 | 20 | 26 | 32 | 24 | 0.3 |

a. DCG—Derived Concentration Guide.

b. Rest Area (new monitor) in place beginning 8/23/00.

Table 3-8. Site surveillance radiochemistry detections for air.

| Location | Quarter | Analyses Type | Concentration (E-15 μCi/cc)[a] | % of DCG[b] |
|---|---|---|---|---|
| Rest Area | 3rd | Pu-239/240 | 0.01 ± 0.008 | 0.06 |
| TRA | 3rd | Pu-239/240 | 0.01 ± 0.006 | 0.07 |
| TRA Location B | 3rd | Pu-239/240 | 0.02 ± 0.008 | 0.1 |
| Rest Area | 4th | Sr-90 | 0.11 ± 0.04 | 0.001 |

a. Uncertainties shown are the associated 2 sigma.

b. DCG—Derived Concentration Guide.

Table 3-9. 2000 annual mean suspended particulate concentrations.

| Location | Annual Mean Concentration ($\mu g/m^3$) | Number of Samples |
|---|---|---|
| ANL-W | 16 | 51 |
| ARA | 11 | 50 |
| CFA | 10 | 50 |
| EBR-I | 15 | 50 |
| EFS | 21 | 50 |
| INTEC | 17 | 51 |
| NRF | 27 | 48 |
| PBF | 16 | 51 |
| RWMC | 14 | 51 |
| TAN | 15 | 51 |
| TRA | 42 | 50 |
| VANB | 18 | 51 |
| Blackfoot | 23 | 49 |
| Craters of the Moon | 12 | 51 |
| Idaho Falls | 26 | 48 |
| Rexburg | 32 | 51 |
| Rest Area | 88 | 17 |

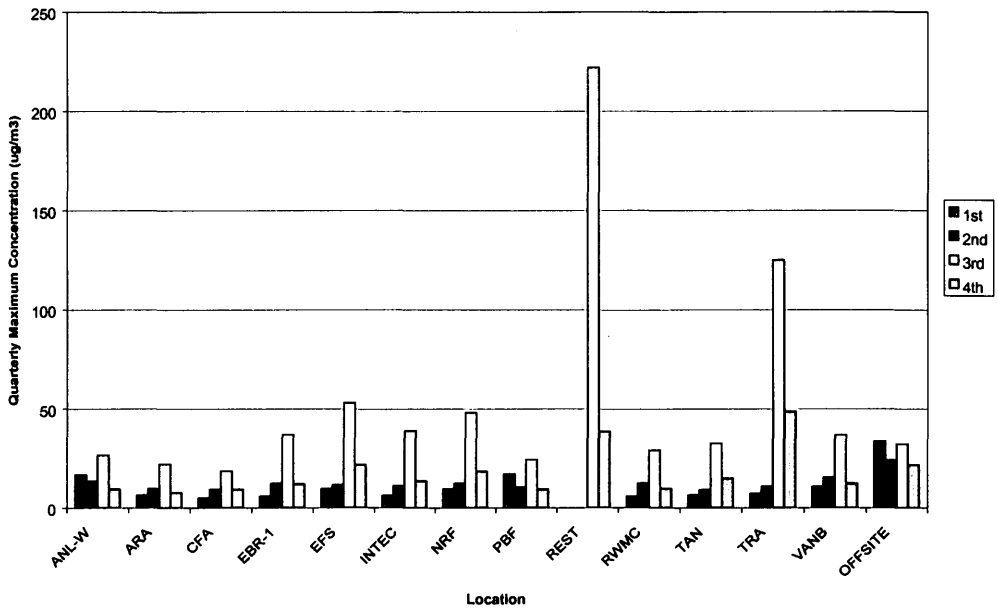



Figure 3-5. 2000 maximum quarterly suspended particulate concentrations.

### 3.1.3 Special Study

In 2000, wildfires burned 36,000 acres at the INEEL (Figure 3-6). To assess the impact of the fires, air filters were collected and analyzed from six of the monitors before the scheduled routine collection. These monitors were selected based on proximity to the fires and wind direction. The six monitors were at: TRA, RWMC, INTEC, EFS, Van Buren, and NRF.

Natural radioactivity in soil and vegetation increased radioactivity in airborne dust during and following the wildfires. Screening analyses for gross alpha and gross beta radioactivity concentrations in air particulate filters collected the week of the fires were slightly elevated compared to filters collected the preceding weeks and compared to the same period in 1999.

Measurable increases of gross alpha and gross beta concentrations are expected during and following wildfires due to increased particulate matter in the air (Table 3-9). The natural radioactivity in the soil and vegetation is redistributed by the fire and winds. Gross alpha and gross beta concentrations also slightly increased during the summers of 1994 and 1996, when other large fires burned on or near the INEEL. Similar increases occur in communities where wood burning stoves are used for home heating. Changing meteorological conditions often cause daily and seasonal fluctuations in airborne radioactive concentrations.

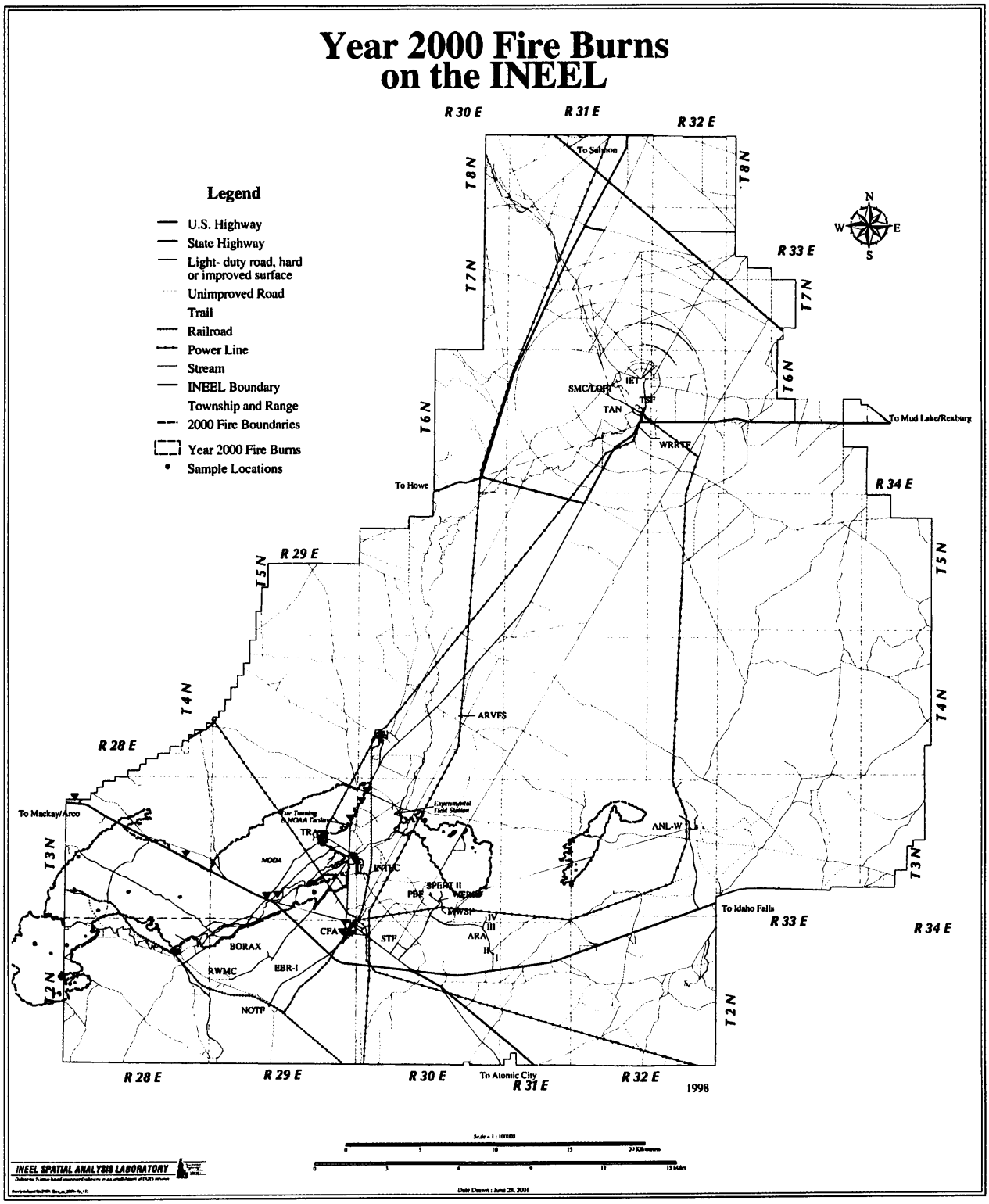



Figure 3-6. Year 2000 fire burns on the INEEL.

During 2000, the maximum gross alpha and gross beta concentrations occurred during the wildfires in July 2000. The maximum gross alpha concentration was 12.0 ± 3.0 E-15 μCi/cc at EFS (Table 3-10). The maximum gross beta concentration was 58.0 ± 9.0 E-15 μCi/cc at INTEC (Table 3-10). These on-Site concentrations were not significantly different from off-Site concentrations during the fires. The highest off-Site gross alpha concentration was 8.0 ± 2.0 E-15 μCi/cc, and the highest off-Site gross beta was 67.0 ± 2.0 E-15 μCi/cc. These concentrations occured at Blackfoot where there was also a fire close to the monitor. All the concentrations were well below radiation protection guidelines and represent no threat to human health.

All air filters collected during the wildfires were analyzed for specific gamma-emitting and alpha-emitting radionuclides. No manmade radionuclides were detected on these filters. Table 3-10 presents the analysis results for the six filters collected during the fires.

Table 3-10. Air monitoring concentrations during July 2000 widlfires.

| | Sampling Period | | | | | | |
|---|---|---|---|---|---|---|---|
| Location[a] | Start | Stop | Gross Alpha (E-15 μCi/cc ) | Gross Beta (E-15 μCi/cc ) | Specific Gamma | Specific Alpha | Sr-90 |
| TRA | 07/26 | 07/31 | 5.0 ± 3.0 | 37 ± 6 | ND[b] | ND | ND |
| RWMC | 07/26 | 07/31 | 3.5 ± 1.2 | 33 ± 3 | ND | ND | ND |
| INTEC | 07/26 | 07/31 | 8.0 ± 5.0 | 58 ± 9 | ND | ND | ND |
| EFS | 07/26 | 07/31 | 12.0 ± 3.0 | 45 ± 6 | ND | ND | ND |
| Van Buren | 07/26 | 07/31 | 10.0 ± 4.0 | 54 ± 7 | ND | ND | ND |
| NRF | 07/26 | 07/31 | 1.3 ± 1.4 | 41 ± 4 | ND | ND | ND |

a. Samples selected for early analysis.

b. ND = Nondetect. No samples were greater than 2 sigma.

## 3.2 Surface Water Runoff

Surface water runoff is collected at waste management facilities (RWMC and WERF) (see Appendix A) to determine if radionuclide concentrations exceed alert levels or if concentrations have increased significantly compared to historical data.

Radionuclides could be transported outside the RWMC boundaries via surface water runoff. Surface water runs off at the Subsurface Disposal Area only during periods of rapid snow melt or heavy precipitation. At these times, water may be pumped out of the Subsurface Disposal Area into a drainage canal. Water also runs off the asphalt pads around the Transuranic Storage Area and into drainage culverts and the drainage canal, which direct the flow outside the RWMC. The canal also carries outside runoff that has been diverted around the RWMC. Ponding of the runoff in a few low areas may increase subsurface saturation, which would increase subsurface migration of radionuclides.

Since in 1994, quarterly surface water runoff samples have been collected at the WERF seepage basins to determine if stored waste has released contamination. Two control locations 2.0 km (1.24 mi) north of the RWMC are sampled. The control location for the Transuranic Storage Area and WERF is on the west side of the rest rooms at the Lost River Rest Area, and the control location for the Subsurface Disposal Area is 1.5 km (0.93 mi) west on U.S. Highway 20 from the Van Buren Boulevard intersection and 10 m (33 ft) north on the T-12 access road (see Figures A-12 and -18).

### 3.2.1 Data Summary and Assessment for Waste Management Surveillance

Surface water runoff samples were collected during all quarters of 2000 at the RWMC. Cobalt-60 and cesium-137 were the only manmade, gamma-emitting radionuclides detected at RWMC. The maximum cobalt-60 concentration was 3.7 ± 1.0 E-09 μCi/mL and was collected during the second quarter at the control location. This concentration represents 0.01% of the Derived Concentration Guide for releases of cobalt-60 to the public. The maximum cesium-137 concentration was 3.8 ± 0.6 E-07 μCi/mL and was collected during the second quarter at the TSA-2 location. This concentration represents 0.12% of the Derived Concentration Guide and is comparable to historical concentrations.

Second-quarter samples were analyzed for alpha- and beta-emitting radionuclides. Americium-241 and plutonium-239/240 were detected in one sample collected from the TSA-2 sample location. The americium-241 concentration was 3.22 ± 1.22 E-11 μCi/mL. This concentration represents 0.11% of the Derived Concentration Guide. The plutonium-239/240 concentration was 2.27 ± 0.63 E-11 μCi/mL. This concentration represents 0.07% of the appropriate Derived Concentration Guide. These concentrations are consistent with samples collected from waters with higher volumes of suspended particulates.

Samples were collected from the WERF seepage basins during all quarters of 2000. Cesium-137 was detected in one sample collected during the first quarter at the WERF south basin. The concentration was 9.0 ± 3 E-10 μCi/mL. This concentration represents 0.12% of the Derived Concentration Guide and is comparable to historical concentrations.

## 3.3 Soil Surveillance

During 2000, soil was sampled at both waste management facilities (RWMC) and site surveillance locations (Argonne National Laboratory-West [ANL-W]) (see Appendix A). The samples were analyzed by gamma spectrometry. Selected samples were submitted for radiochemistry analysis.

### 3.3.1 Data Summary and Assessment for Waste Management Surveillance

**3.3.1.1** ***Radioactive Waste Management Complex.*** During 2000, 24 soil samples were collected from the RWMC and analyzed by gamma spectroscopy. The maximum cesium-137 concentration was 1.19 ± 0.10 E+00 pCi/g (19.8% of the Environmental Concentration Guide), and was collected at the RWMC control location. Eleven RWMC soil samples were submitted for radiochemistry analyses. Americium-241, plutonium-239/240, and strontium-90 were detected in all samples. The maximum americium-241 detection was 1.54 ± 0.12 E+00 pCi/g and represents 3.85% of the Environmental Concentration Guide. The maximum plutonium-239/240 concentration was 1.22 ± 0.12 E+00 pCi/g and represents 1.53% of the Environmental Concentration Guide. The maximum strontium-90 concentration was 3.08 ± 0.29 E-01 pCi/g and represents 5.13% of the Environmental Concentration Guide. These concentrations were above background for the INEEL but are consistent with historical concentrations at RWMC.

### 3.3.2 Data Summary and Assessment for Site Surveillance

**3.3.2.1** ***Argonne National Laboratory-West.*** During 2000, 13 soil samples were collected from outside the ANL-W and analyzed by gamma spectroscopy. Cesium-137 was the only manmade gamma radionuclide detected. The maximum cesium-137 concentration was 1.20 ± 0.06 E+00 pCi/g (20% of Environmental Concentration Guide), which was collected at location EBR II-11.

Thirteen ANL-W soil samples were submitted for radiochemistry analyses. Americium-241, plutonium-239/240, and strontium-90 were detected in all samples. The maximum americium-241 concentration was 8.41 ± 1.93 E-03 pCi/g and represents 0.02% of the Environmental Concentration Guide. The maximum plutonium-239/240 concentration was 2.75 ± 0.51 E-02 pCi/g and represents 0.03% of the Environmental Concentration Guide. The americium-241 and plutonium-239/240 concentrations were all within the background range for the INEEL and surrounding areas and are attributable to past fallout. The maximum strontium-90 concentration was 3.69 ± 0.32 E-01 pCi/g and represents 6.15% of the Environmental Concentration Guide. The strontium-90 concentrations were above background for the INEEL, but are consistent with historical concentrations at ANL-W.

## 3.4 Biotic Surveillance

Plant uptake of radionuclides at the RWMC has been documented by the Radiological and Environmental Sciences Laboratory.[44] Therefore, biotic surveillance is conducted at waste management facilities (RWMC and WERF).

At the RWMC, vegetation is collected from the five major areas. Crested wheatgrass is collected in odd-numbered years and is clipped at ground level within a 0.9 × 0.9-m (3 × 3-ft) frame. Russian thistle is collected in even-numbered years, and the entire plant is pulled up within a 0.9 × 0.9-m (3 × 3-ft) frame. Either rabbitbrush or sagebrush is collected in odd-numbered years by clipping 20% of the branches from the designated plants. Thus, the same plant can be sampled biennially. Soil excavated by small burrowing mammals is collected in even-numbered years. Vegetation sample collection from WERF began in 1984 and is scheduled every 3 years.

### 3.4.1 Data Summary and Assessment for Waste Management Surveillance

**3.4.1.1** Russian thistle was scheduled to be collected during 2000. However, due to increased operational activity and the disturbance of the ground cover in and around the RWMC, representative samples could not be obtained; thus, no Russian thistle samples were collected during 2000.

Samples of soil excavated by burrowing animals was scheduled to be collected during 2000 at the RWMC. No samples were collected due to lack of small mammal burrows. Perennials and crested wheatgrass are scheduled to be collected during 2001.

Vegetation collection at WERF is performed every 3 years. The next vegetation (sagebrush) samples are scheduled to be collected during 2002.

## 3.5 Direct Radiation

Thermoluminescent dosimeters (TLDs) measure cumulative exposures to ambient ionizing radiation for both waste management surveillance and site surveillance (see Appendix A for locations). The TLDs detect changes in ambient exposures attributed to handling, processing, transporting, or disposing radioactive waste. The TLDs are sensitive to beta energies greater than 200 kilo-electron-volts

(KeV) and to gamma energies greater than 10 KeV. The TLD packets contain five lithium fluoride chips and are placed about 0.9 m (3 ft) above the ground at specified locations. The five chips provide replicate measurements at each location. The TLD packets are replaced in May and November of each year. The sampling periods for 2000 were from November 1999 through May 2000 (spring) and from May through November 2000 (fall).

Background exposures result from direct radiation from:

- Natural terrestrial sources (rocks and soil)
- Cosmic radiation
- Fallout from testing nuclear weapons
- Local industrial processes.

The background exposures used in this report are exposure averages measured by TLDs in distant communities located outside the INEEL boundary.

In addition to TLDs, the Environmental Surveillance Program uses a global positioning radiometric scanner system to conduct gamma-radiation surveys. The global positioning radiometric scanner is mounted on a four-wheel drive vehicle; two plastic scintillation detectors identify contaminated areas, and both global positioning system and radiometric data are recorded. The vehicle is driven at approximately 8 kilometers per hour (5 mph) to collect survey data.

### 3.5.1 Data Summary and Assessment for Waste Management Surveillance

**3.5.1.1 *Thermoluminescent Dosimeters.*** Thermoluminescent dosimeter cumulative 6-month area exposure data for 1989 through 2000 from RWMC (Subsurface Disposal Area and Transuranic Storage Area) and WERF are presented in Figure 3-7. (Data from the distant communities are excluded from the trend chart.) To indicate the general trend in values over time, data in the graph were smoothed using negative exponential smoothing. The data are plotted on a logarithmic scale to more clearly illustrate the trends. Although some values have cycled, the graph illustrates a gradual declining trend in penetrating radiation exposures over time.

Table 3-11 summarizes TLD exposures for 1999 and 2000 by facility. Figure 3-8 provides box and whisker plots of the TLD exposure by facility (including the distant communities) for both 1999 and 2000. The 1999 TLD exposures are included to illustrate short-term changes in levels.

When comparing the median 2000 exposures to 1999, all groupings increased (WERF, Subsurface Disposal Area, Transuranic Storage Area, and the distant communities). The differences in median exposures for all of the groupings, except for WERF, were statistically significant (at the 0.05 level), using the Kruskal-Wallis test for differences in medians.

Table 3-12 presents thermoluminescent dosimeter exposures for 1999 and 2000 by season. Figure 3-9 presents the thermoluminescent dosimeter exposures (including all facilities and the distant communities) for 1999 and 2000 by season. (The 1999 data are provided for comparison purposes.) From 1999 to 2000, both the overall spring and fall median exposures increased. For 2000, the overall median exposures for the spring (ending May 2000) was 76 mR, while for the fall (ending November 2000) was 71 mR. The Kruskal-Wallis test for differences in medians indicated that the difference in the spring and fall exposures during 2000 was statistically significant (at the 0.05 level).

Figure 3-10 shows the exposures at Stations 40 and 41 (located along the east and northeast borders of the Transuranic Storage Area). Station 41 exposures are expected to remain elevated due to the increased waste stored in the Type II storage buildings.

Station 8 is located 50 m (164 ft) northwest of WERF, which is near a temporary waste storage area. Exposures at Station 8 have changed over the past few years due to periodic movement of waste and are shown in Figure 3-11.

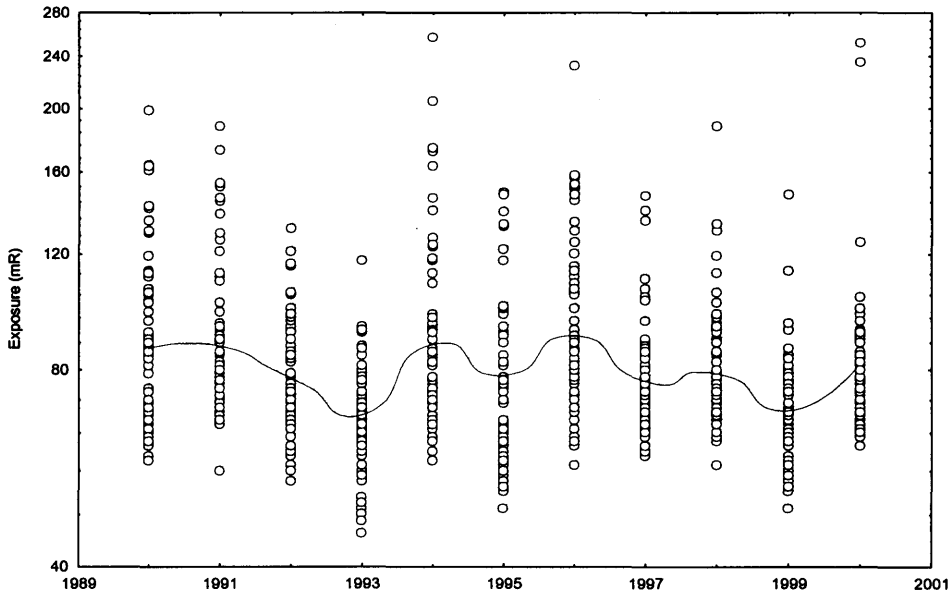



Figure 3-7. 1989–2000 RWMC and WERF thermoluminescent dosimeter exposures using negative exponential smoothing.

Table 3-11. Thermoluminescent dosimeter summary statistics by facility.

| Location | Number of Samples | Mean (mR) | Median (mR) | Minimum (mR) | Maximum (mR) |
|---|---|---|---|---|---|
| | | | **1999** | | |
| Subsurface Disposal Area | 38 | 67 | 64.5 | 49 | 94 |
| Transuranic Storage Area | 24 | 71 | 63.0 | 52 | 148 |
| WERF | 22 | 71 | 67.0 | 59 | 113 |
| Distant Communities | 14 | 58 | 58.0 | 50 | 70 |
| | | | **2000** | | |
| Subsurface Disposal Area | 37 | 80 | 76.0 | 64 | 125 |
| Transuranic Storage Area | 23 | 92 | 77.0 | 61 | 251 |
| WERF | 22 | 72 | 71.0 | 63 | 85 |
| Distant Communities | 14 | 67 | 67.5 | 60 | 74 |

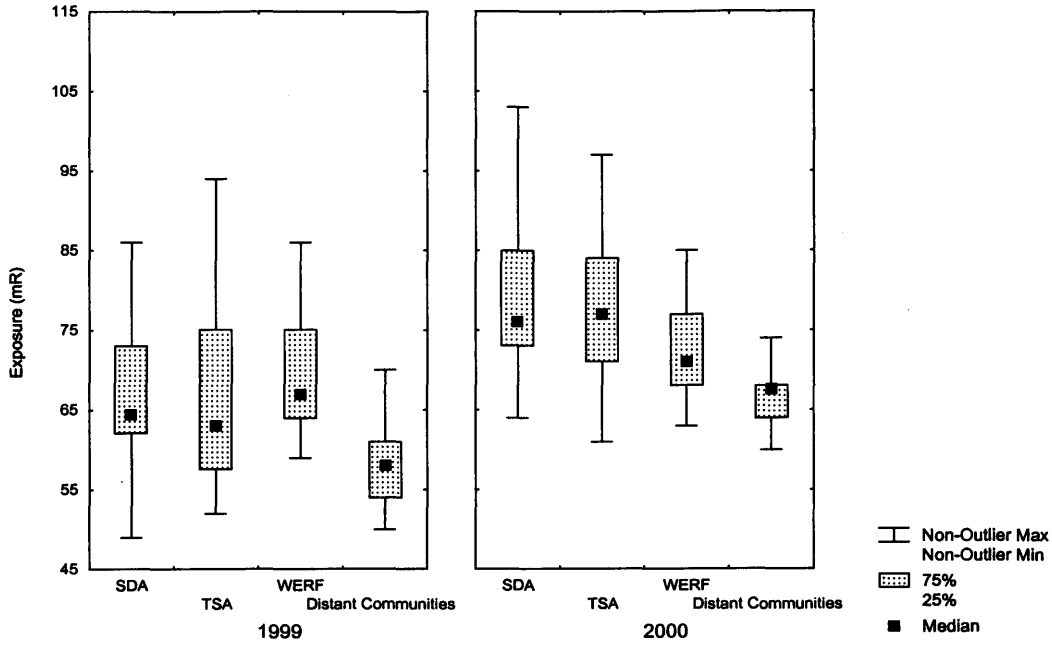



Figure 3-8. Comparison of 1999 and 2000 thermoluminescent dosimeter exposure by facility.

Table 3-12. Thermoluminescent dosimeter summary statistics by season.

| Location | Season | Number of Samples | Mean (mR) | Median (mR) | Minimum (mR) | Maximum (mR) |
|---|---|---|---|---|---|---|
| | | **1999** | | | | |
| SDA | Spring | 19 | 69 | 66.0 | 58 | 94 |
| SDA | Fall | 19 | 65 | 64.0 | 49 | 86 |
| TSA | Spring | 12 | 69 | 63.5 | 57 | 113 |
| TSA | Fall | 12 | 72 | 62.5 | 52 | 148 |
| WERF | Spring | 11 | 68 | 65.0 | 59 | 92 |
| WERF | Fall | 11 | 75 | 70.0 | 63 | 113 |
| Distant Communities | Spring | 7 | 57 | 58.0 | 53 | 61 |
| Distant Communities | Fall | 7 | 59 | 59.0 | 50 | 70 |
| 1999 Overall | Spring | 49 | 67 | 64.0 | 53 | 113 |
| 1999 Overall | Fall | 49 | 68 | 65.0 | 49 | 148 |
| | | **2000** | | | | |
| SDA | Spring | 19 | 85 | 77.0 | 73 | 125 |
| SDA | Fall | 18 | 75 | 72.5 | 64 | 92 |
| TSA | Spring | 12 | 93 | 76.5 | 68 | 251 |
| TSA | Fall | 11 | 91 | 78.0 | 61 | 235 |
| WERF | Spring | 11 | 77 | 77.0 | 70 | 85 |
| WERF | Fall | 11 | 67 | 68.0 | 63 | 72 |
| Distant Communities | Spring | 7 | 66 | 68.0 | 62 | 70 |
| Distant Communities | Fall | 7 | 67 | 67.0 | 60 | 74 |
| 2000 Overall | Spring | 49 | 83 | 76.0 | 62 | 251 |
| 2000 Overall | Fall | 47 | 76 | 71.0 | 60 | 235 |

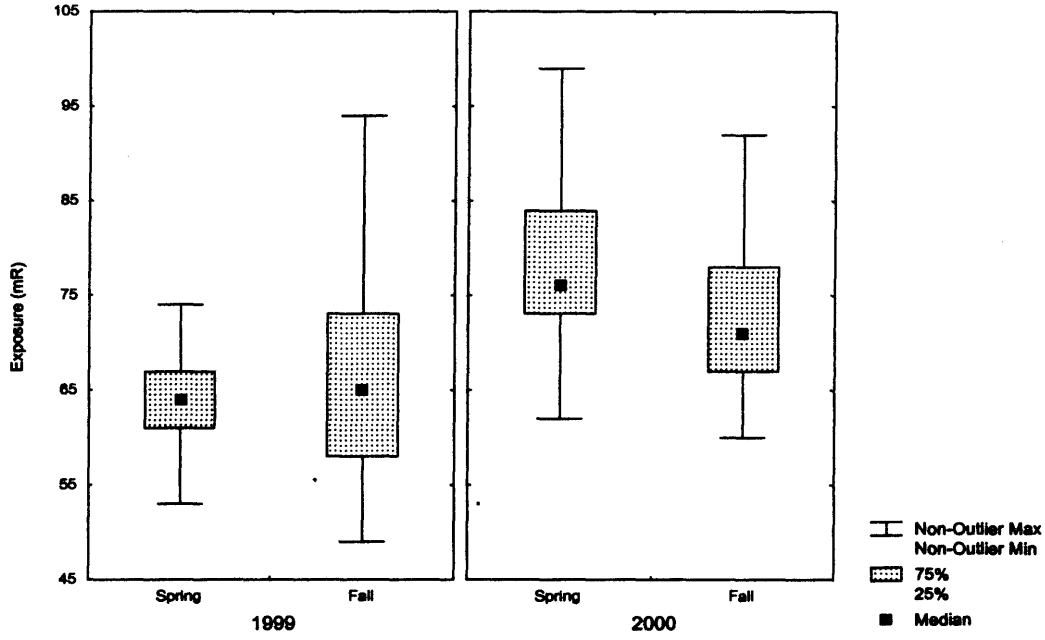
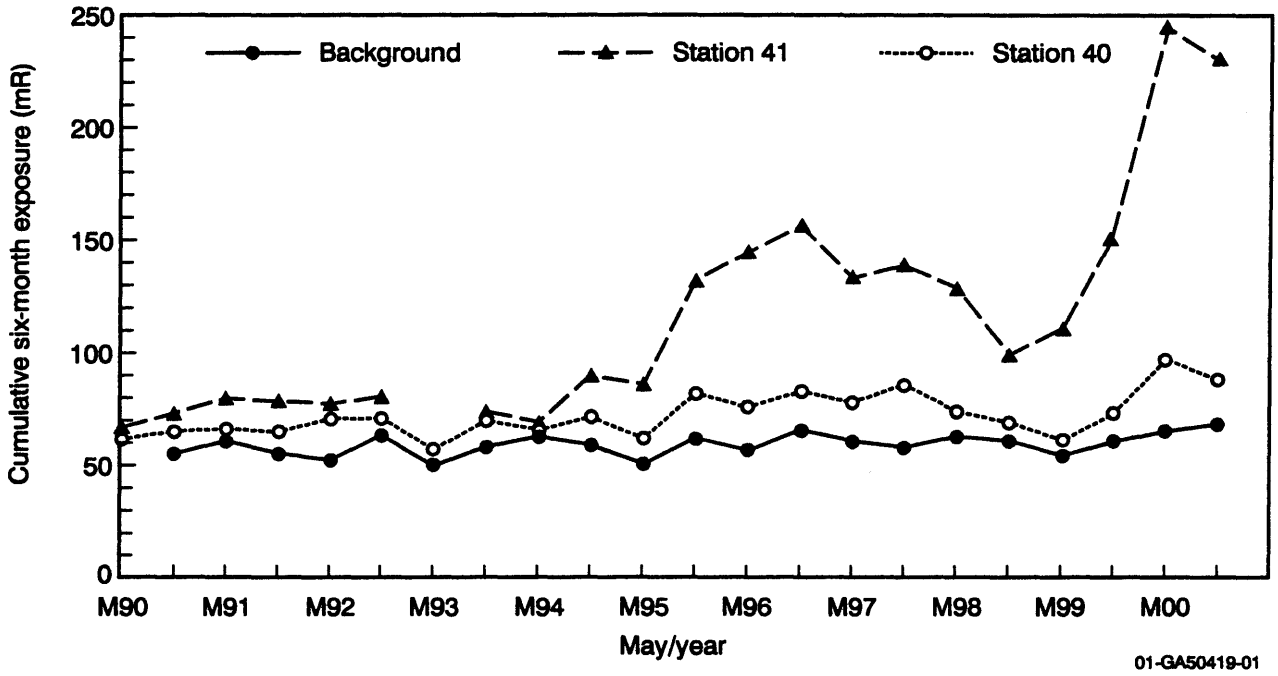



Figure 3-9. Comparison of 1999 and 2000 thermoluminescent dosimeter exposure by season.




NOTE: TLD missing or destroyed in May 1993.

Figure 3-10. Six-month exposures measured by thermoluminescent dosimeters on the east and northeast borders of Transuranic Storage Area.

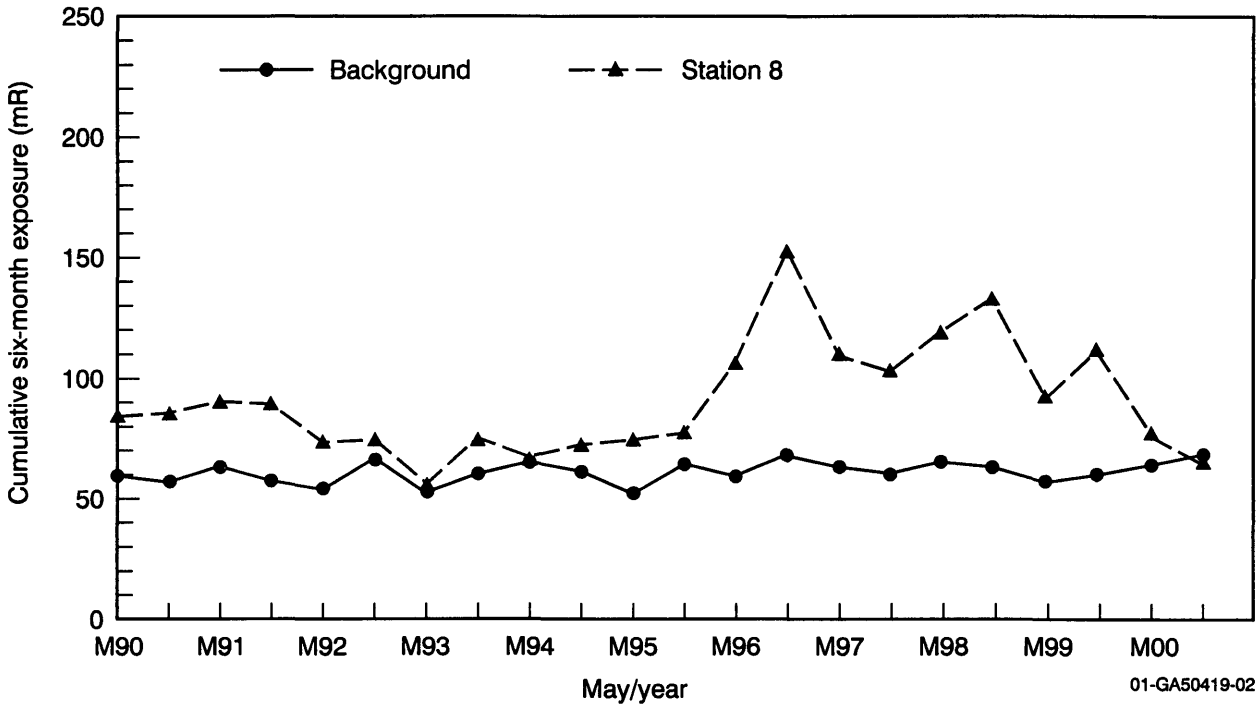



Figure 3-11. Six-month exposures measured by thermoluminescent dosimeters around Waste Experimental Reduction Facility.

**3.5.1.2** ***Surface Radiation.*** Figure 3-12 shows the radiation readings from the 2000 RWMC spring global positioning radiometric scanner (GPRS) survey, and Figure 3-13 shows the radiation readings from the 2000 RWMC fall GPRS survey. The spring and fall surveys around the active pit were comparable to or lower than historical measurements for that area. No new elevated readings were identified during either survey. In the spring survey, the maximum activity, excluding the operating low-level waste pit, was 582 microR/hr and located along Soil Vault Row #18. The maximum activity, excluding the operating low-level waste pit, for the fall survey was 607 microR/hr and was also along Soil Vault Row #18. These are comparable to 1999 measurements taken at the same location.

Pad A cannot be surveyed via the GPRS because of driving restrictions. Therefore, it was traversed with a hand-held HHD-440. No elevated readings were identified on Pad A during either survey.

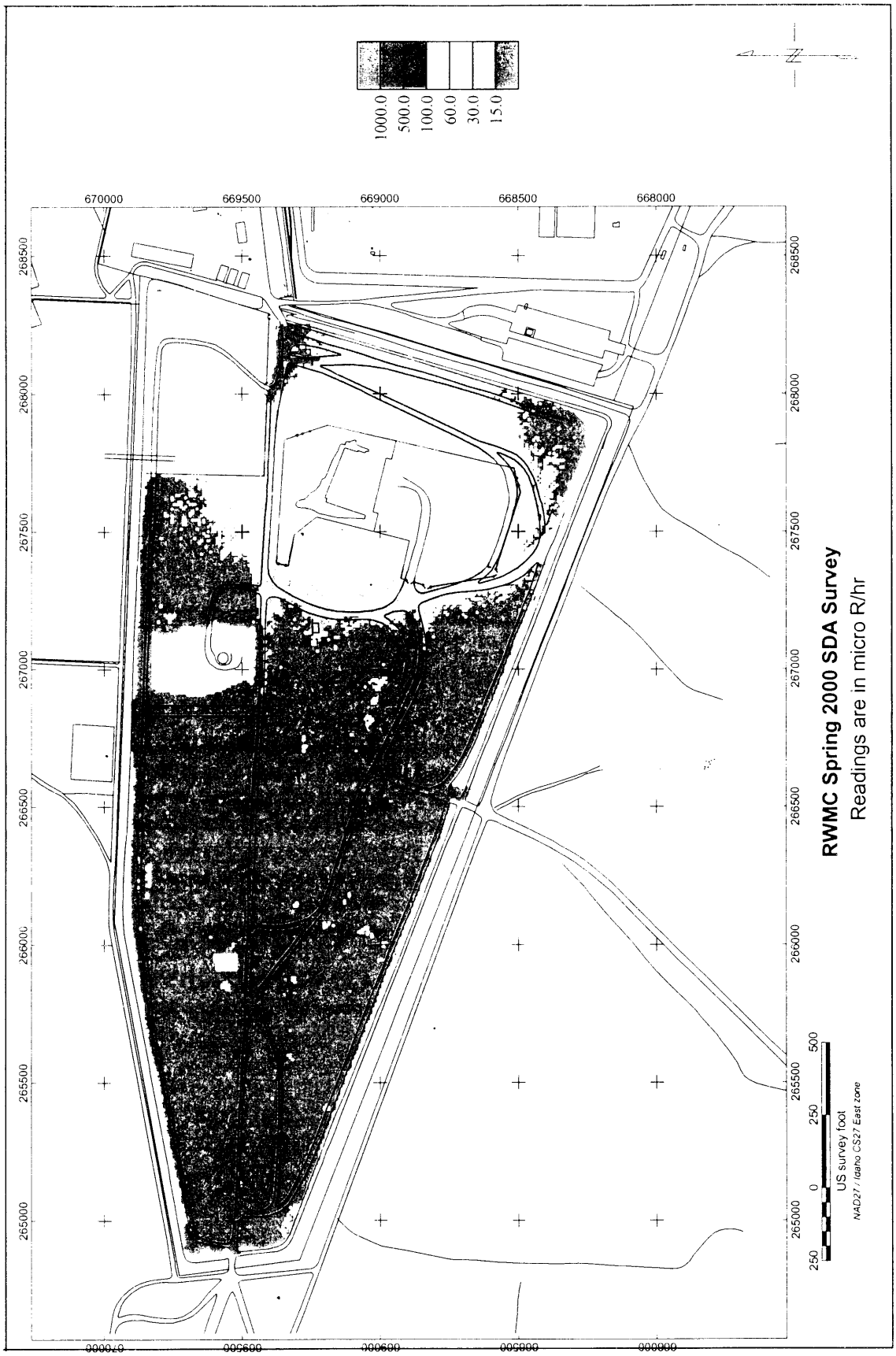



Figure 3-12. Spring 2000 Radioactive Waste Management Complex surface radiation

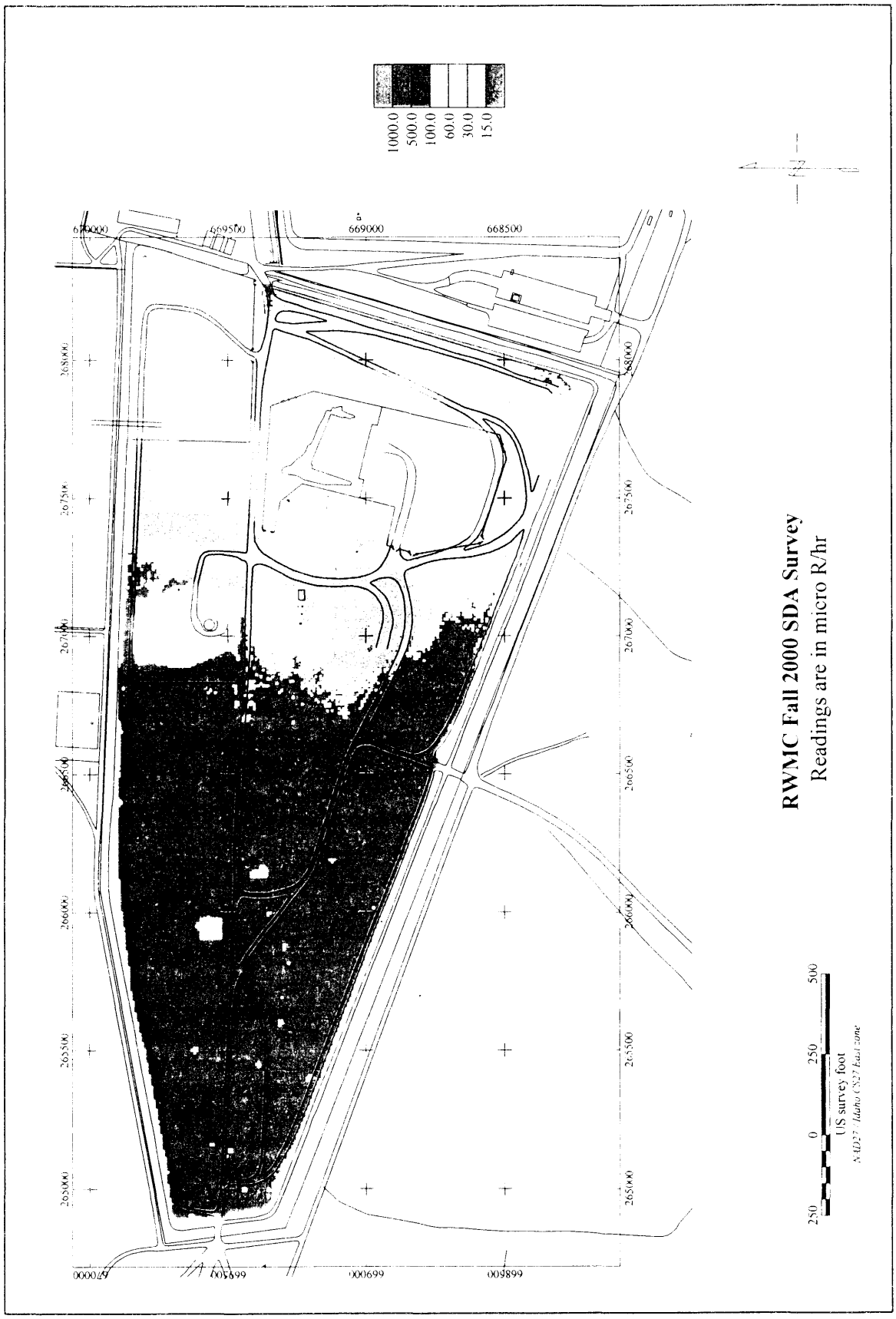



Figure 3-13. Fall 2000 Radioactive Waste Management Complex surface radiation

### 3.5.2 Data Summary and Assessment for Site Surveillance

**3.5.2.1 *Thermoluminescent Dosimeters.*** Table 3-13 shows the maximum TLD exposures from the site surveillances from 1996 through 2000.

The ICPP 9 TLD is located in a controlled access area, which used to be a contaminated soil area, and ICPP 20 is near a radioactive material storage area. Calendar Year 2000 exposures at ICPP 9, ICPP 20, and INTEC Tree Farm 1 were all comparable to historical exposures.

TRA 2, 3, and 4 are adjacent to the former radioactive disposal pond, which has been drained and covered with clean soil. These locations are also close to a radioactive storage area, which is inside the facility fence line. TRA 3 had the maximum exposure at 692 ± 98 mR. This location is the closest to the radioactive storage area, where the amount of temporarily stored material increased.

Table 3-13. Comparison of the site surveillance 2000 thermoluminescent dosimeter exposures to past exposures.

| | Maximum Annual Exposures[a] (mR) | | | | |
|---|---|---|---|---|---|
| Location | 1996 | 1997 | 1998 | 1999 | 2000 |
| ICPP 9 | 283 ± 36 | 196 ± 16 | 200 ± 16 | 172 ± 22 | 211 ± 29 |
| ICPP 20 | 251 ± 26 | 245 ± 20 | 233 ± 18 | 229 ± 32 | 268 ± 37 |
| INTEC Tree Farm 1 | 214 ± 30 | 208 ± 24 | 214 ± 24 | 163 ± 18 | 205 ± 29 |
| TRA 2 | 270 ± 20 | 257 ± 18 | 293 ± 24 | 254 ± 32 | 466 ± 68 |
| TRA 3 | 345 ± 32 | 328 ± 28 | 574 ± 116 | 468 ± 42 | 692 ± 98 |
| TRA 4 | 255 ± 20 | 246 ± 24 | 250 ± 12 | 215 ± 22 | 282 ± 39 |

a. Uncertainties shown are the associated 2 sigma.

b. Removed during decontamination and decommission.

## 3.6 Quality Assurance/Quality Control

The management and operating contractor analytical laboratories analyze all Environmental Surveillance Program samples as specified in the statements of work. These laboratories participate in a variety of intercomparison quality assurance programs, which verify all the methods used to analyze environmental samples. The programs include the DOE Environmental Measurements Laboratory Quality Assurance Program and the Environmental Protection Agency Environmental Measurements Systems Laboratory Quality Assurance Program. The results of quality control sample analyses and laboratory performance in these programs are available in the annual site environmental report.[41] The laboratories met the performance objectives specified by the Environmental Measurements Laboratory and Environmental Measurements Systems Laboratory.

The Environmental Surveillance Program met its completeness goals. Samples were collected and analyzed as planned from all available media. The Environmental Surveillance Program submitted duplicate, blank, and control samples with routine samples for analyses. Quality assurance/quality control samples were also routinely submitted with program samples and demonstrated an acceptable agreement ratio with spiked values for all radionuclides.

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# Appendix A

# Facility Maps with Monitoring Locations

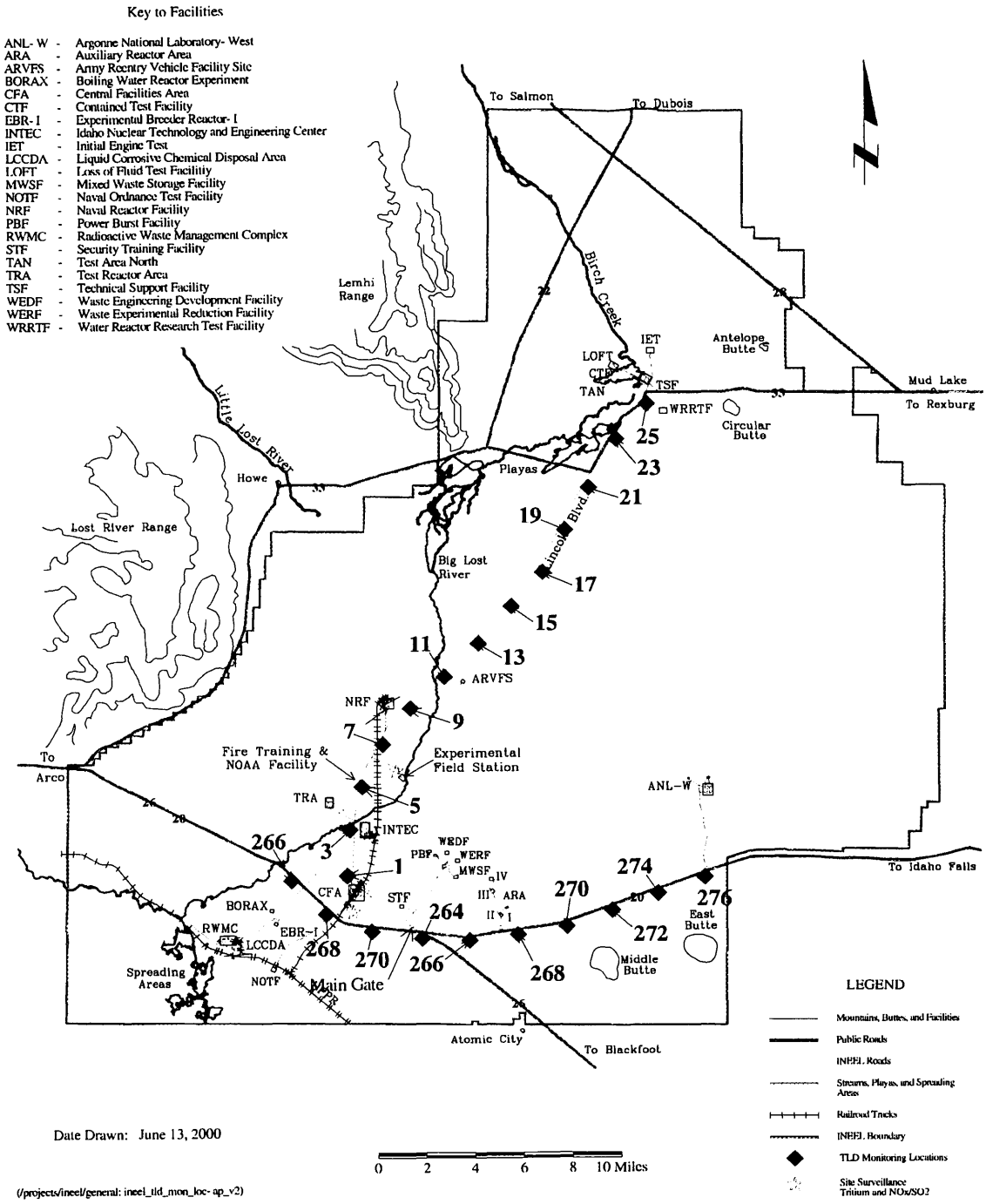


Figure A-1. Thermoluminescent dosimeter, tritium, and nitrogen dioxide/sulfur dioxide monitoring locations.

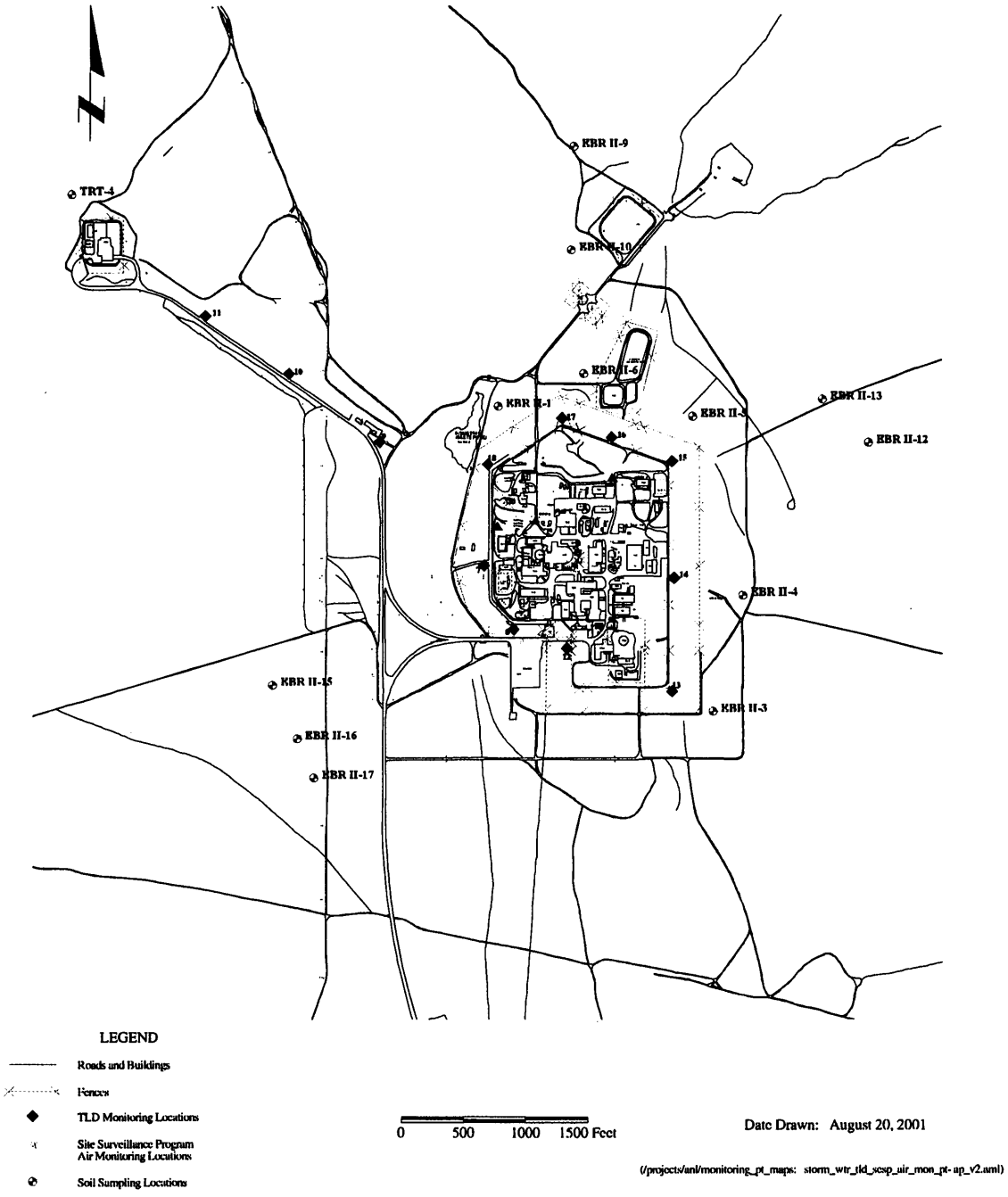


Figure A-2. Argonne National Laboratory-West monitoring locations.

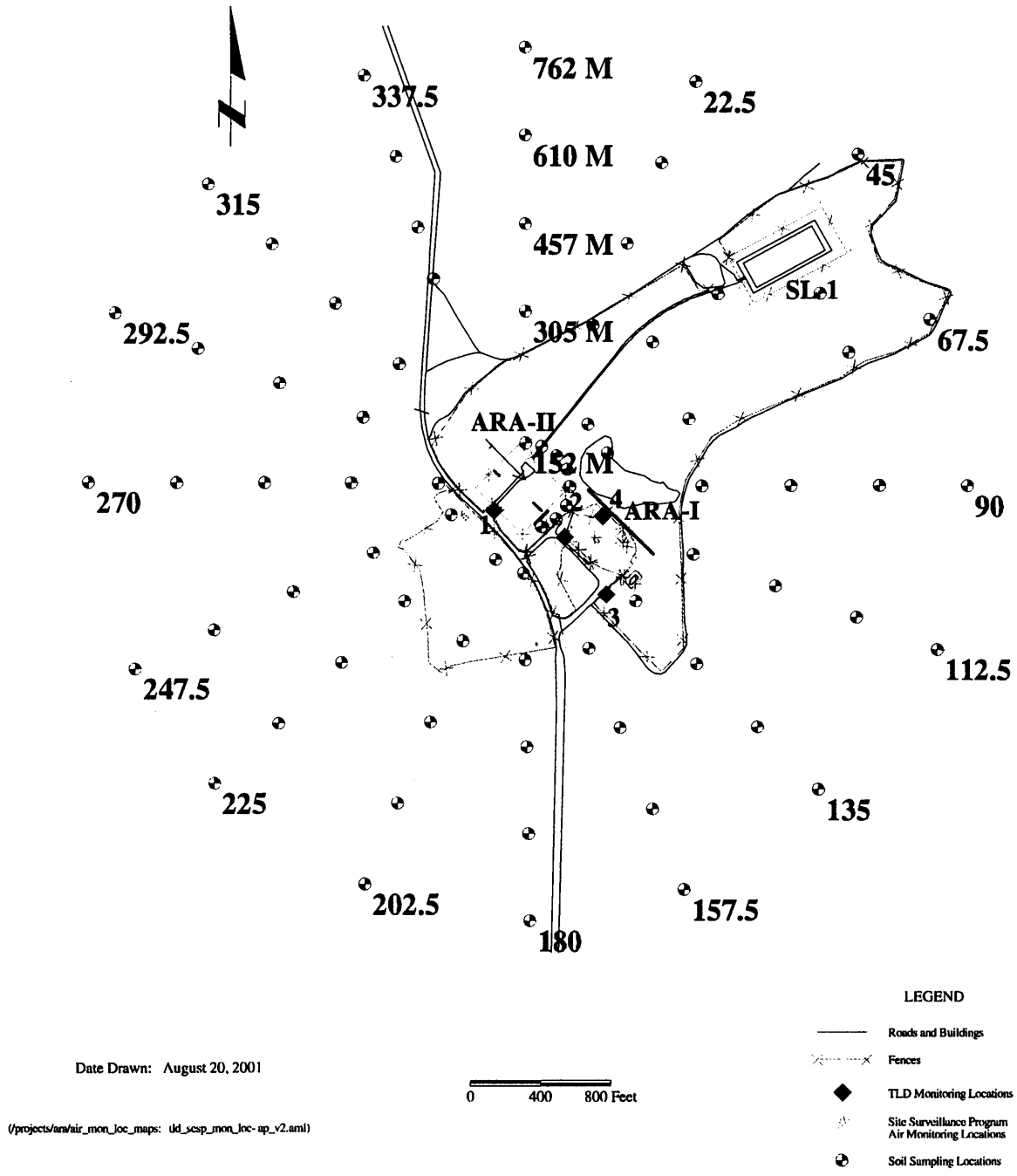


Figure A-3. Auxiliary Reactor Area monitoring locations.

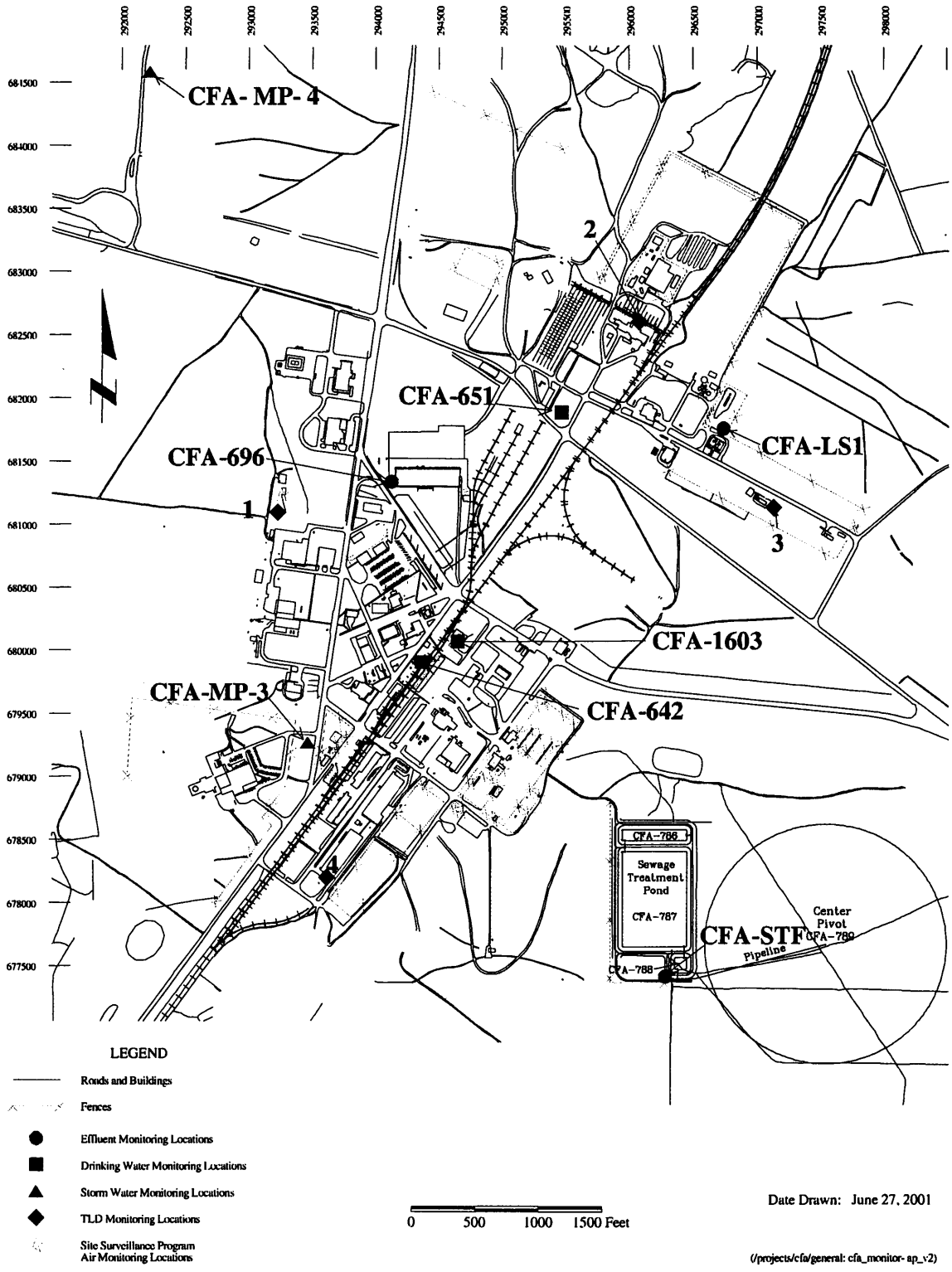


Figure A-4. Central Facilities Area monitoring locations.

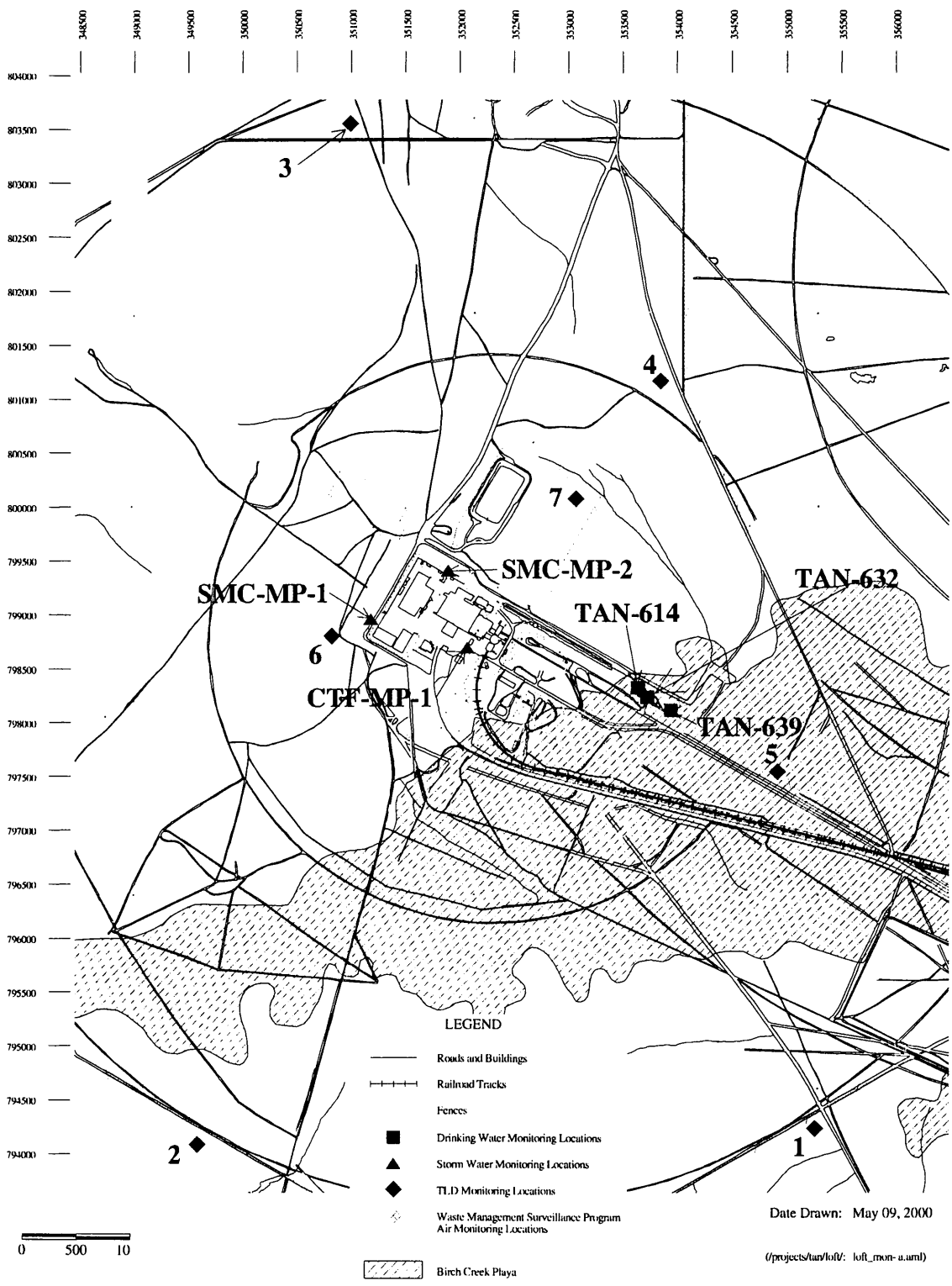


Figure A-5. Test Area North/Specific Manufacturing Capability monitoring locations.

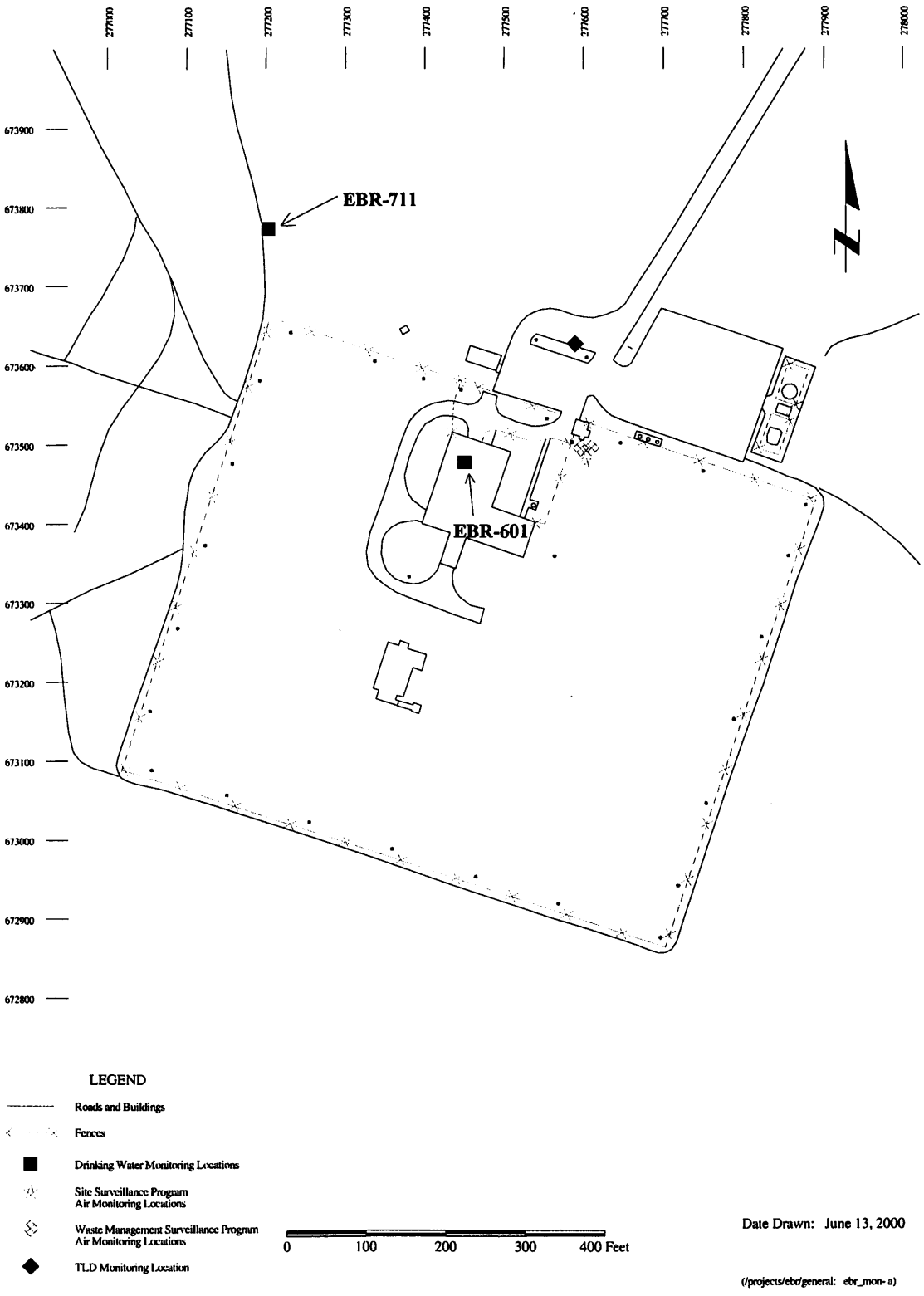


Figure A-6. Experimental Breeder Reactor-I monitoring locations.

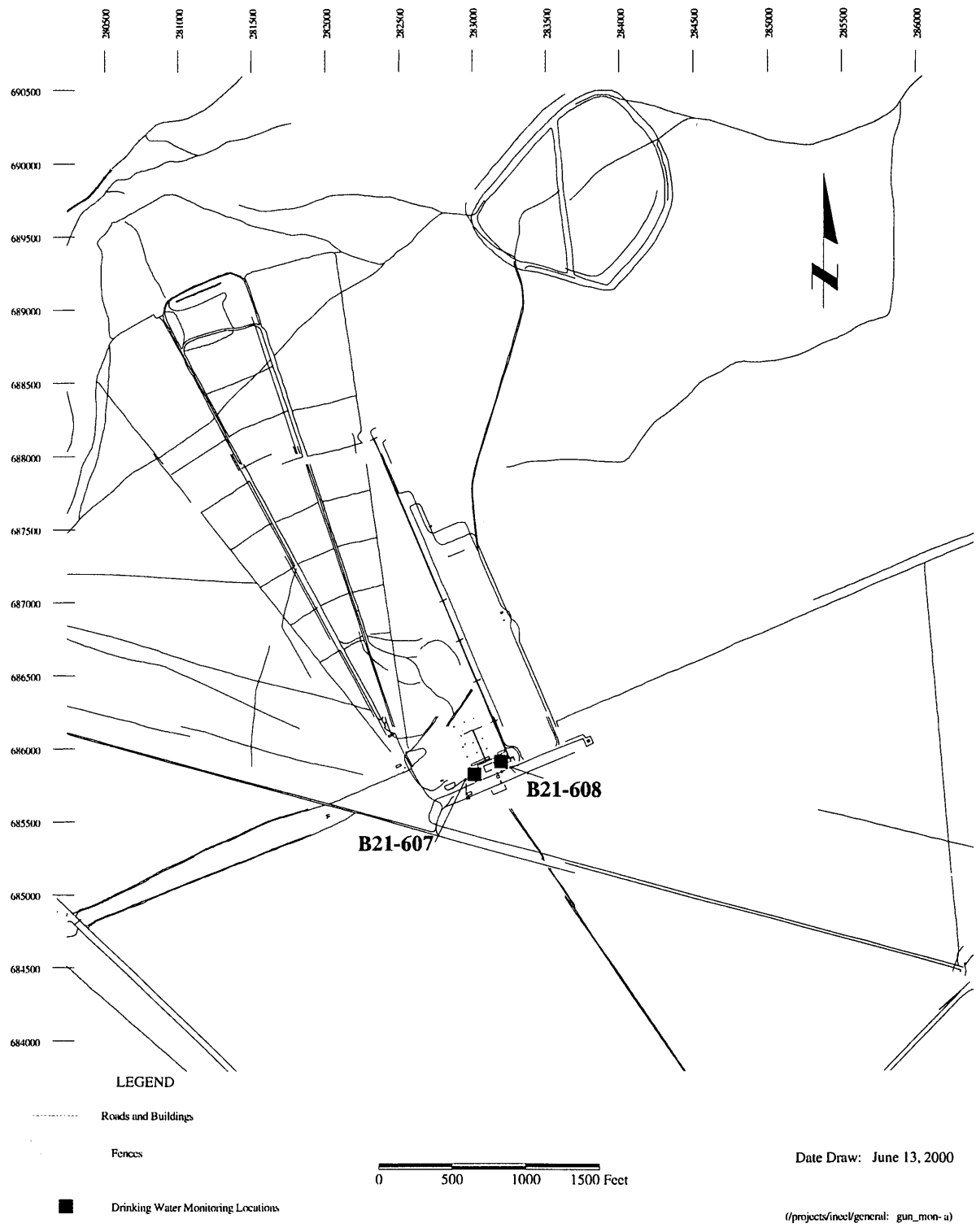


Figure A-7. Gun Range monitoring locations.

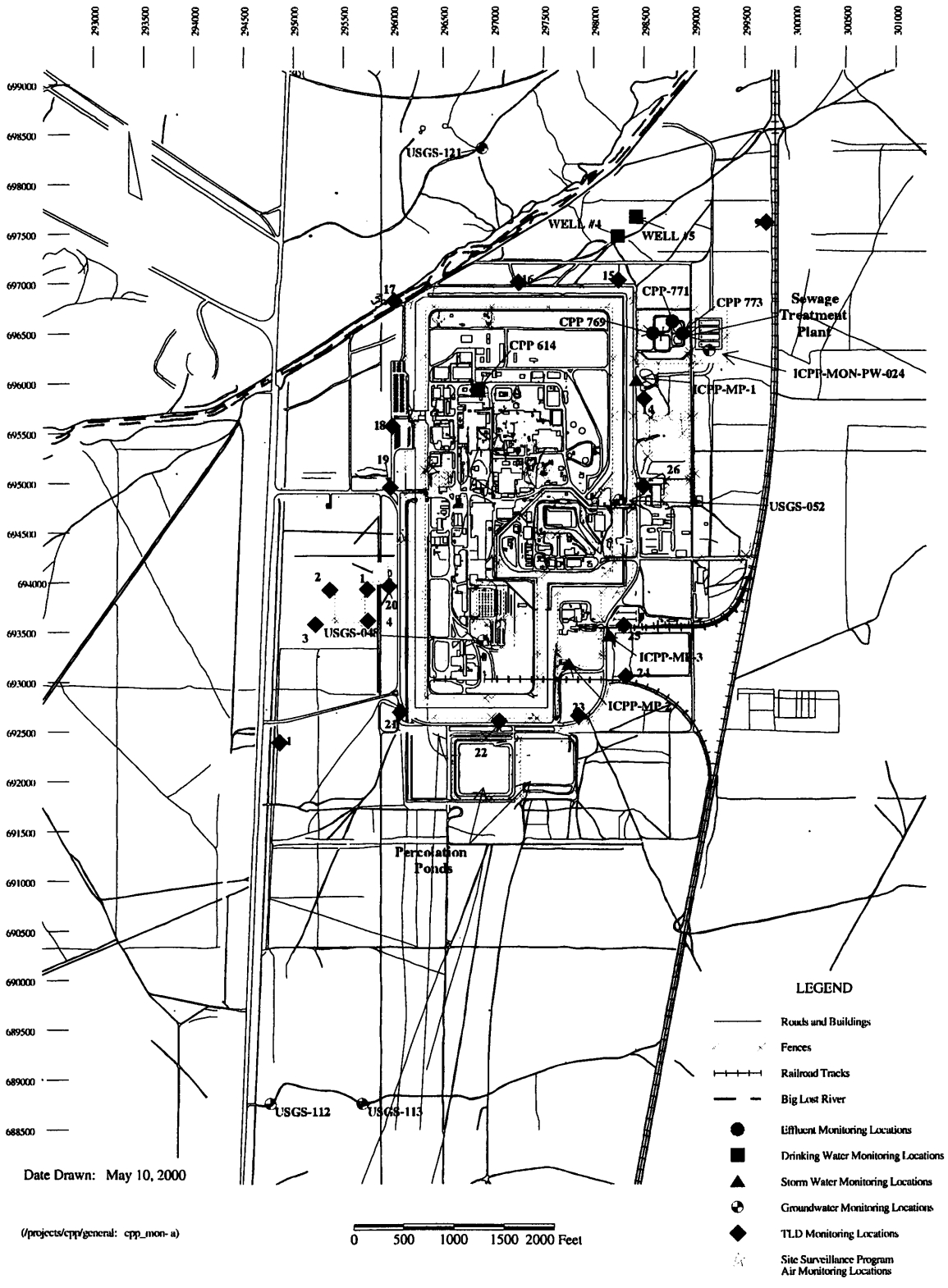


Figure A-8. Idaho Nuclear Technology and Engineering Center monitoring locations.

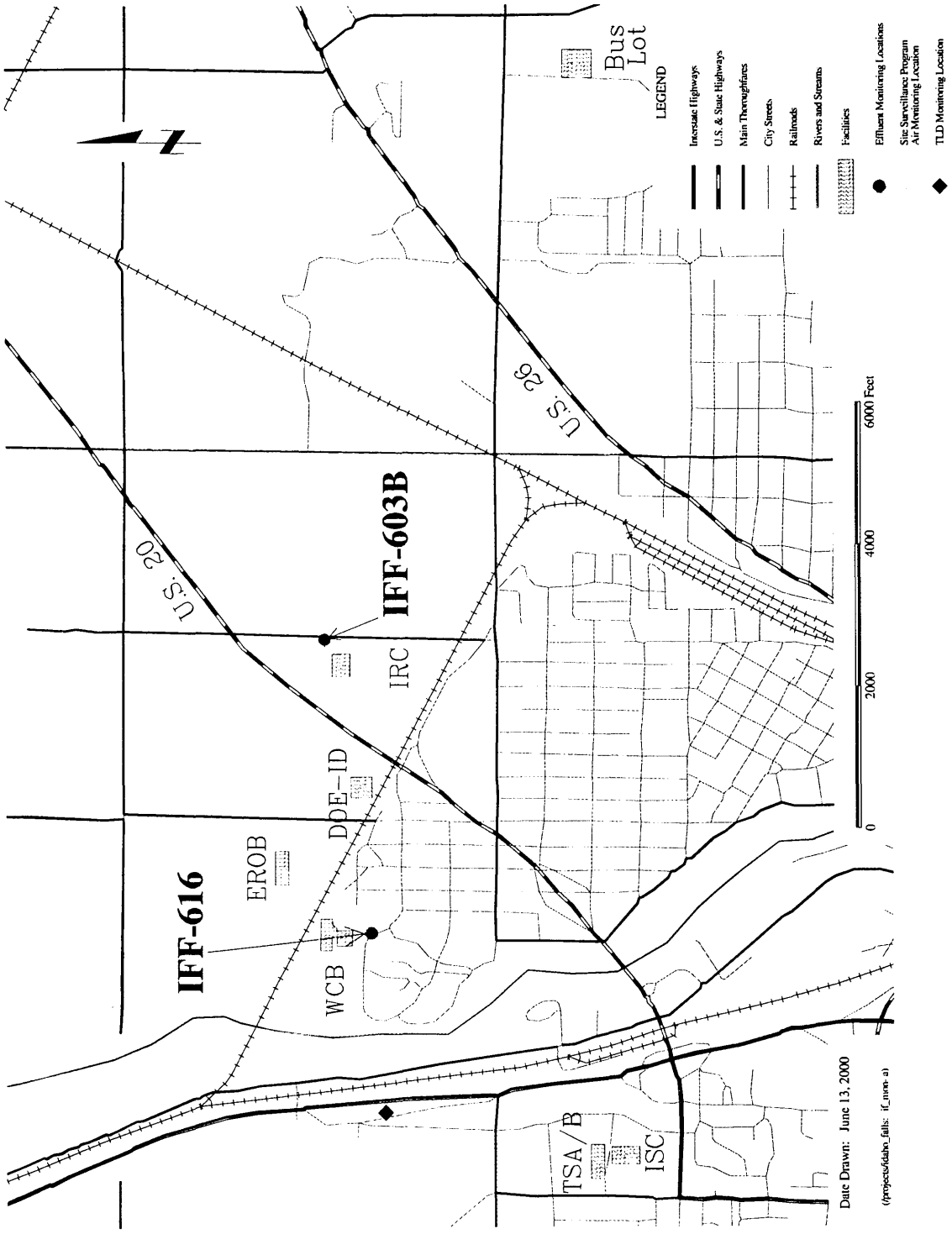


Figure A-9. Idaho Falls monitoring locations.

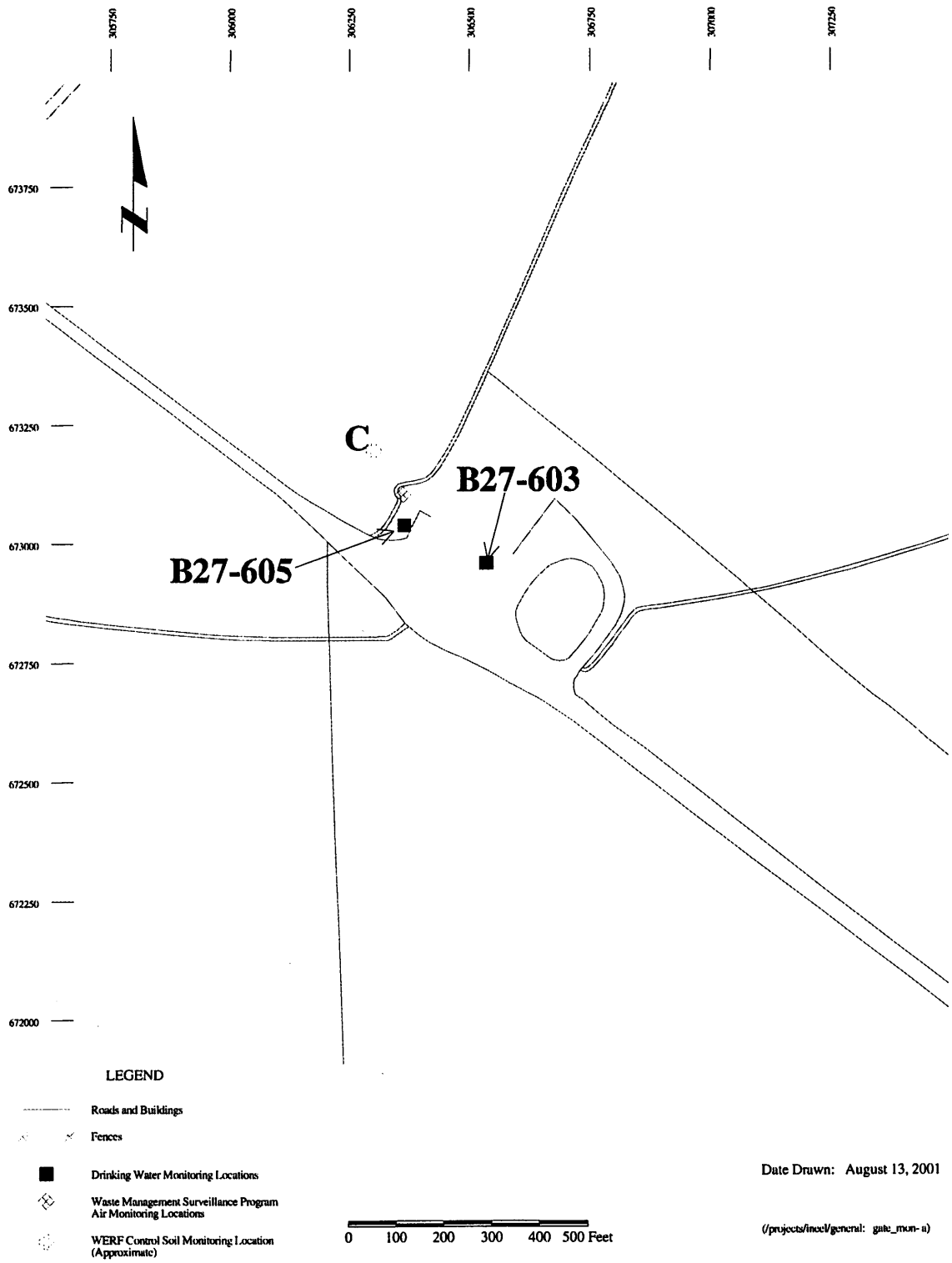


Figure A-10. Main Gate monitoring locations.

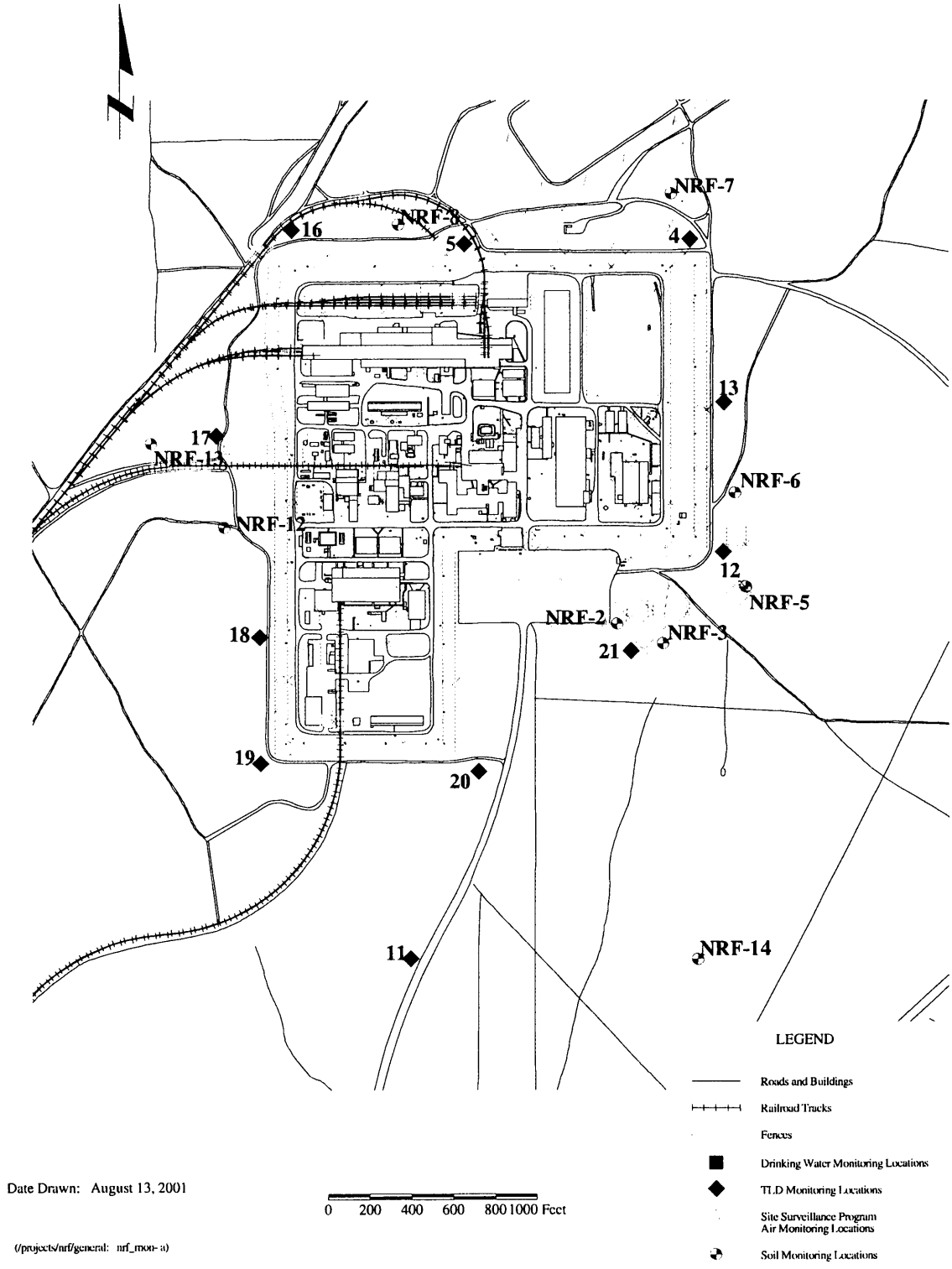


Figure A-11. Naval Reactors Facility monitoring locations.

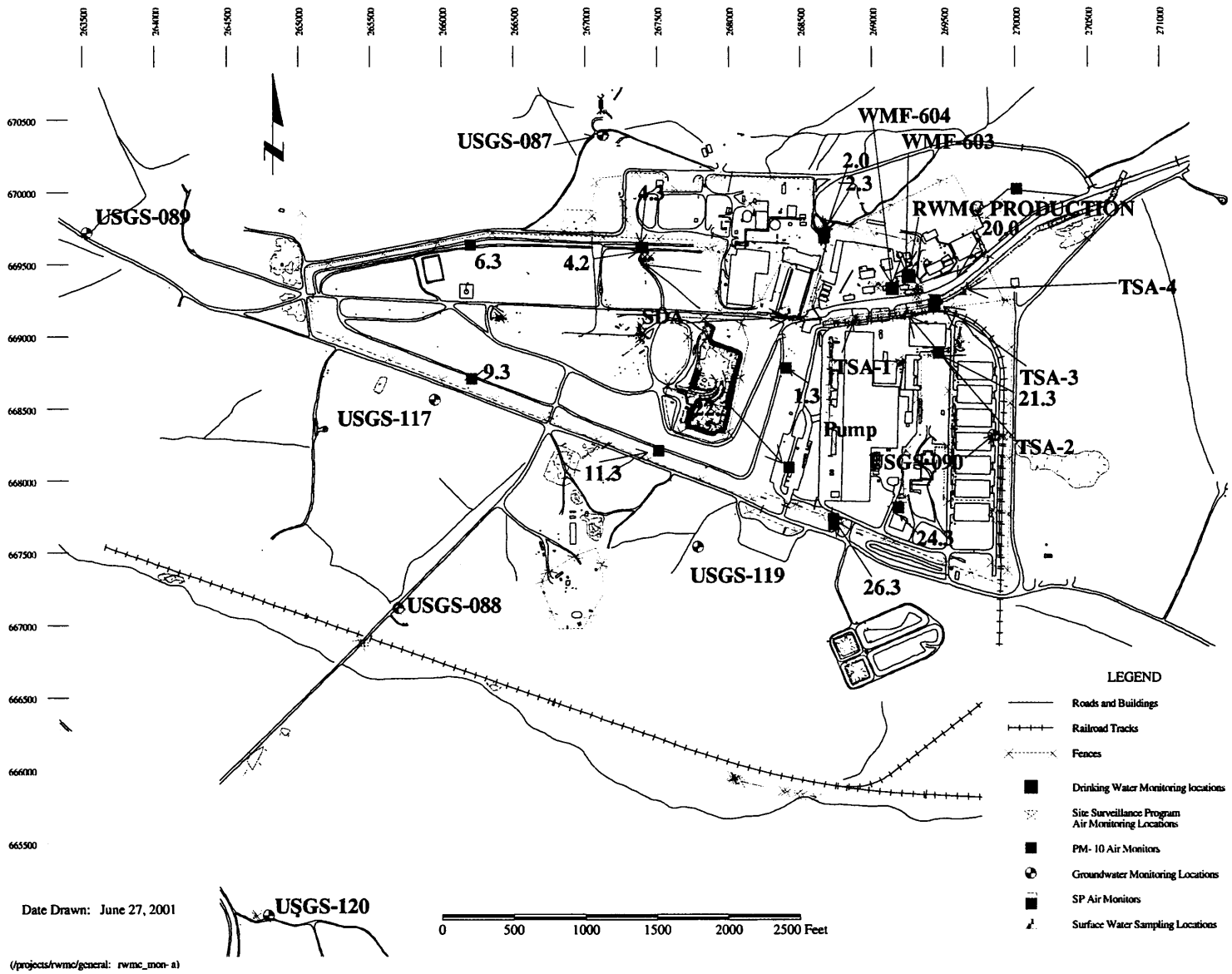


Figure A-12. Radioactive Waste Management Complex monitoring locations.

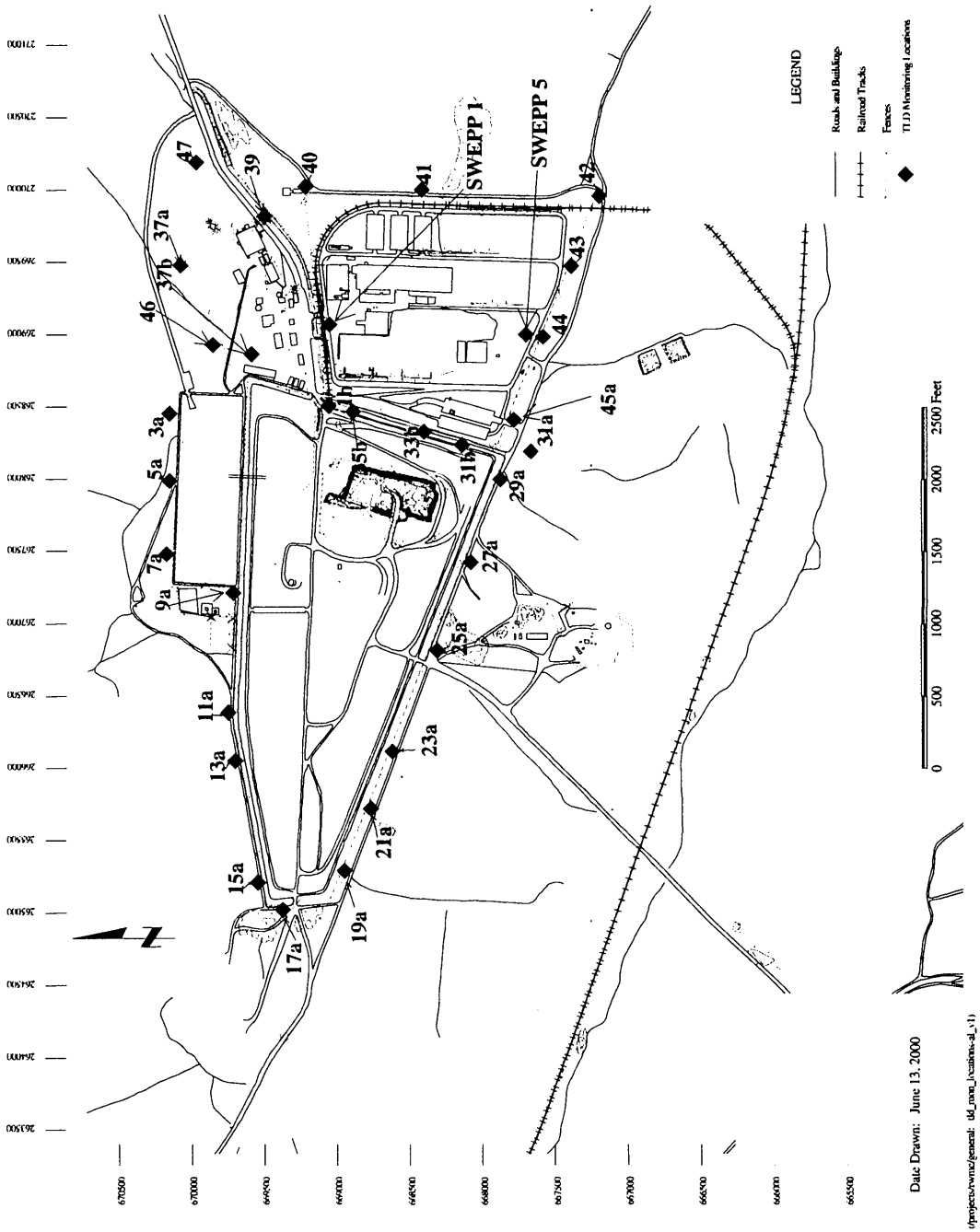


Figure A-13. Radioactive Waste Management Complex thermoluminescent dosimeter monitoring locations.

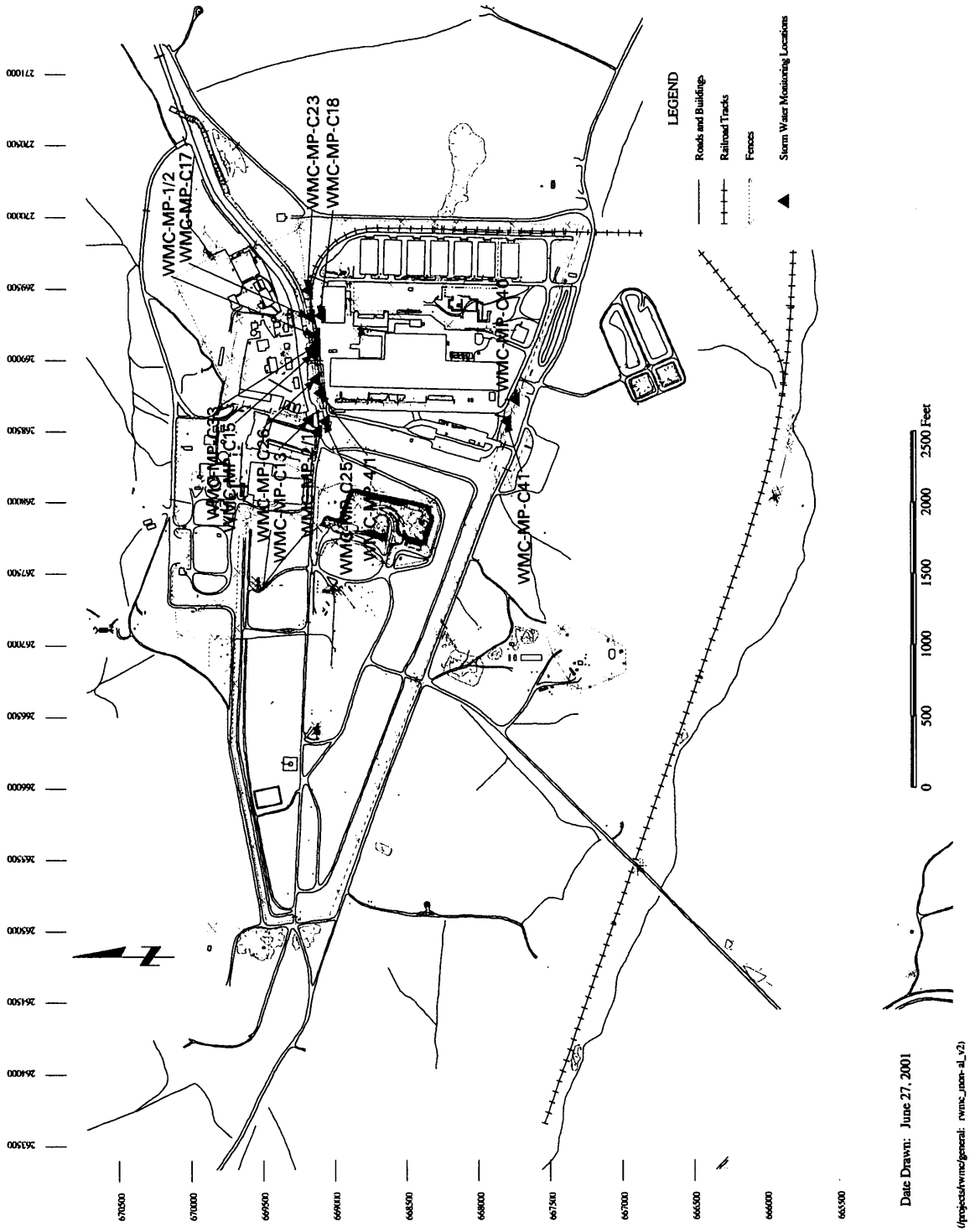


Figure A-14. Radioactive Waste Management Complex storm water monitoring locations.

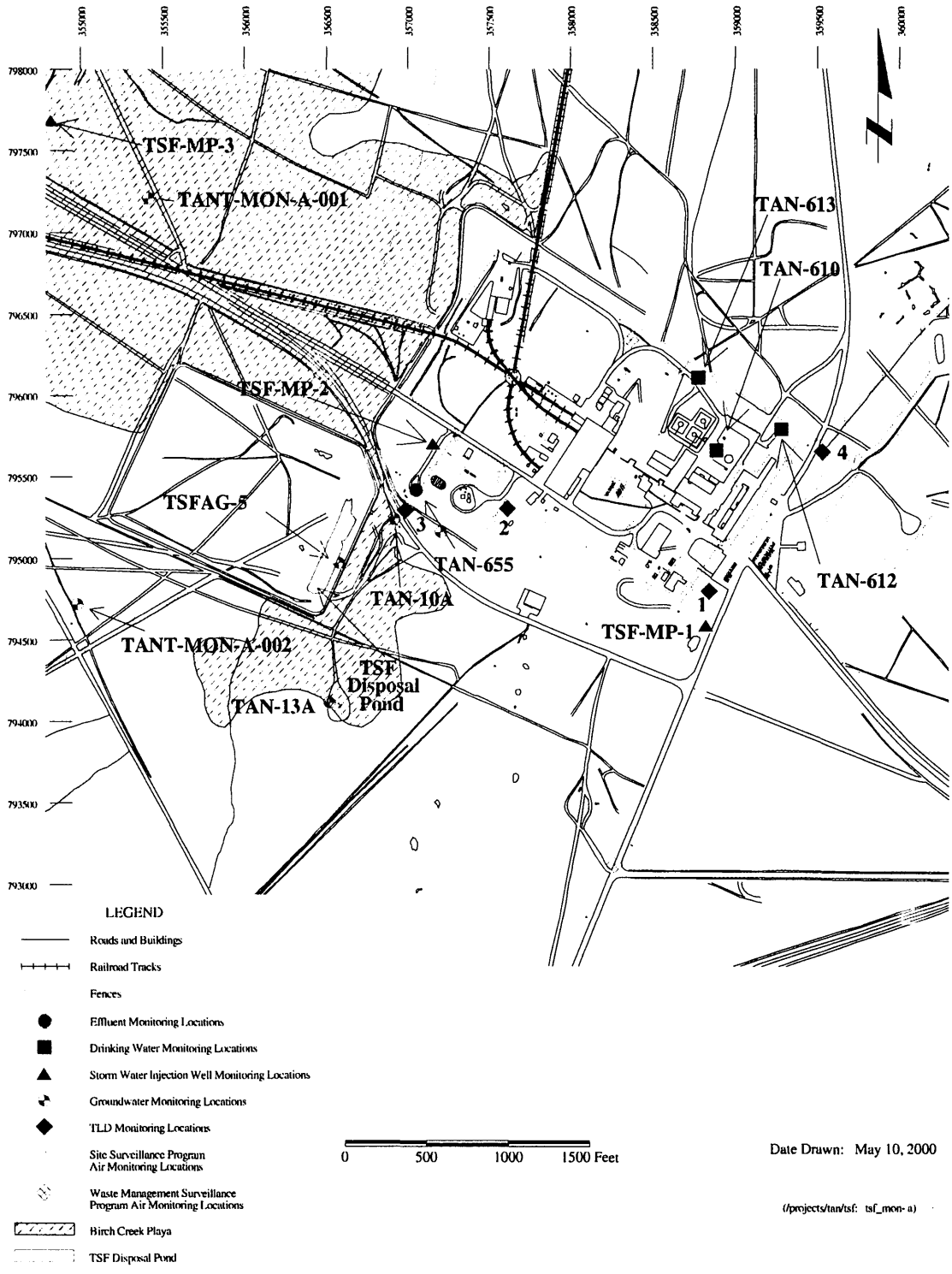


Figure A-15. Test Area North/Technical Support Facility monitoring locations.

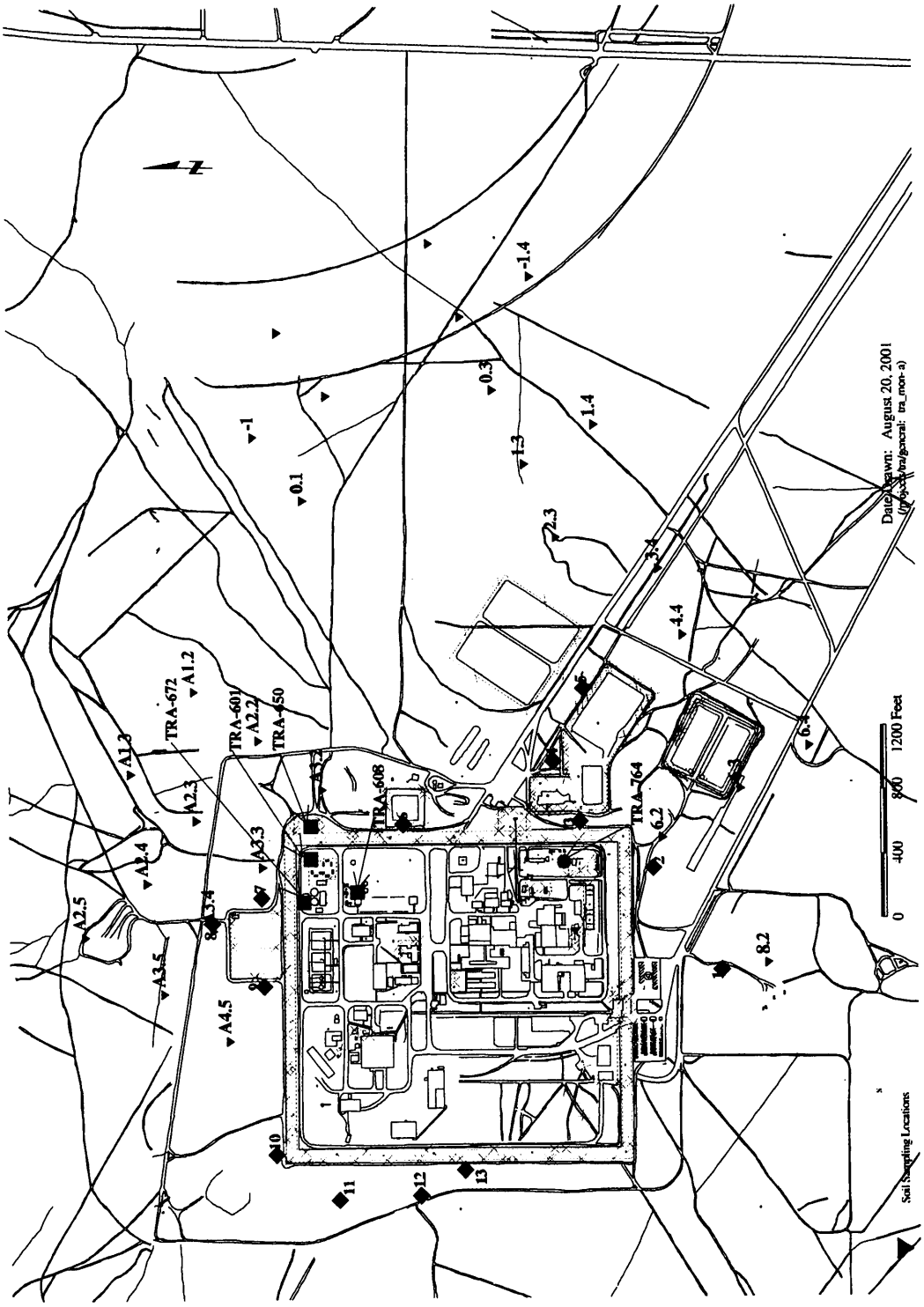


Figure A-16. Test Reactor Area monitoring locations.

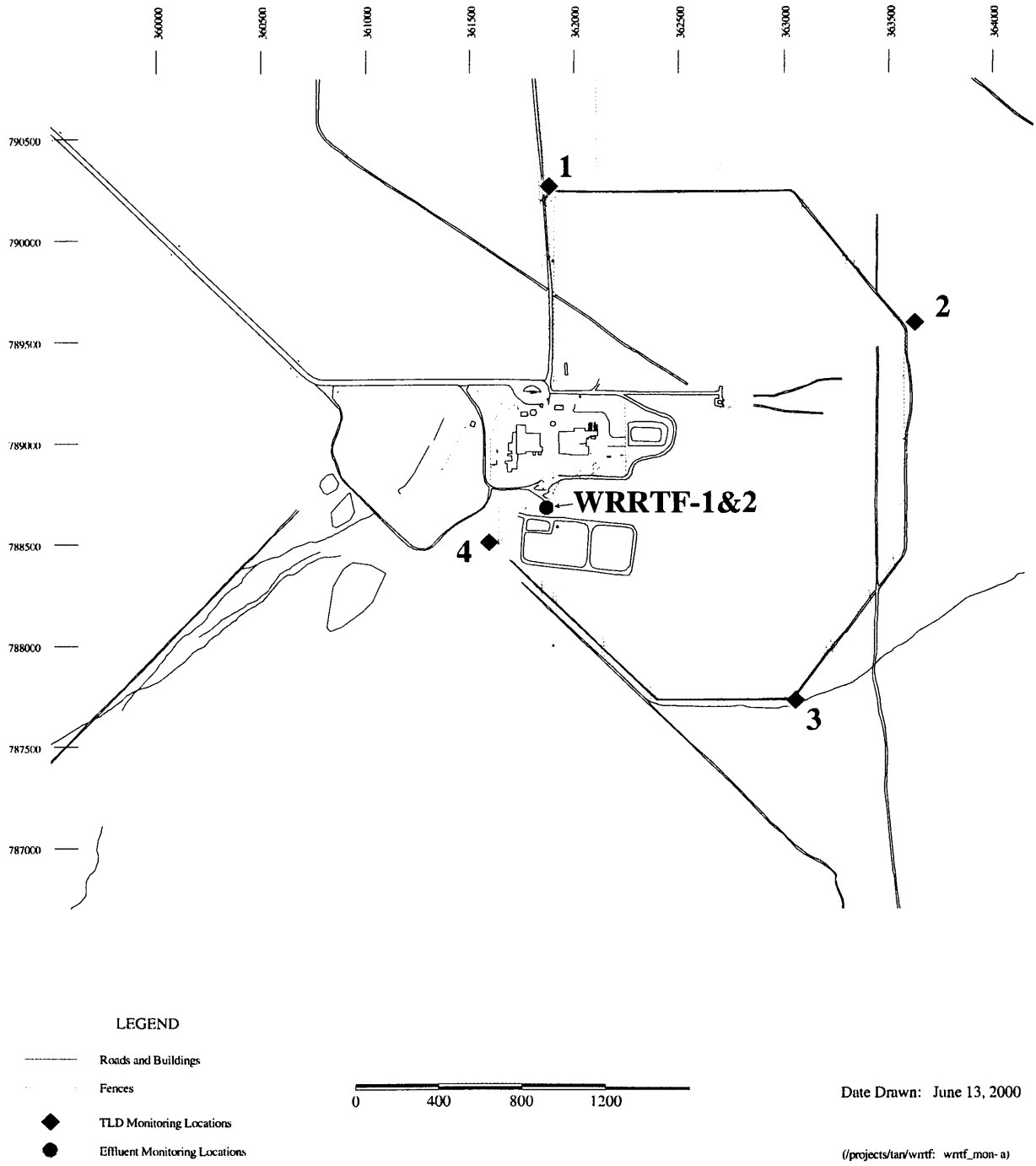


Figure A-17. Water Reactor Research Test Facility monitoring locations.

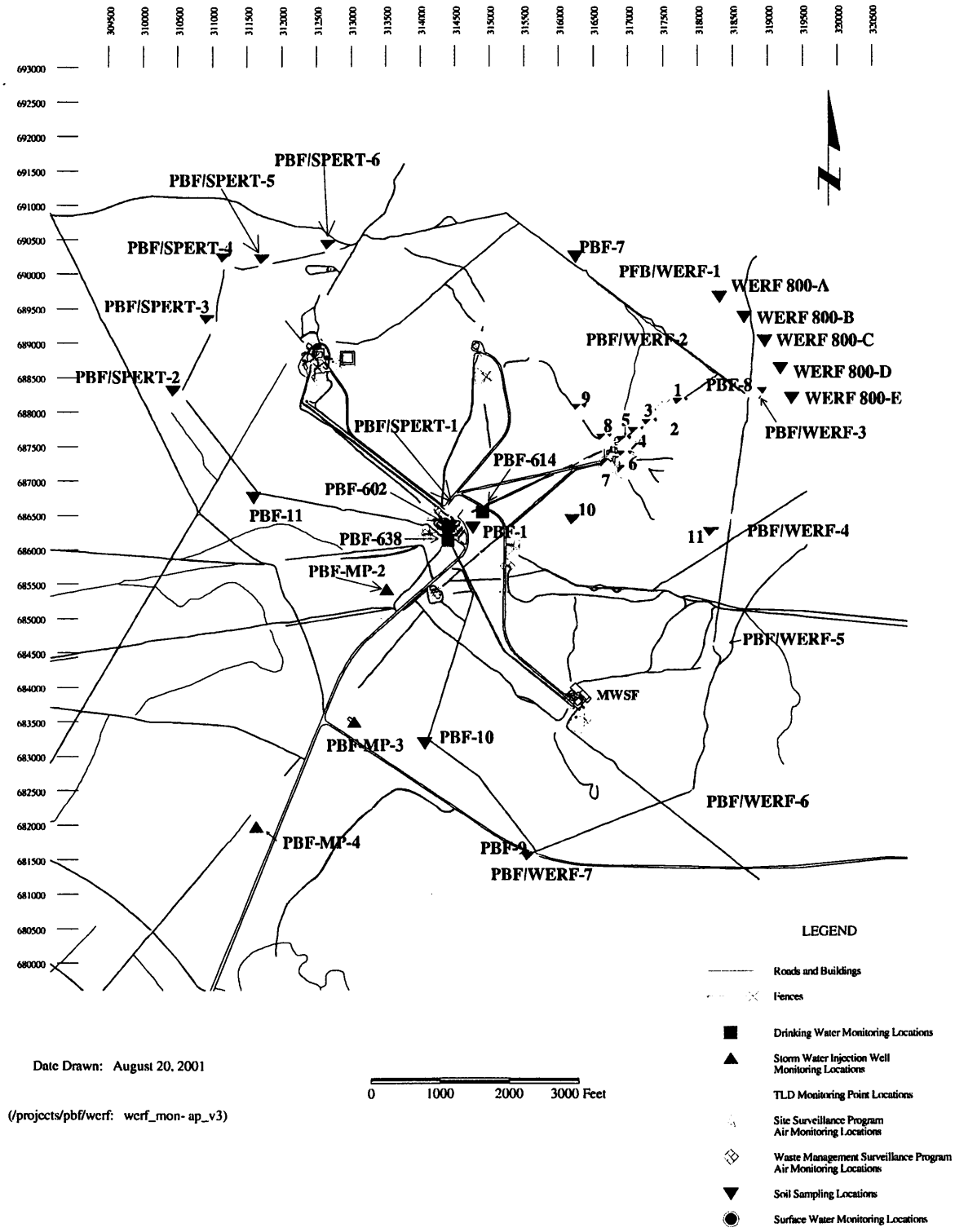


Figure A-18. Waste Experimental Reduction Facility monitoring locations.

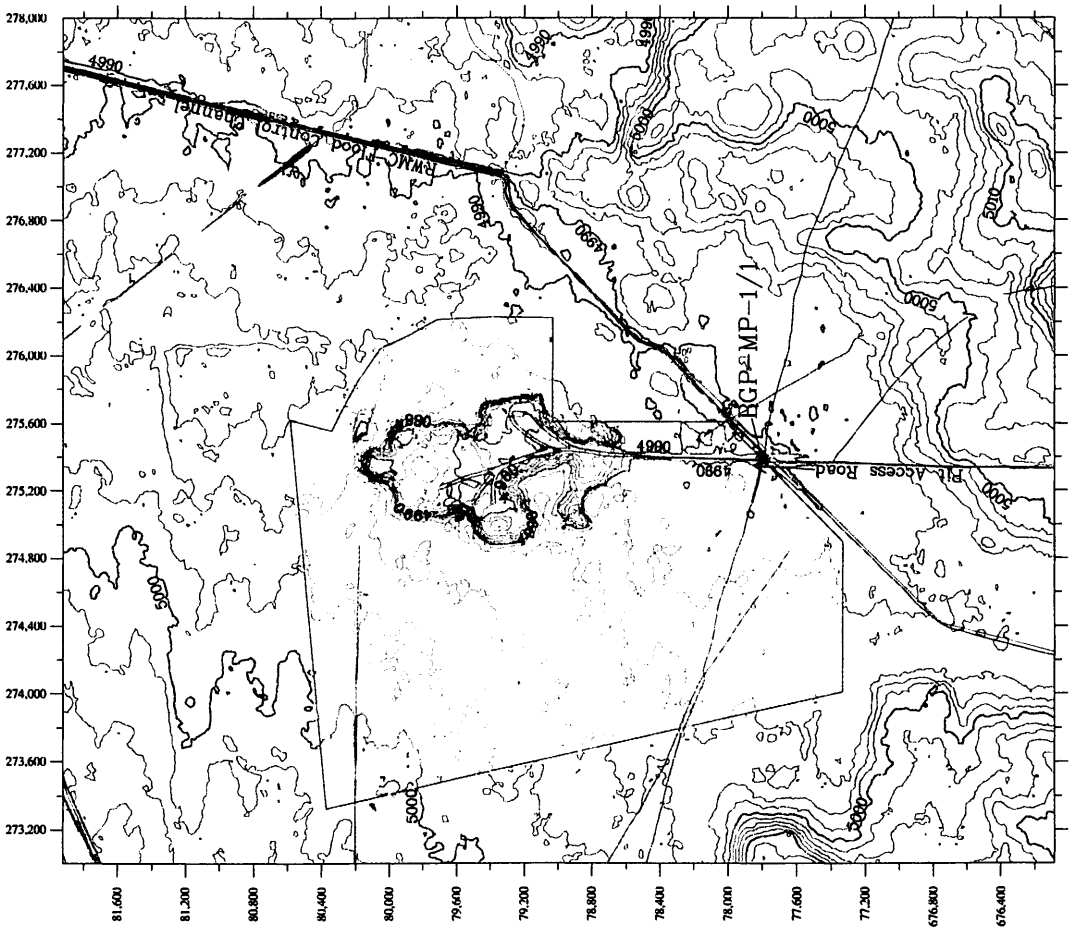


Figure A-19. Adams Boulevard storm water monitoring locations.

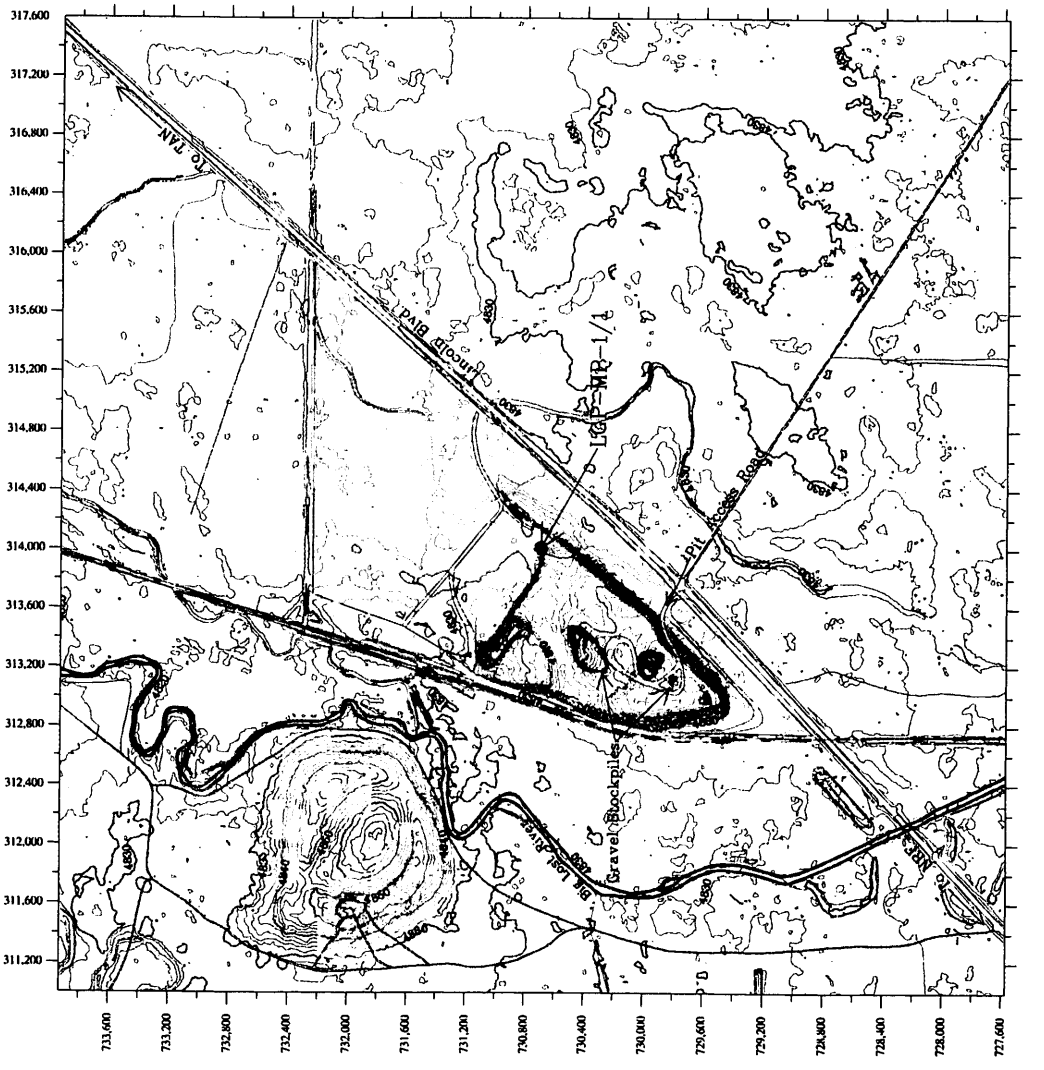


Figure A-20. Lincoln Boulevard Gravel Pit storm water monitoring locations.

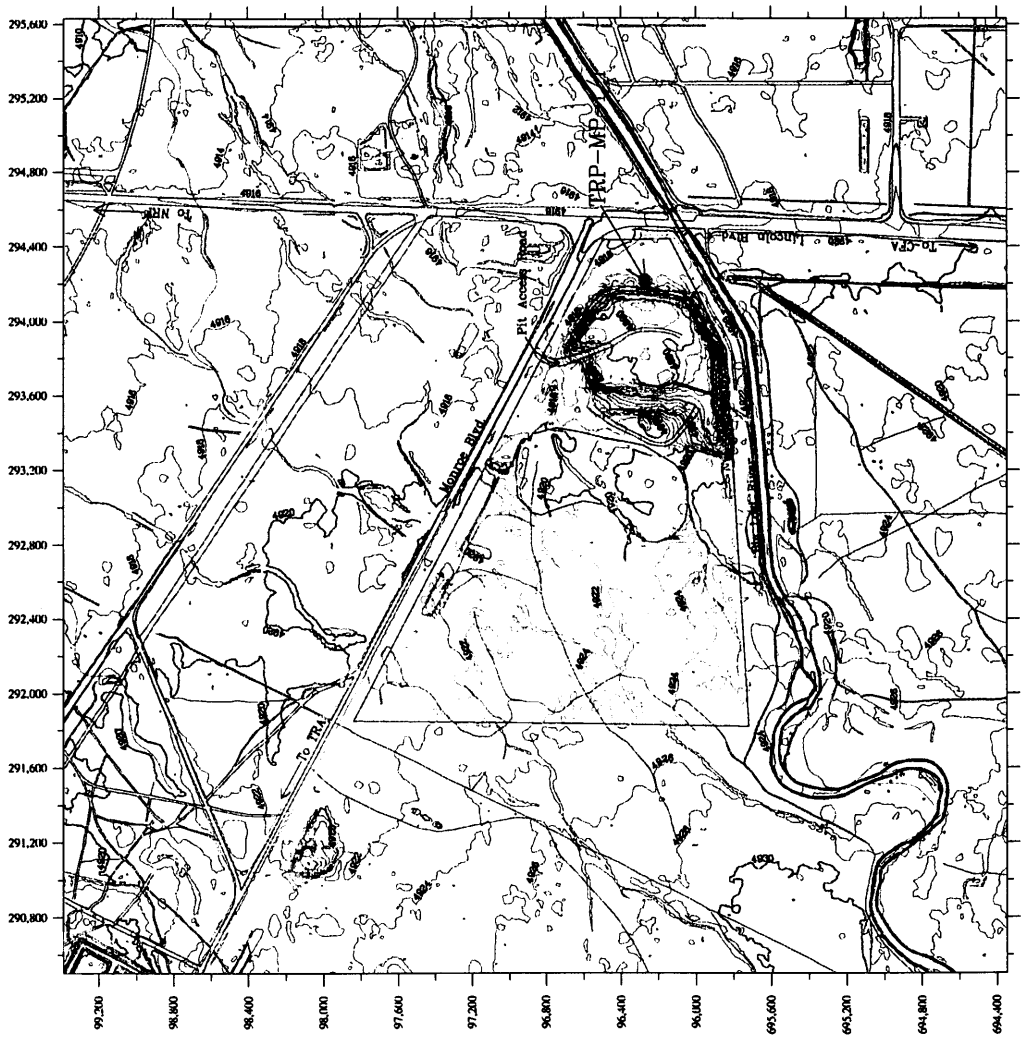


Figure A-21. Monroe Boulevard storm water monitoring locations.

Figure A-22. T-12 Gravel Pit storm water monitoring locations.

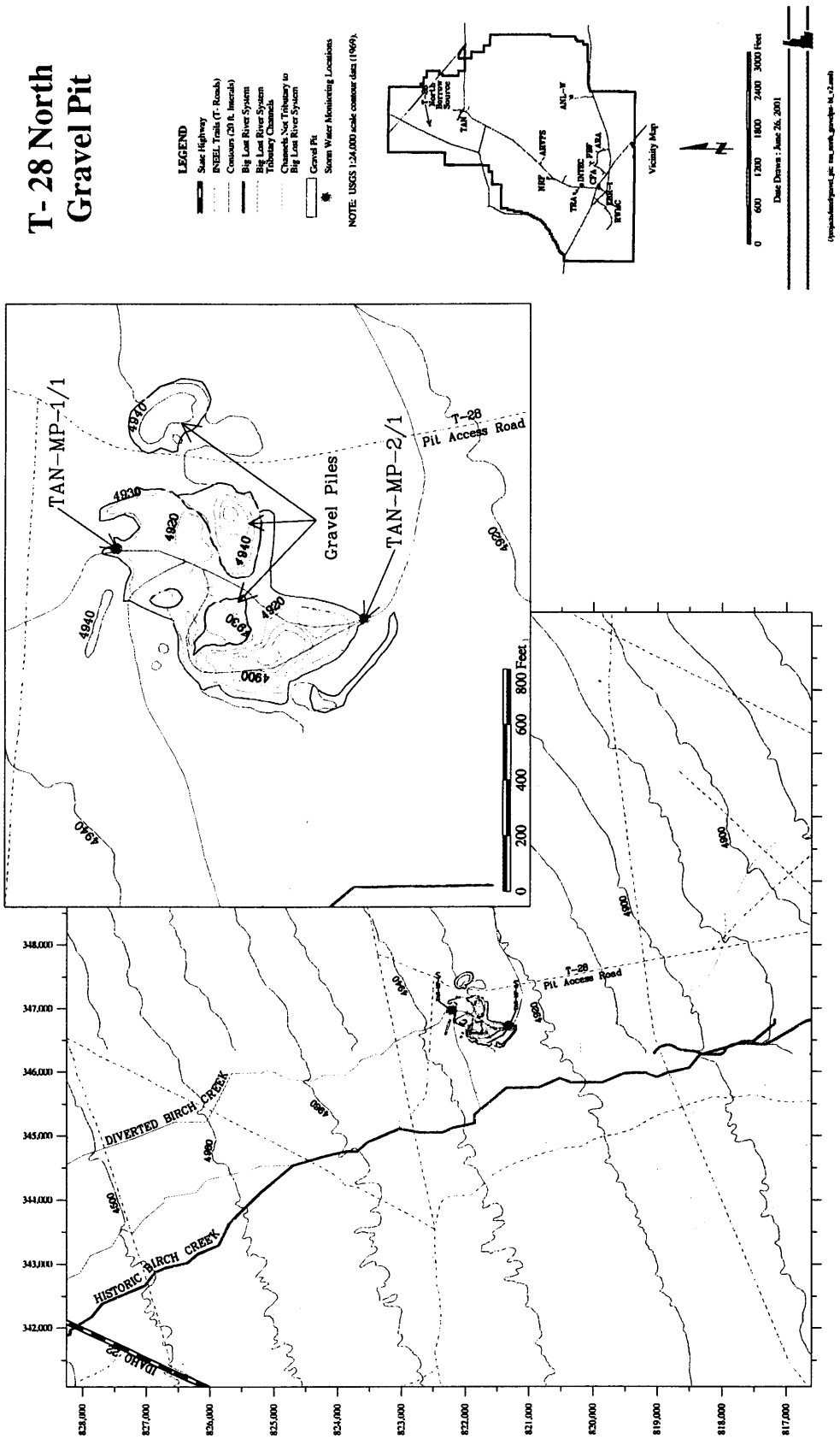


Figure A-23. T-28 North Gravel Pit storm water monitoring locations.

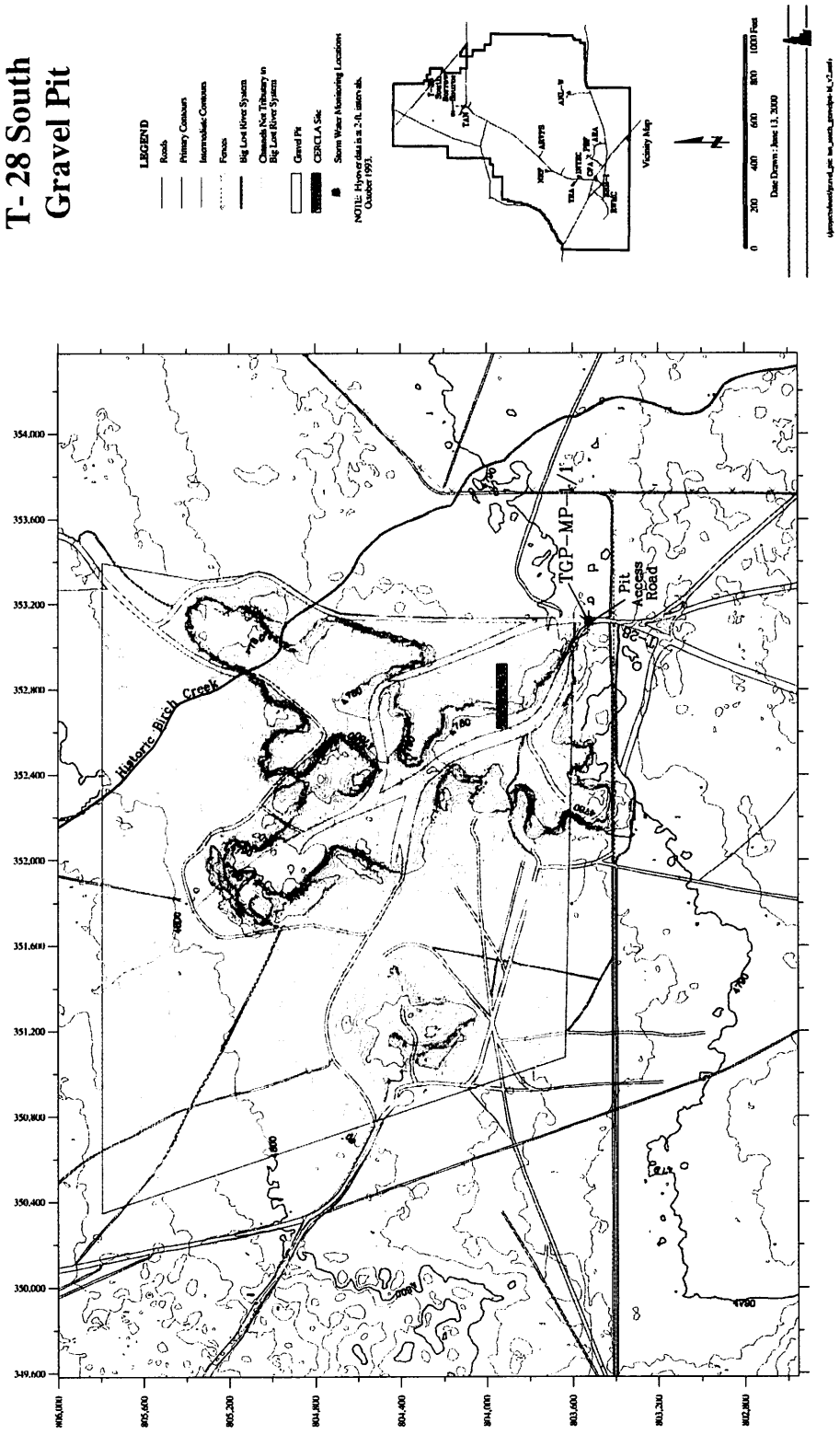


Figure A-24. T-28 South Gravel Pit storm water monitoring locations.

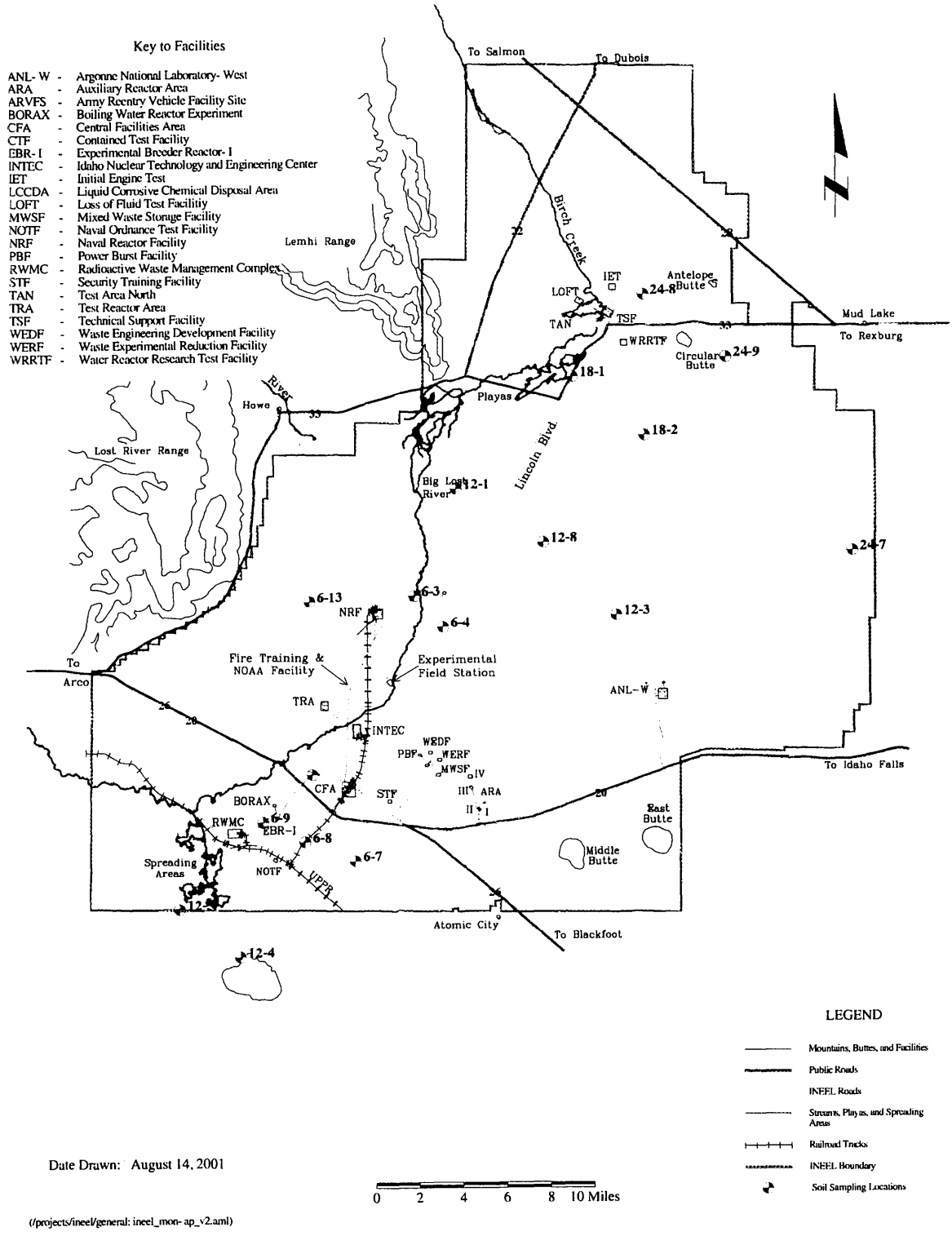


Figure A-25. INEEL soil sampling large grid.

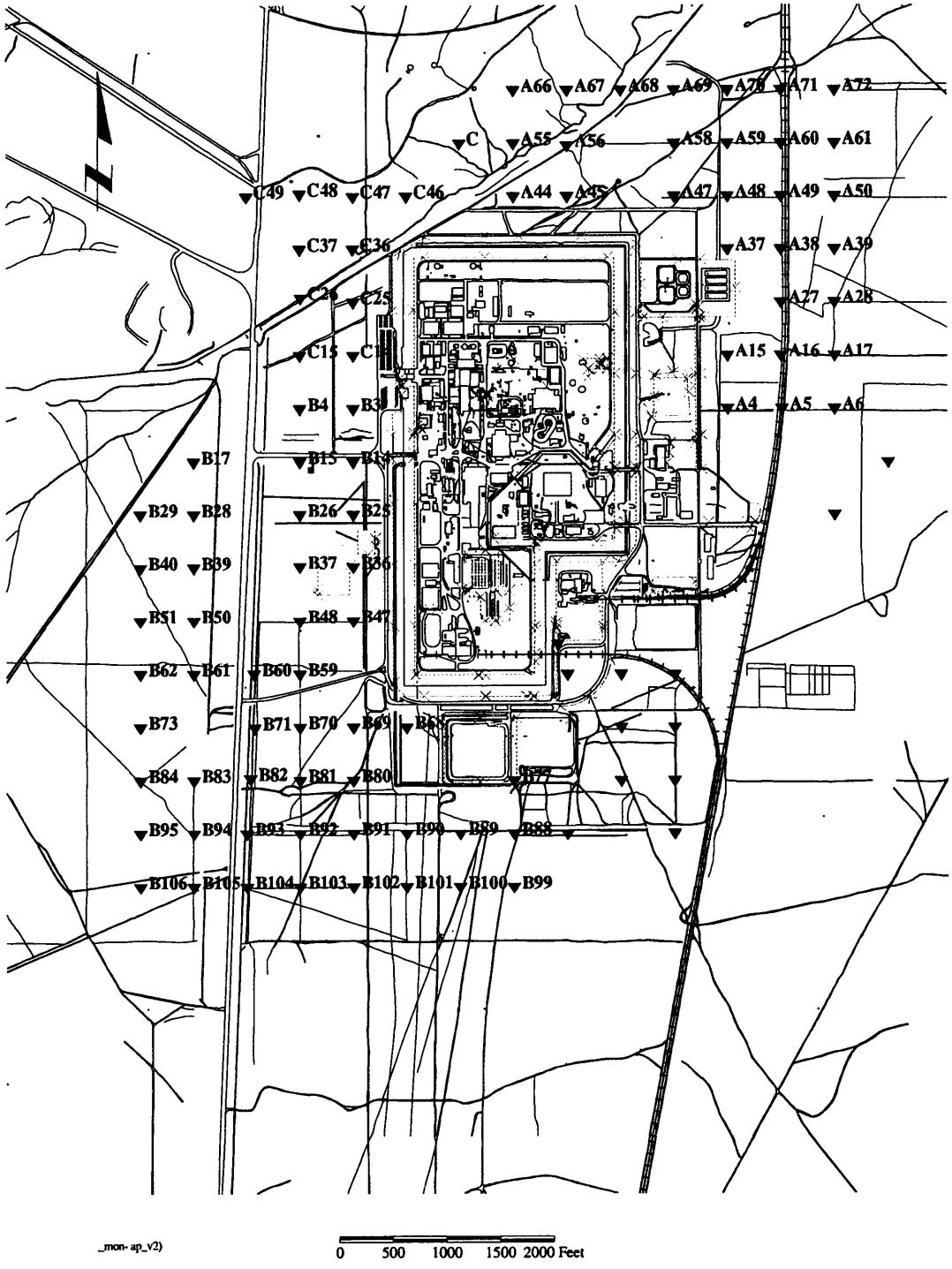


Figure A-26. INTEC soil sampling small grid.

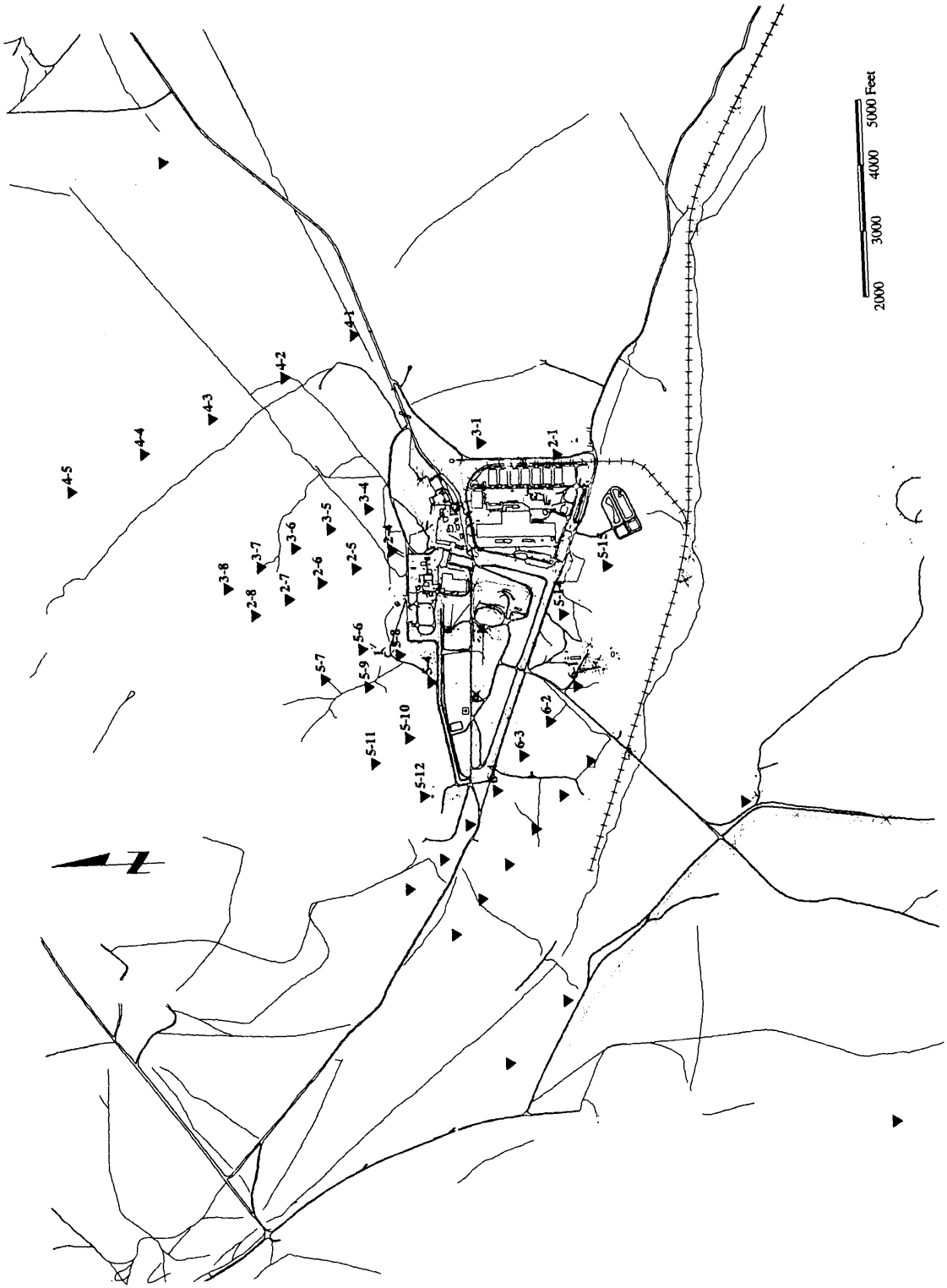


Figure A-27. RWMC soil monitoring locations.

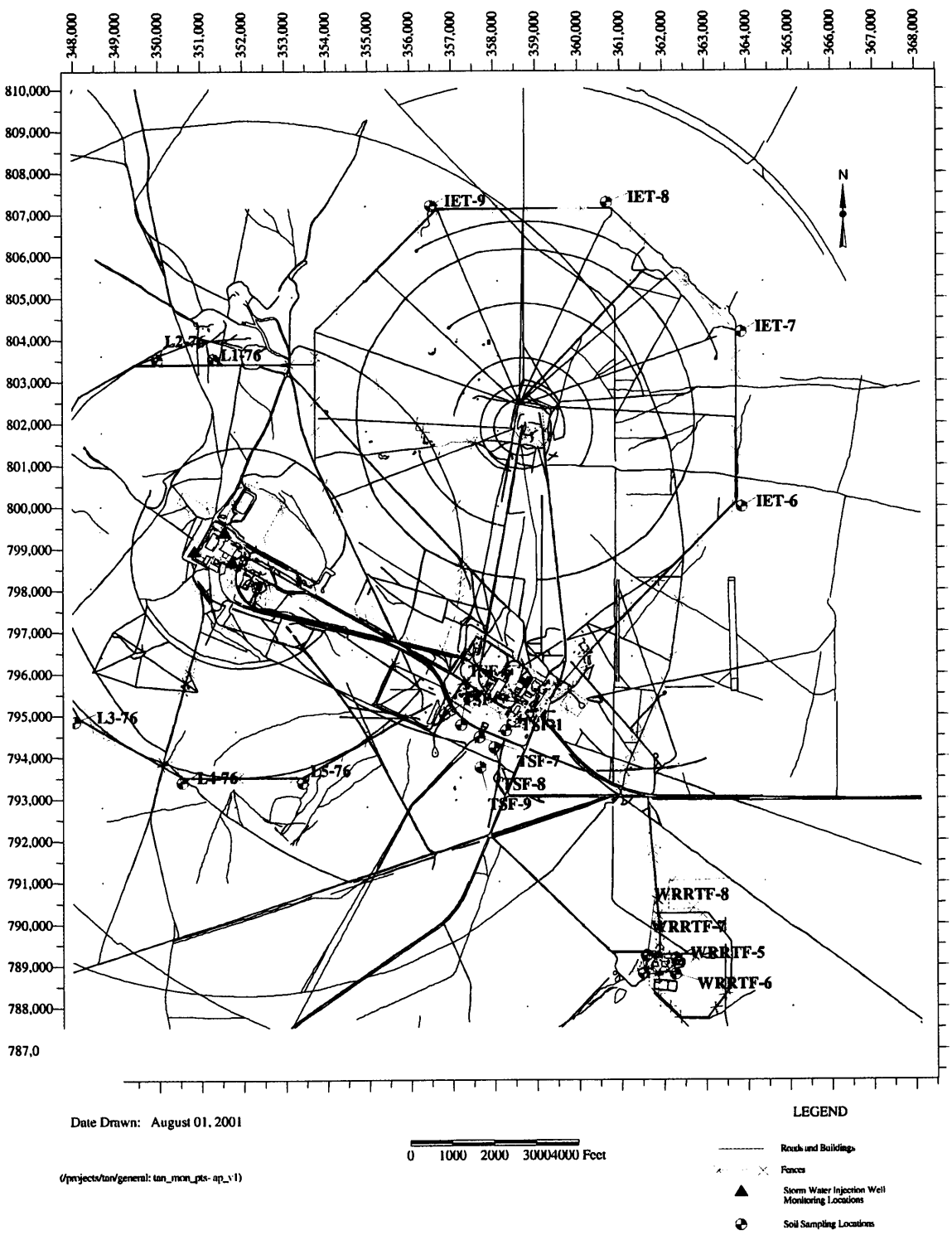


Figure A-28. Test Area North soil sampling locations.

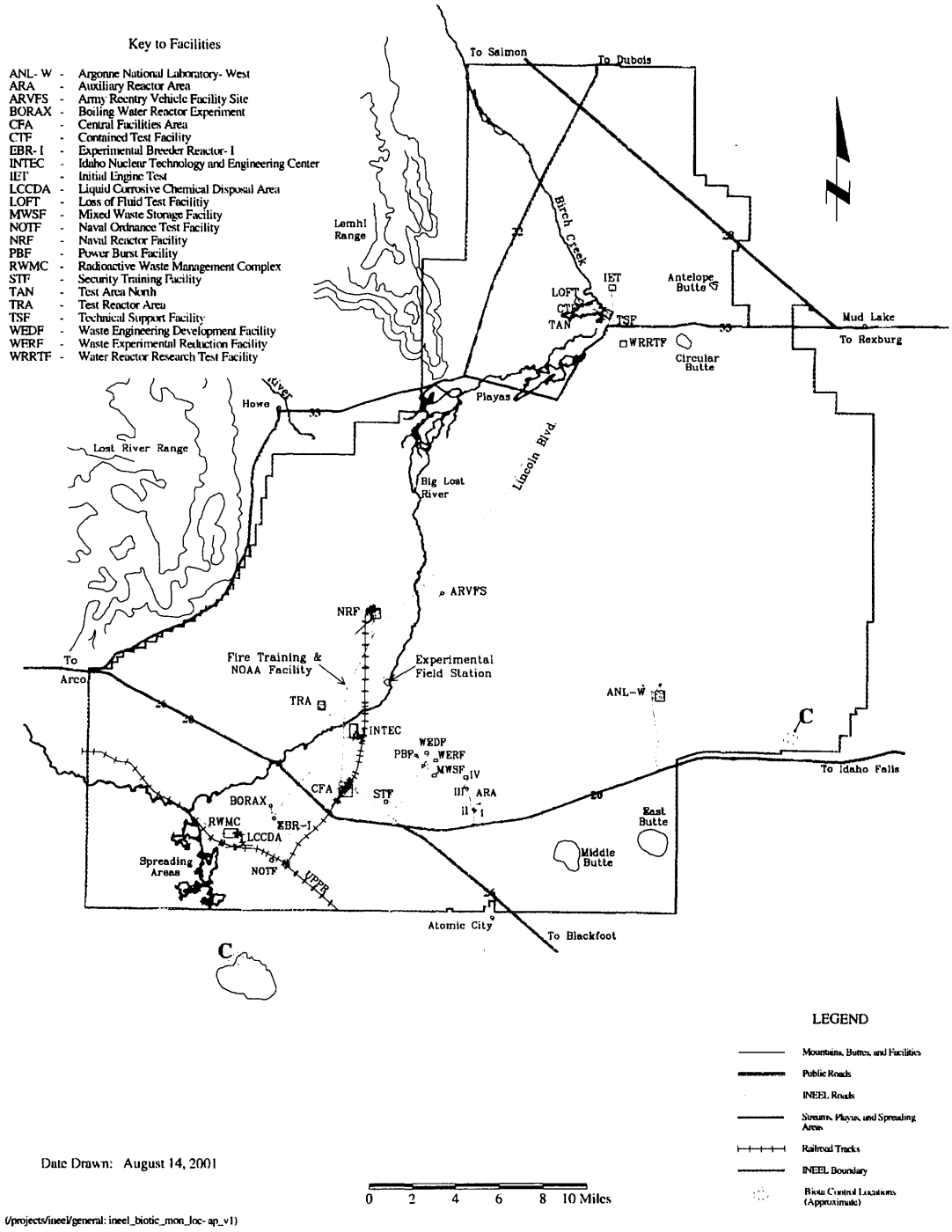


Figure A-29. Biota control locations (RWMC—Frenchman's Cabin, WERF—Tractor Flats).

# Appendix B

# Statistical Analysis Methods

# Appendix B

# Statistical Analysis Methods

## INTRODUCTION

This appendix summarizes the statistical methods used to analyze programmatic data presented in this report.

## LIQUID EFFLUENT MONITORING PROGRAM

### Data Pretreatment and Validation

Liquid Effluent Monitoring Program data are validated following validation procedures to determine the quality of the analytical results. After the quality of the data is determined, program personnel assess the usability of the data. Data entry is also verified to prevent using inaccurate data results due to entry errors.

### Control Charts

The control chart is a statistical tool used primarily to study a continuous process. For the Liquid Effluent Monitoring Program, the concentrations of analytes in the wastewater streams are the continuous processes of interest. While the concentrations of the analytes of interest for a specific stream are known to vary over time, plotting the values on a control chart can help assess the data for changes that might indicate a loss of process control or an unplanned release.

For each stream currently monitored, control charts are generated for each nonvolatile organic compound/nonradiological analyte with sufficient historical data to establish control limits. Available historical data from 1986 forward are used to generate the control limits. Current-year data are charted with the control limits to assess possible changes from historical stream characteristics. Currently, control limits are not calculated for radionuclides or volatile organic compounds due to the number of measurements below the detection limit and the lack of historical data prior to 1992.

By using control charts, it is assumed that the process is in control. Therefore, historical data are screened to exclude outliers and data from known periods when the effluent process changed. With the exception of pH, the concern is for unusually high concentrations. The control charts for these parameters are generated with a center line (based on the average of the historical data) and two upper control limits. The Level 1 upper control limits are calculated such that there is less than a 5% chance of exceeding the limit due to random fluctuations in the analyte concentration. For the Level 2 upper control limit, there is less than a 1% chance of exceeding the limit due to random fluctuations. Unusually low or high concentrations are both concerns for pH. Therefore, the pH control charts are generated with a lower and upper control limit. These limits are calculated such that there is less than a 1% chance that a concentration will fall outside either limit due to random fluctuations in the pH for the effluent.

Current year concentrations that exceed the Level 2 control limit (or either the upper or lower limit for pH) fall outside what is expected based on historical stream characteristics, but do not necessarily indicate an adverse environmental consequence. Instances where monitoring data exceed the Level 2 control limit (or either limit for pH) are reviewed to determine if a significant change occurred in the effluent stream or to determine if there are possible adverse environmental consequences. In most cases,

no concern is identified. When the change is substantial and environmental or regulatory issues are identified, appropriate followup action is taken.

# ENVIRONMENTAL SURVEILLANCES

## Data Pretreatment

Before statistical analyses, data are screened to identify gross data errors, such as transcription errors, missing values, and out-of-range data points that do not meet other specific criteria, and to eliminate data from instruments that do not meet the minimum required operating characteristics as specified in the data quality objectives. After the initial screening, the data are screened for outliers. Graphical techniques, such as probability plots, stem and leaf plots, box plots, and other exploratory data analysis techniques, are the primary tools used for detecting potential data outliers. In cases where outliers are traceable to a specific error, a corrected value may be used to replace the outlier. If no correction is possible, then the point may be deleted from the data set. However, outliers with unattributable causes are rarely eliminated from data sets. Such outliers may be truly accurate data measurements indicative of unusual but important phenomena. Typically, two sets of analyses are performed, one with and one without the outlying data, and the two results are compared.

## Trend Analyses

To visually evaluate long-term trends, cumulative data are presented graphically. For waste management surveillance gross alpha and gross beta air data, concentration data for specific locations are plotted over the year of interest.

For thermoluminescent dosimeter (TLD) data, cumulative six-month exposure data from specific locations, with background data (or distant community), are plotted over time. All historical data are smoothed and plotted on a linear scale to reveal the trend over time.

## Comparisons Between Groupings

### Penetrating Radiation Data from Thermoluminescent Dosimeters

Differences in yearly TLD exposures, either seasonally or by facility location, are analyzed using the nonparametric Kruskal-Wallis test for differences in medians. Nonparametric analyses are performed because the data are not expected to follow a normal distribution. Changes among groups are considered to be statistically significant if the p-value, associated with the null hypothesis, is less than 0.05. The null hypothesis is that the different samples in the groupings were from the same distribution or from distributions with the same median.

The statistical significance of changes in median exposures from the previous year to the current year is determined by facility. Facility groupings consist of background (or distant community) exposures, as well as individual waste management locations. Since the TLDs are changed every six months, the significance of the differences in the median seasonal exposure (either spring or fall) is also of interest.

Box and whisker plots graphically display the differences in median exposures between groups (either by facility or season). For each grouping, the median exposures of all the data is shown on the box and whisker plots, along with a box indicating the 25–75 percentile range based on all the data. The whiskers on the plots indicate the (nonoutlier) minimum and maximum exposures within each grouping.

For the box and whisker plots, the word "outlier" applies to those data values that are either greater than or less than 1.5 times the range of the box. This type of graph is used because it visually depicts differences in the medians of the groupings; therefore, the outliers are not shown since the scale required to show them would mask most of the visual differences in the medians calculation. Even though the outliers are not shown on the box and whisker plots, they are included in the calculation of the medians.

### Airborne (Gross Alpha and Gross Beta) Data

Differences in year-to-year median concentrations for facility groupings of airborne data are also analyzed using the Kruskal-Wallis test for differences in medians. Data from the current year are grouped by facility for each contaminant and monitor type (that is, gross alpha or gross beta and $PM_{10}$ or suspended particulate monitor). Differences in groupings are also graphically displayed using the box and whisker plots discussed above.

# Appendix C

# Detection Limits

# Appendix C
# Detection Limits

## ENVIRONMENTAL SURVEILLANCE PROGRAM GAMMA SPECTROMETRY ANALYSES DETECTION LIMITS

Tables C-1 and C-2 give absolute detection limits in the right-hand column for each sample type. The absolute detection limits are the total activities that may be present in the sample aliquot taken for analyses. These activities should be detected under the counting conditions described and calculated according to the definition of L. A. Currie. This definition is as follows:

$$Detection\ limit = \frac{2.71 + 4.66\,B^{1/2}}{t \times E \times P \times 2.22}$$

where

$B$ = Total correction in counts (Compton, background, blanks, etc., for the same counting time)

$t$ = Counting time in minutes

$E$ = Counting efficiency as a fraction

$P$ = Gamma-ray emission probability for the particular gamma ray being measured

$2.22$ = dpm/pCi.

The figures in the left-hand column of each sample type give the same detection limits expressed in terms of pCi/unit weight or volume for the average sample sizes expected to be analyzed. The absolute detection limits must remain constant for a given counting time and efficiency; therefore, the detection limits in terms of concentrations become higher or lower as the sample size actually used in the analyses becomes smaller or larger. Table C-3 presents descriptions of environmental monitoring samples for gamma spectrometry analyses and counting conditions for stated detection limits.

## ENVIRONMENTAL SURVEILLANCE PROGRAM RADIOCHEMICAL ANALYSES DETECTION LIMITS

Tables C-1 and C-3 list approximate detection limits of present methods used to analyze the samples discussed in this report. These limits are based on sample sizes and forms as described in this report. Actual detection limits may vary depending upon background, yield, counting time, and sample volume.

The detection limits given in Table C-3 in terms of activity per unit weight or volume are derived from the total activities in microcuries ($\mu$Ci) that must be present in the sample aliquot. The detection limits are calculated under the following conditions:

- A counting time of 1,000 minutes

- A counting efficiency of about 25%
- A chemical yield of about 80%
- Clean detector and reagent blanks that give not more than about 5 counts in 1,000 minutes in any given energy interval
- The calculation performed according to the definition of detection limits given by L. A. Currie as follows:

$$Detection\ limit = \frac{2.71 + 4.66\,B^{1/2}}{t \times E \times Y \times 2.22E + 6}\,\mu Ci$$

where

| | | |
|---|---|---|
| $B$ | = | Total background and blank correction |
| $t$ | = | Counting time in minutes |
| $E$ | = | Counting efficiency as a fraction |
| $Y$ | = | Chemical yield as a fraction |
| $2.22E+6$ | = | dpm/$\mu$Ci. |

These absolute detection limits, in terms of total microcuries per sample, are approximately 3E-6 for strontium-90 and approximately 3E-8 for all alpha-emitting nuclides. To determine the detection limits as activity concentration, the absolute detection limits must be divided by the sample size taken for analyses. On samples, the activity found is divided by the actual sample size analyzed or reported in terms of total activity per sample.

Table C-1. Absolute detection limits for waste management surveillances of air, water, and soil samples for gamma spectrometry.

| | Air Filters | | Water Filtrate | | Water Insoluble | | Soils | |
|---|---|---|---|---|---|---|---|---|
| Radionuclides | E-9 pCi/mL | Total pCi | E-2 pCi/mL | Total pCi | E-4 pCi/mL | Total pCi | pCi/g | Total pCi |
| Sc-46 | 1 | 6 | 0.2 | 8 | 5 | 2 | 0.19 | 120 |
| Cr-51 | 5 | 3 | 1.1 | 44 | 20 | 8 | 0.5 | 300 |
| Mn-54 | 0.5 | 3 | 0.5 | 20 | 3 | 1.2 | 0.1 | 60 |
| Co-58 | 0.5 | 3 | 0.09 | 3.6 | 4 | 1.6 | 0.1 | 60 |
| Fe-59 | 0.9 | 5.4 | 1.5 | 60 | 7 | 2.8 | 0.11 | 60 |
| Co-60 | 0.8 | 4.8 | 0.8 | 32 | 6 | 2.4 | 0.2 | 120 |
| Zn-65 | 1 | 6 | 0.5 | 20 | 15 | 6 | 0.2 | 120 |
| Nb-94 | 0.5 | 3 | 0.15 | 6 | 4 | 1.6 | 0.1 | 60 |
| Nb-95 | 0.5 | 3 | 0.11 | 4.4 | 80 | 32 | 0.1 | 60 |
| Zr-95 | 0.8 | 4.8 | 0.3 | 8 | 7 | 2.8 | 0.11 | 60 |
| Ru-103 | 0.7 | 4.2 | 0.16 | 6.4 | 4 | 1.6 | 0.1 | 60 |
| Ru-106 | 5 | 30 | 0.12 | 4.8 | 40 | 1.6 | 0.5 | 300 |
| Ag-110m | 0.5 | 3 | 0.15 | 6 | 5 | 20 | 0.1 | 60 |
| Sb-124 | 0.5 | 3 | 0.13 | 5.2 | 5 | 2 | 0.1 | 60 |
| Sb-125 | 1.5 | 9 | 0.3 | 12 | 15 | 6 | 0.2 | 120 |
| Cs-134 | 0.6 | 3.6 | 0.09 | 3.6 | 4 | 1.6 | 0.1 | 60 |
| Cs-137 | 0.8 | 4.8 | 0.3 | 12 | 20 | 8 | 0.1 | 60 |
| Ce-141 | 0.9 | 5.4 | 0.3 | 12 | 6 | 2.4 | 0.1 | 60 |
| Ce-144 | 5 | 30 | 1.0 | 40 | 20 | 8 | 0.4 | 240 |
| Eu-152 | 2 | 12 | 0.5 | 20 | 15 | 6 | 0.2 | 120 |
| Eu-154 | 2 | 12 | 0.3 | 12 | 15 | 6 | 0.3 | 180 |
| Eu-155 | 2 | 12 | 0.8 | 32 | 10 | 4 | 0.3 | 180 |

Table C-1. (continued).

| | Air Filters | | Water Filtrate | | Water Insoluble | | Soils | |
|---|---|---|---|---|---|---|---|---|
| Radionuclides | E-9 pCi/mL | Total pCi | E-2 pCi/mL | Total pCi | E-4 pCi/mL | Total pCi | pCi/g | Total pCi |
| Hf-181 | 0.6 | 3.6 | 0.12 | 4.8 | 6 | 2.4 | 0.1 | 60 |
| Ta-182 | 2 | 12 | 0.5 | 20 | 20 | 8 | 0.4 | 240 |
| Hg-203 | 0.5 | 3 | 0.15 | 6 | 2 | 0.8 | 0.1 | 60 |
| Am-241 | 4 | 24 | 1.5 | 60 | 40 | 16 | 1.2 | 700 |
| Gross beta | 9.5 | NA | NA | NA | NA | NA | NA | NA |
| Gross alpha | 3.3 | NA | NA | NA | NA | NA | NA | NA |

Table C-2. Absolute detection limits for waste management surveillance of biotic samples for gamma spectrometry.[a]

| | Small Mammals | | Vegetation | |
|---|---|---|---|---|
| Radionuclide | pCi/g | Total pCi | pCi/g | Total pCi |
| Sc-46 | 0.2 | 12 | 0.07 | 12 |
| Cr-51 | 1.4 | 84 | 0.4 | 67 |
| Mn-54 | 0.18 | 11 | 0.05 | 8.4 |
| Co-58 | 0.3 | 18 | 0.05 | 8.4 |
| Fe-59 | 0.6 | 36 | 0.08 | 14 |
| Co-60 | 1 | 60 | 0.1 | 17 |
| Zn-65 | 0.7 | 42 | 0.13 | 22 |
| Nb-94 | 0.2 | 12 | 0.05 | 8.4 |
| Nb-95 | 0.2 | 12 | 0.04 | 6.7 |
| Zr-95 | 0.3 | 18 | 0.07 | 12 |
| Ru-103 | 0.2 | 120 | 0.04 | 6.7 |
| Ru-106 | 2 | 12 | 0.5 | 84 |
| Ag-110m | 0.2 | 12 | 0.05 | 8.4 |
| Sb-124 | 0.2 | 12 | 0.04 | 6.7 |
| Sb-125 | 0.7 | 42 | 0.11 | 18 |
| Cs-134 | 0.3 | 18 | 0.04 | 6.7 |
| Cs-137 | 1.3 | 78 | 0.13 | 22 |
| Ce-141 | 0.2 | 12 | 0.05 | 8.4 |
| Ce-144 | 1.1 | 66 | 0.16 | 27 |
| Eu-152 | 0.6 | 36 | 0.1 | 17 |
| Eu-154 | 0.7 | 42 | 0.15 | 25 |
| Eu-155 | 0.6 | 36 | 0.1 | 17 |
| Hf-181 | 0.2 | 12 | 0.04 | 6.7 |
| Ta-182 | 1.1 | 66 | 0.3 | 50 |
| Hg-203 | 0.16 | 96 | 0.05 | 8.4 |
| Am-241 | 2 | 120 | 0.3 | 50 |

a. No biota samples collected in 2000.

Table C-3. Detection limits for environmental surveillance samples for radiochemical analyses.

| Nuclide | Detection Limits | | | |
|---|---|---|---|---|
| | Air (μCi/cc) | Water (μCi/mL) | Soil (μCi/g) | Veg. (μCi/g) |
| Am-241, Pu-238, Pu-239, Pu-240 | 8 E-18 | 2 E-11 | 3 E-9 | 6 E-10 |
| Sr-90 | 1 E-16 | 3 E-10 | 6 E-8 | 1.2 E-8 |
| U-234 | 6 E-18 | 6 E-11 | 3 E-9 | 2 E-9 |
| U-235 and U-238 | 4 E-18 | 4 E-11 | 6 E-9 | 1 E-9 |
| H-3 | 1 E-11 | — | — | — |

# Appendix D

# Environmental Standards

# Appendix D
# Environmental Standards

## ENVIRONMENTAL SURVEILLANCE PROGRAM

Radionuclide concentrations in air and runoff samples are compared with Derived Concentration Guide values for air and water.[1] The Derived Concentration Guide values listed are provided as reference values for conducting radiological protection programs at operational Department of Energy facilities and sites.

Table D-1 lists applicable Derived Concentration Guides. The Derived Concentration Guides represent the concentrations of radioactivity in air inhaled or water ingested continuously during a year that resulted in a 100-mrem, 50-year committed effective dose equivalent. The Derived Concentration Guides are used as a point of reference only. Comparing individual measurements to the Derived Concentration Guides gives the maximum dose a person could receive at the location where the sample was collected, given the following two assumptions: (1) the concentration was at the Derived Concentration Guide level continuously for the entire year, and (2) the person receiving the exposure was at that location for the entire year, continually drinking the water or inhaling the air. In practice, Derived Concentration Guides are rarely, if ever, exceeded for even a short period during the year. In addition, the radionuclide concentration at any area accessible to the public will be even less due to the dispersion from the facility boundary (where the sample was collected) to the site boundary (the closest location where the public has unrestricted access).[2] DOE Order 5400.5[1] contains the principle standards and guides for release of radionuclides at the INEEL.

Table D-2 shows the Department of Energy and Environmental Protection Agency standards. Table D-3 shows the ambient air quality standards.

Table D-4 lists Environmental Concentration Guidelines for the radionuclides in soil that are most likely to be found in environmental samples. The Environmental Concentration Guidelines in Table D-4 are based on a homestead scenario. This scenario considers the radiation dose to the homesteader from inhaling and ingesting radionuclides, as well as external radiation. Since the hypothetical homesteader is assumed to live on a uniformly contaminated area that is large enough for subsistence farming, this scenario results in very conservative concentration guidelines. The homestead scenario overestimates the actual doses that would be received by off-homestead individuals from radionuclides in soil.

## WATER

The following environmental regulations apply to the Drinking Water Program:

- Federal Safe Drinking Water Act[3]
- Code of Federal Regulations (40 CFR Parts 141-143)[4,5,6]
- Idaho Regulations for Public Drinking Water Systems, IDAPA 58.01.08000-.08999[7]
- DOE Order 5400.5[8]
- *Environmental Compliance Planning Manual.*[9]

Table D-5 lists the parameters monitored, regulated, and reported.

The City of Idaho Falls developed an Industrial Pretreatment Program in accordance with 40 CFR 403 and the Clean Water Act. Industrial Wastewater Acceptance Forms issued by the City authorize discharges to the City of Idaho Falls sewer system in compliance with Chapter 1, Section 8, of the City of Idaho Falls Sewer Ordinance. Table D-6 lists the 2000 concentration limits for discharges to the City of Idaho Falls sewer.

Table D-7 lists the Environmental Protection Agency benchmark concentrations used as voluntary comparison criteria for the Storm Water Monitoring Program data. The Environmental Protection Agency benchmark concentrations are from the 1995 Storm Water Multi-Sector General Permit in the *Federal Register*.[10]

Table D-1. Derived Concentration Guides.

| | DCGs for the Public[a,b] | |
|---|---|---|
| Radionuclide | DCG for Air ($\mu$Ci/mL) | DCG for Water ($\mu$Ci/mL) |
| H-3 | 1 E-7 | 2 E-3 |
| Sc-46 | 6 E-10 | 2 E-5 |
| Cr-51 | 5 E-8 | 1 E-3 |
| Mn-54 | 2 E-9 | 5 E-5 |
| Co-58 | 2 E-9 | 4 E-5 |
| Fe-59 | 8 E-10 | 2 E-5 |
| Co-60 | 8 E-11 | 5 E-6 |
| Zn-65 | 6 E-10 | 9 E-6 |
| Sr-90[c] | 9 E-12 | 1 E-6 |
| Nb-95 | 3 E-9 | 6 E-5 |
| Zr-95 | 6 E-10 | 4 E-5 |
| Ru-103 | 2 E-9 | 5 E-5 |
| Ru-106 | 3 E-11 | 6 E-6 |
| Ag-110m | 2 E-10 | 1 E-5 |
| Sb-125 | 1 E-9 | 5 E-5 |
| I-129 | 7 E-11 | 5 E-7 |
| I-131 | 4 E-10 | 3 E-6 |
| Cs-134 | 2 E-10 | 2 E-6 |
| Cs-137 | 4 E-10 | 3 E-6 |
| Ce-141 | 1 E-9 | 5 E-5 |
| Ce-144 | 3 E-11 | 7 E-6 |
| Eu-152 | 5 E-11 | 2 E-5 |
| Eu-154 | 5 E-11 | 2 E-5 |
| Ra-226 | 1 E-12 | 1 E-7 |
| Pu-238 | 3 E-14 | 4 E-8 |
| Pu-239[c] | 2 E-14 | 3 E-8 |
| Am-241 | 2 E-14 | 3 E-8 |
| U-235 | 1 E-13 | 6 E-7 |
| U-238 | 1 E-13 | 6 E-7 |
| Gross alpha | 2 E-14[c] | — |
| Gross beta | 9 E-12[c] | — |

a. This table contains the air and water Derived Concentration Guides based on concentrations that could be continuously inhaled or ingested, respectively, and do not exceed an effective dose equivalent of 100 mrem/yr.

b. Derived Concentration Guides apply to radionuclide concentrations in excess of those occurring naturally or due to fallout.

c. The Derived Concentration Guides of Pu-239 and Sr-90 are the most restrictive for alpha- and beta-emitting nuclides, respectively, and are appropriate to use for gross alpha and gross beta Derived Concentration Guides.

Table D-2. Radiation standards for protection of the public at the INEEL.

| | Effective Dose Equivalent | |
|---|---|---|
| | mrem/yr | mSv/yr |
| DOE standard for routine DOE activities[a] (all pathways) | 100 | 1 |
| EPA standard for site operations (airborne pathway only) | 10 | 0.1 |

a. The effective dose equivalent for any member of the public from all routine DOE operations including remedial activities and release of naturally-occurring radionuclides shall not exceed this value. Routine operations refers to normal, planned operations and does not include accidental or unplanned releases.

Table D-3. Environmental Protection Agency ambient air quality standards.

| Pollutant | Type of Standard[a,b] | Sampling Period | EPA[c] ($\mu g/m^3$) |
|---|---|---|---|
| Sulfur dioxide | S | 3-hour average | 1,300 |
| | P | 24-hour average | 365 |
| | P | Annual average | 80 |
| Nitrogen dioxide | S&P | Annual average | 100 |
| | S | 24-hour average | 150 |
| Total particulates | S&P | Annual average | 50 |

a. National primary (P) ambient air quality standards define levels of air quality to protect the public health. Secondary (S) ambient air quality standards define levels of air quality to protect the public welfare from any known or anticipated adverse effects of a pollutant.

b. The primary and secondary standard to the annual average applies only to "particulates with an aerodynamic diameter less than or equal to a nominal 10 micrometers."

c. The State of Idaho has adopted these same ambient air quality standards.

Table D-4. Environmental Concentration Guidelines for common radionuclides found in environmental soil samples.

| Radionuclide | Environmental Concentration Guidelines for Soil[a] ($\mu$Ci/g) |
|---|---|
| Mn-54 | 4 E-6 |
| Co-58 | 4 E-6 |
| Co-60 | 1 E-6 |
| Ru-106 | 2 E-5 |
| Sb-125 | 8 E-6 |
| Cs-134 | 2 E-6 |
| Cs-137 | 6 E-6 |
| Ce-144 | 6 E-5 |
| Eu-152 | 3 E-6 |
| Am-241 | 4 E-5 |
| Sr-90 | 6 E-6 |
| U-232 | 2 E-6 |
| U-233 | 2 E-4 |
| U-234 | 2 E-4 |
| U-235 | 2 E-5 |
| U-238 | 1 E-4 |
| Pu-238 | 8 E-5 |
| Pu-239, -240 | 8 E-5 |

a. See Reference 2. Concentrations correspond to a 50-yr dose commitment of 100 mrem/yr to a homesteader beginning in the first year after release from facility. This concentration assumes uniform contamination of an area adequate for subsistence farming.

Table D-5. Parameters and maximum contaminant levels.[a]

| Parameter | Maximum Contaminant Level |
|---|---|
| **REGULATED VOLATILE ORGANIC COMPOUNDS** | |
| Benzene | 0.005 mg/L |
| Vinyl chloride | 0.002 mg/L |
| Carbon tetrachloride | 0.005 mg/L |
| 1,2-dichloroethane | 0.005 mg/L |
| Trichloroethylene | 0.005 mg/L |
| 1,1-dichloroethylene | 0.007 mg/L |
| 1,2,4-trichlorobenzene | 0.07 mg/L |
| 1,1,1-trichloroethane | 0.200 mg/L |
| 1,1,2-trichloroethane | 0.005 mg/L |
| Para-dichlorobenzene | 0.075 mg/L |
| Cis-1,2-dichloroethylene | 0.07 mg/L |
| 1,2-dichloropropane | 0.005 mg/L |
| Dichloromethane | 0.005 mg/L |
| Ethylbenzene | 0.7 mg/L |
| Chlorobenzene | 0.1 mg/L |
| o-dichlorobenzene | 0.6 mg/L |
| Styrene | 0.1 mg/L |
| Tetrachloroethylene | 0.005 mg/L |
| Toluene | 1.0 mg/L |
| Trans-1,2-dichloroethylene | 0.1 mg/L |
| Xylenes (total) | 10.0 mg/L |
| **MICROBIOLOGICAL** | |
| Total coliform | If less than 40 samples per month collected, no more than 1 positive |
| **INORGANIC** | |
| Asbestos | 7 million fibers per liter (>10 $\mu$m) |
| Fluoride | 4 mg/L |
| Cadmium | 0.005 mg/L |
| Chromium | 0.1 mg/L |
| Mercury | 0.002 mg/L |
| Selenium | 0.05 mg/L |

Table D-5. (continued).

| Parameter | Maximum Contaminant Level |
|---|---|
| Arsenic | 0.05 mg/L |
| Barium | 2 mg/L |
| Lead | 0.015 mg/L |
| Nitrate | 10 mg/L (as nitrogen) |
| Nitrite | 1 mg/L (as nitrogen) |
| Copper | 1.3 mg/L |
| Antimony | 0.006 mg/L |
| Beryllium | 0.004 mg/L |
| Thallium | 0.002 mg/L |
| Cyanide | 0.2 mg/L |
| **ORGANICS** | |
| Alachor | 0.002 mg/L |
| Atrazine | 0.003 mg/L |
| Carbofuran | 0.04 mg/L |
| Chlordane | 0.002 mg/L |
| Dibromochloropropane (DBCP) | 0.0002 mg/L |
| 2,4-D | 0.07 mg/L |
| Ethylene dibromide (EDB) | 0.00005 mg/L |
| Heptachlor | 0.0004 mg/L |
| Heptachlor epoxide | 0.0002 mg/L |
| Lindane | 0.0002 mg/L |
| Methoxychlor | 0.04 mg/L |
| Polychlorinated biphenyls (PCBs) | 0.0005 mg/L |
| Toxaphene | 0.003 mg/L |
| 2,4,5-TP (silvex) | 0.05 mg/L |
| Pentachlorophenol | 0.001 mg/L |
| Aldicarb | 0.003 mg/L |
| Aldicarb sulfone | 0.002 mg/L |
| Aldicarb sulfoxide | 0.004 mg/L |
| Dalapon | 0.2 mg/L |
| Dinoseb | 0.007 mg/L |
| Diquat | 0.02 mg/L |
| Endothall | 0.1 mg/L |

Table D-5. (continued).

| Parameter | Maximum Contaminant Level |
|---|---|
| Endrin | 0.002 mg/L |
| Glyphosate | 0.7 mg/L |
| Oxamyl (vydate) | 0.2 mg/L |
| Picloram | 0.5 mg/L |
| Simazine | 0.004 mg/L |
| Benzo(a)pyrene, (PAH) | 0.0002 mg/L |
| Di(2-ethylhexyl), (adipate) | 0.4 mg/L |
| Di(2-ethylhexyl), (phthalate) | 0.006 mg/L |
| Hexachlorobenzene | 0.001 mg/L |
| Hexachlorocyclo-pentadience (HEX) | 0.05 mg/L |
| 2,3,7,8-TCDD (dioxin) | 0.00000003 mg/L |
| **RADIONUCLIDES** | |
| Radium-226/228 | 5 pCi/L |
| Gross alpha particle activity (including radium-226, but excluding radon and uranium) | 15 pCi/L |
| Beta particle/photon radioactivity | Shall not produce annual dose equivalent to the total body or internal organ greater than 4 millirem/year |
| Tritium | 20,000 pCi/L |
| Strontium-90 | 8 pCi/L |
| **DISINFECTION BY-PRODUCTS** | |
| Total trihalomethanes (the sum of the concentrations of bromodichloromethane, dibromochloromethane, tribomomethane [bromoform] and trichloromethane [chloroform]) | 0.10 mg/L |
| **SECONDARY DRINKING WATER STANDARDS** | |
| Aluminum | 0.05 to 0.2 mg/L |
| Chloride | 250 mg/L |
| Color | 15 color units mg/L |
| Copper | 1.0 mg/L |
| Corrosivity | Noncorrosive |
| Fluoride | 2.0 mg/L |
| Foaming agents | 0.5 mg/L |

Table D-5. (continued).

| Parameter | Maximum Contaminant Level |
|---|---|
| Iron | 0.3 mg/L |
| Manganese | 0.05 mg/L |
| Odor | 3 threshold odor number |
| pH | 6.5–8.5 |
| Silver | 0.1 mg/L |
| Sulfate | 250 mg/L |
| Total dissolved solids (TDS) | 500 mg/L |
| Zinc | 5 mg/L |

a. 40 CFR 141.24, "Organic Chemicals Other Than Total Trihalomethanes, Sampling and Analytical Requirements," current edition.

Table D-6. City of Idaho Falls Sewer Code effluent concentration limits for 2000.

| Parameter | Sewer Limit (mg/L) |
|---|---|
| pH | 5.5–9.0 |
| Arsenic | 0.04 |
| Cadmium | 0.26 |
| Chromium, total | 2.77 |
| Copper | 1.93 |
| Cyanide | 1.04 |
| Lead | 0.29 |
| Mercury | 0.002 |
| Nickel | 2.38 |
| Silver | 0.43 |
| Oil and grease (petroleum or mineral oil products) | 100 |
| Oil and grease (animal and vegetable based) | 250 |
| Trichloroethylene | 0.00 |
| Zinc | 0.90 |
| Stoddard solvent | 0.00 |

Table D-7. Environmental Protection Agency benchmark concentrations for storm water monitoring parameters.[a]

| Chemical | NPDES Benchmark (mg/L) |
|---|---|
| Aluminum | 0.75 |
| Antimony | 0.636 |
| Arsenic | 0.168 |
| Beryllium | 0.13 |
| Cadmium | 0.0159 |
| Copper | 0.0636 |
| Iron | 1.0 |
| Lead | 0.0816 |
| Nickel | 1.417 |
| Selenium | 0.2385 |
| Silver | 0.0318 |
| Zinc | 0.117 |
| Mercury | 0.0024 |
| Solids, total suspended | 100 |
| Nitrogen, nitrate + nitrite | 0.68 |
| Phosphorous, total | 2 |
| Oil and grease, total | 15 |
| Oxygen demand, biochemical | 30 |
| Oxygen demand, chemical | 120 |
| Hydrogen ion (pH) | 6.0 to 9.0 |

a. Benchmark concentrations are from 1995 NPDES Storm Water Multi-Sector General Permit, *Federal Register*, Vol. 60, #189, p. 50826, Sept. 29, 1995.[10]

# REFERENCES


1. DOE Order 5400.5, "Radiation Protection of the Public and the Environment," U.S. Department of Energy, February 8, 1990.

2. EG&G Idaho, Inc., *Development of Criteria for Release of Idaho National Engineering Laboratory Sites Following Decontamination and Decommissioning*, EGG-2400, August 1986.

3. Public Law 99-339, *Safe Drinking Water Act*, Current edition.

4. 40 CFR 141, "National Primary Drinking Water Standards," *Code of Federal Regulations*, Office of the Federal Register, Current edition.

5. 40 CFR 142, "National Primary Drinking Water Regulations Implementation," *Code of Federal Regulations*, Office of the Federal Register, June 18, 1996.

6. 40 CFA 143, "National Secondary Drinking Water Regulations," *Code of Federal Regulations*, Office of the Federal Register, Current edition.

7. IDAPA 58.01., "Idaho Regulations for Public Drinking Water Systems," Current edition.

8. DOE Order 5400.5, Change 2, "Radiation Protection of the Public and the Environment," U.S. Department of Energy, January 7, 1993.

9. U.S. Department of Energy Idaho Operations Office, *Environmental Compliance Planning Manual*, May 1995.

10. 60 FR 189, "Final National Pollutant Discharge Elimination System Storm Water Multi-Sector General Permit for Industrial Activities," *Federal Register*, U.S. Environmental Protection Agency, September 1995, p. 50804.