Idaho National Engineering and Environmental Laboratory

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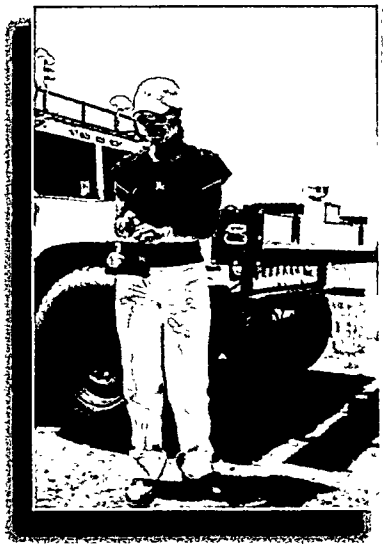
1999 Environmental Monitoring Program Report



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1999 Environmental Monitoring Program Report

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Idaho National Engineering and Environmental Laboratory
Environmental Monitoring Group
Idaho Falls, Idaho 83415

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ABSTRACT

This report describes the calendar year 1999 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, Effluent, Storm Water, Groundwater Monitoring, and Environmental Surveillance Programs. This report compares the 1999 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 expectation of nitrogen in two disposal pond effluent streams, iron and total coliform bacteria in groundwater downgradient from one disposal well, and coliform bacteria in drinking water systems at two facilities. Maintenance activities were performed on the two drinking water systems and tested prior to putting back into service. 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 runoff, 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.

Coliform bacteria were detected in drinking water systems at the Idaho Nuclear Technology and Engineering Center and the Test Reactor Area. The drinking water system at the Idaho Nuclear Technology and Engineering Center was super chlorinated. Then the distribution system was sampled and put back in service. The chlorination system at the Test Reactor Area was not working properly. Repairs were made to the system, and it was put back in service after the sampling results were negative for coliform.

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 six monthly samples. In 1998, an engineering study was conducted to determine the cause of the elevated nitrogen concentrations and to recommend actions to bring nitrogen concentrations into compliance. Most of the maintenance and operational

corrective actions identified in this study have been completed. As part of the ongoing nitrogen study, an in-depth inventory of nitrogen sources contributing to the Idaho Nuclear Technology and Engineering Center sewage will be conducted. The inventory will be evaluated to determine the cause of increasing nitrogen concentrations. If the corrective actions do not reduce the nitrogen to acceptable concentrations, additional operational and plant modifications will be implemented.

At Test Area North, wastewater effluent and groundwater were monitored for compliance with the Sewage Treatment Plant Wastewater Land Application Permit. The permit limit for effluent total nitrogen (20 mg/L) was exceeded in June. The concentration was over seven times higher than the historical average and appears to be anomalous. An investigation was conducted; however, no cause was identified. During the remainder of the reporting period, the concentrations were comparable to the historical waste stream data. Some contaminant concentrations in the groundwater exceeded applicable limits. Groundwater concentrations of iron, sodium, and total coliform exceeded secondary maximum contaminant level and maximum allowable concentration standards. These observations are consistent with the results of the past few years and are not believed to be related to any recent operational changes. The relationship between the elevated contaminant concentrations and discharges to the Disposal Pond is not well defined since historic groundwater contamination and ongoing groundwater remediation efforts continue to significantly impact the groundwater at Test Area North.

During 1999, storm water samples were collected from 11 National Pollutant Discharge Elimination System locations and two injection well basins. No permit or regulatory limits were exceeded. Visual examinations of runoff samples revealed that small amounts of suspended sediments were usually present. No other obvious indicators of storm water pollution were observed. National Pollutant Discharge Elimination System Storm Water Permit analytical results were compared to Environmental Protection Agency benchmark concentrations. Aluminum, iron, zinc, chemical oxygen demand, nitrate + nitrite, and total suspended solids exceeded the Environmental Protection Agency benchmarks. The Environmental Protection Agency stresses that exceeding a benchmark concentration does not imply that violation of standards will occur in the receiving water body. In 1999, runoff was discharged from the Radioactive Waste Management Complex to a man-made channel that is considered a tributary of the Big Lost River; however, the discharge did not reach the Big Lost River. At Test Area North, a small amount of snowmelt discharged into Birch Creek from the gravel pit; however, based upon the analytical results, the water quality was not affected. Since no rainfall or snowmelt runoff was observed at the five injection wells, storm water samples were collected from only two of the seven injection wells. At these two locations, no permit limits were exceeded. However, iron, aluminum, and pH were reported at levels that did not meet the associated secondary maximum contaminant levels.

Environmental surveillance programs monitor ambient air, direct radiation, soils, biota, and surface water. Surveillance of environmental media during 1999 did not identify any trends in data that indicated a loss of control or unplanned releases from facility operations.

Ambient air quality 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 monitors. Cesium-137 was the only man-made gamma-emitting radionuclide detected that could be attributed to facility operations. Cesium-137 was found in one sample collected from the Radioactive Waste Management Complex and from the quarterly composite sample collected from the Auxiliary Reactor Area. Strontium-90 was detected at the Power Burst Facility. The concentrations of all detected radionuclides were consistent with historical data.

The New Waste Calcining Facility at the Idaho Nuclear Technology and Engineering Center operated only approximately 4 months in 1999. As a result, 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 1999 at the Radioactive Waste Management Complex. Cesium-137 was the only man-made, gamma-emitting radionuclide 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.

Crested wheatgrass samples were collected at the Radioactive Waste Management Complex in 1999. No gamma-emitting radionuclides were detected in any of the samples. Americium-241, strontium-90, and plutonium-239/240 were detected at concentrations comparable to historical results.

Soil samples were collected from the Waste Experimental Reduction Facility and the Stored Waste Examination Pilot Plant. Cesium-137 was detected at both locations. At the Waste Experimental Reduction Facility, the concentration was lower than previous concentrations. At the Stored Waste Examination Pilot Plant, the concentration was comparable to historical concentrations and within the range attributed to fallout. Americium-241, plutonium-239/240, and strontium-90 were also detected at the Stored Waste Examination Pilot Plant at concentrations consistent with those previously seen in and around the Radioactive Waste Management Complex.

Soil samples were collected at the Power Burst Facility. Cesium-137 was detected at background concentrations.

Direct radiation exposures measured by thermoluminescent dosimeters and soil surveys were consistent with historical data.

Results from the Environmental Monitoring Program demonstrate that the public health and environment were protected.

CONTENTS

FIGURES

TABLES

ACRONYMS

Am	americium
ARA	Auxiliary Reactor Area
BBWI	Bechtel BWXT Idaho, LLC
BOD	biological oxygen demand
cc	cubic centimeter
CFA	Central Facilities Area
cfm	cubic ft per minute
CFR	Code of Federal Regulations
CN	cyanide
CPP	Chemical Processing Plant
Cs	cesium
CTF	Contained Test Facility
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
L	liter
m	meter
MCL	maximum contaminant level
mg	milligram
mL	milliliter
mR	milliroentgen
mrem	millirem
NA	not applicable
NH_3N	ammonia
NNN	nitrate + nitrite as nitrogen
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
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
WERF	Waste Experimental Reduction Facility
WMF	Waste Management Facility
WRRTF	Water Reactor Research Test Facility

1999 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 1999. 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, and Lockheed Martin Idaho Technologies Company was the previous management and operating contractor (from October 1994 to October 1999).

The Atomic Energy Commission established the INEEL as the National Reactor Testing Station in 1949 to conduct research and further the development of 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 to the Idaho National Engineering and Environmental Laboratory in 1997.

Early monitoring activities were focused on evaluating the potential for radiological exposure of the general public caused by 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 former Atomic Energy Commission and the Radiological Environmental Sciences Laboratory were responsible for conducting most of the sampling and analysis of 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. During those early years, management and operating contractors conducted limited sampling of liquid and airborne effluents from facilities to develop waste inventory information.

Currently, environmental monitoring is conducted by the management and operating contractor, the United States Geological Survey, the Environmental Science and Research Foundation, and the INEEL Oversight Program. The primary emphasis of management and operating contractor environmental monitoring is on-Site compliance. The United States Geological Survey and the Environmental Science and Research Foundation conduct both on-Site and off-Site surveillance, while the INEEL Oversight Program provides an independent verification program both on- and off-Site.

1.1 Scope

The management and operating contractor Environmental Monitoring Program is responsible for routine compliance monitoring and environmental surveillance at the INEEL. The primary purposes of the monitoring and surveillance activities are to:

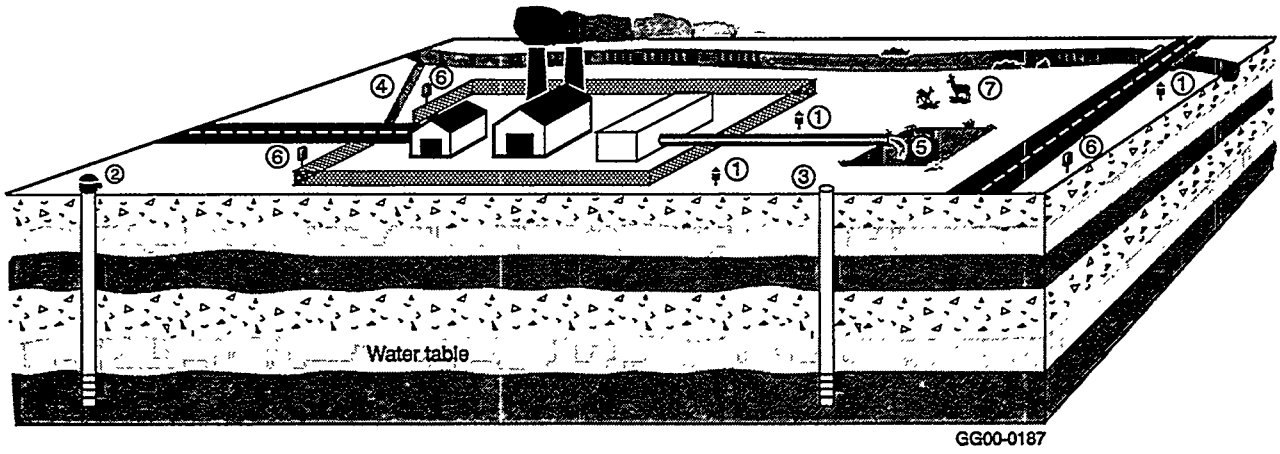
- Evaluate environmental conditions
- Provide and interpret data
- Verify compliance with applicable regulations or standards

- 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 and summarizes them in this annual Environmental Monitoring Program report.



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

Figure 1-1. Environmental Monitoring media sampled (GG00 0187).

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 Permits[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 rules, regulations, permits, and orders 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 proposed and implemented 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 support operations managers to resolve 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 generally follows this technical guide.

2. QUALITY ASSURANCE/QUALITY CONTROL

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

Quality control samples are used to measure and document the uncertainty in analytical data.

2.1 Quality Assurance Program

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.

2.2 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.

3. 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). Fourteen Idaho counties are located in part or entirely within 80 km (50 mi) of the INEEL (Figure 3-1). 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 3-1). 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.

The three secondary facilities are:

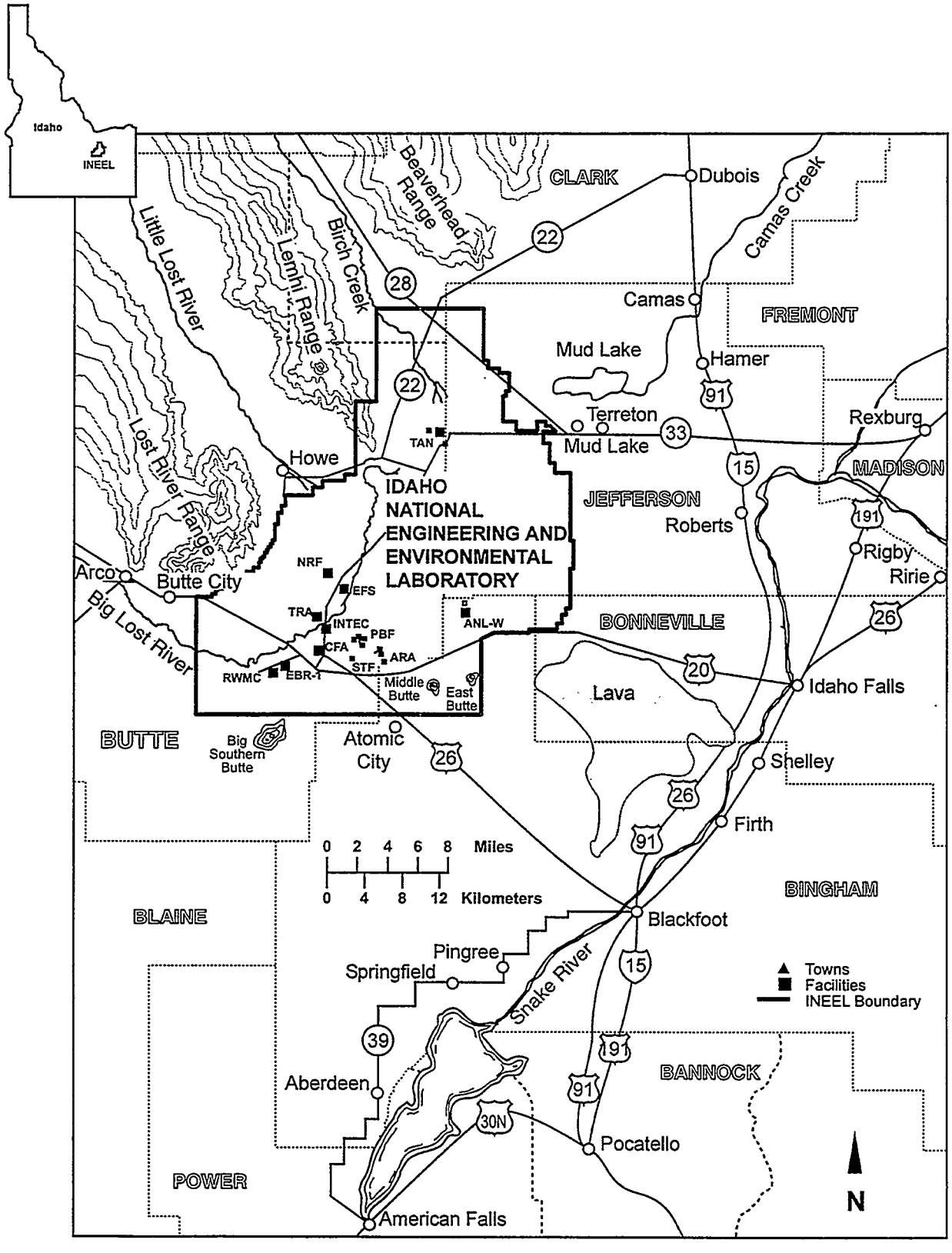
- Experimental Breeder Reactor-I
- Experimental Field Station
- Security Training Facility.

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.



GR99 0040

Figure 3-1. Map of Idaho National Engineering and Environmental Laboratory vicinity showing primary and secondary facilities, counties, and cities (GR 99 0040).

3.1 Demographics

The largest population centers near the INEEL are to the southeast and east along the Snake River and Interstate 15. Table 3-1 lists the largest communities closest to the INEEL boundaries, population, and distance from the INEEL.

Table 3-1. Communities near the Idaho National Engineering and Environmental Laboratory.

Community	Population[a]	Distance from INEEL
Idaho Falls	48,122	35 km (22 mi) east of nearest INEEL boundary
Blackfoot	10,453	37 km (23 mi) southeast of nearest INEEL boundary
Pocatello	53,074	70 km (43 mi) south-southeast of nearest INEEL boundary
Arco	1,091	11 km (7 mi) west of nearest INEEL boundary
Atomic City	26	0.8 km (0.5 mi) south of nearest INEEL boundary
Howe	7	6 km (4 mi) west of nearest INEEL boundary
Terreton	1,263	4 km (2.5 mi) east of nearest INEEL boundary
Mud Lake	188	5 km (3 mi) east of nearest INEEL boundary
Butte City	63	5 km (3 mi) west of nearest INEEL boundary

a. 1998 figures from Idaho Department of Commerce.

3.2 Regional Physical Setting

3.2.1 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 elevations of 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 area on the INEEL is the Big Lost River Sinks at an elevation of 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.

3.2.2 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 between one-quarter and one-third of the annual precipitation. In 1999, snowfall measured 62 cm (25 in.) and contributed 7.6 cm (2.99 in.) to the total precipitation (18.2 cm [7.17 in.]) at CFA.

Average daily air temperatures during 1999 at the INEEL (CFA) ranged from a low of -15°C (5°F) on January 30 to a high of 25°C (77°F) on July 29. The long-term (1950–1999) 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 with the first week in January and continuing through the third week in July. The temperature then decreases over the course of 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 has been 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, TAN usually experiences the highest hourly wind speeds during west-southwest or southwesterly winds. However, strong winds also blow from the northwest and north-northwest.

3.3 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) in thickness.[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 m (400 ft) to 760 m (2,500 ft) or more.[17]

3.4 Hydrology

3.4.1 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 3-1). 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 1999 water year (October 1998 through September 1999), flow was recorded continuously in the Big Lost River at the diversion dam near the Radioactive Waste Management Complex. A total of 133,554,393 m^3 (108,260 acre-ft) of water reached the diversion dam in the river. 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. During peak river flows, 27,497,944 m^3 (22,290 acre-ft) of water flowed to the INEEL spreading areas. A total of 106,056,444 m^3 (85,970 acre-ft) of water flowed downstream of the diversion dam in the Big Lost River channel. Because of infiltration losses in the channel, flow decreased downstream, with 78,102,056 m^3 (63,310 acre-ft) reaching the Lincoln Boulevard bridge and 67,899,813 m^3 (55,040 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.

3.4.2 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 groundwater in the Snake River Plain Aquifer flows chiefly to the south-southwest at rates that range from 1.5 to 6 m/day (5 to 20 ft/day).[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. Lesser amounts of water are derived from local precipitation on the plain. 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.

4. COMPLIANCE MONITORING PROGRAM

This section presents the results of the Compliance Monitoring Program at the INEEL. The Compliance Monitoring Programs sample drinking water, liquid effluents, storm water runoff, and groundwater to show compliance with federal, state, and City of Idaho Falls regulations and permits. Section 4.1 presents the Drinking Water Monitoring Program results, Section 4.2 presents the Liquid Effluent Monitoring Program results, Section 4.3 presents the Storm Water Monitoring Program results, and Section 4.4 presents the Groundwater Monitoring Program results.

4.1 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] 16.01.08),[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 are known to 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) and RWMC.

4.1.1 Program Design Basis

The Drinking Water Program monitors drinking water to ensure it is safe for consumption and 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 16.01.08[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 1996–1998, 1999–2001, 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 usually caused by deteriorating water lines and stagnant water, and resampling of these areas normally indicated compliance with the maximum contaminant level. Table 4-1 lists the 1999 Drinking Water Program monitoring locations, parameters, and frequency.

Table 4-1. 1999 drinking water monitoring locations, parameters, and frequency.

Facility	Sample Point	Parameters	Sample Frequency
CFA	Selected buildings	Bacteriological	2 monthly[a] 4 monthly[b]
		Total trihalomethanes	1 quarterly[b]
	1603	Nitrate	1 annually[a]
	1603, point-of-entry to distribution system after treatment and Well #1	Organics (40 CFR 141.12, .24, .40, and .61)[c]	1, as required (quarterly or annually)[b]
	1603	Metals, inorganics, and secondary drinking water standards	1, as required every 3 years
	Wells #1 and #2 and 1603	Gross alpha, beta, and tritium	1 sample each, quarterly[a]
CTF	Selected buildings	Bacteriological	1 quarterly[a] 3 monthly[b]
	614, point-of-entry to distribution system after treatment	Nitrate	1 annually[a]
		Gross alpha, beta, and tritium	1 quarterly[a]
	614 and Wells #1 and #2	Organics (40 CFR 141.12, .24, .40, and .61)[c]	1, as required (quarterly or annually)[a]
	614	Metals, inorganics, and secondary drinking water standards	1, as required every 3 years
EBR-I	Selected buildings	Bacteriological	1 quarterly[a] 1, May, June, July, August, and September[b]
	601, point-of-entry to distribution system after treatment	Nitrate	1 annually[a]
		Gross alpha, beta, and tritium	1 quarterly[a]
	601 and Well	Organics (40 CFR 141.12, .24, .40, and .61)[c]	1, as required (quarterly or annually)[a]
	601	Metal, inorganics, and secondary drinking water standards	1, as required every 3 years

Table 4-1. (continued).

Facility	Sample Point	Parameters	Sample Frequency
Gun Range	Selected buildings	Bacteriological	1 quarterly[a] 1 monthly[b]
		Total trihalomethanes	1 quarterly[b]
	608, point-of-entry to distribution system after treatment	Nitrate	1 annually[a]
		Gross alpha, beta, and tritium	1 quarterly[a]
	608 and Well	Organics (40 CFR 141.12., .24, .40, and .61)[c]	1, as required (quarterly or annually)[a]
	608	Metals, inorganics, and secondary drinking water standards	1, as required every 3 years
INTEC	Selected buildings	Bacteriological	2 monthly[a] 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 #5	Organics (40 CFR 141.12, .24, .40, and .61)[c]	1, as required (quarterly or annually)[a]
		Gross alpha, beta, tritium, and Sr-90	1 sample each, quarterly[a]
	614	Metals, inorganics, and secondary drinking water standards	1, as required every 3 years
Main Gate	Selected buildings	Bacteriological	1 quarterly[a] 3 monthly[b]
	603, point-of-entry to distribution system after treatment	Nitrate	1 annually[a]
		Gross alpha, beta, and tritium	1 quarterly[a]
	603 and Well	Organics (40 CFR 141.12, .24, .40 and .61)[c]	1, as required (quarterly or annually)[b]
		Metals, inorganics, and secondary drinking water standards	1, as required every 3 years
PBF	Selected buildings	Bacteriological	1 quarterly[a] 3 monthly[b]
	638, point-of-entry to distribution system after treatment	Nitrate	1 annually[a]
	638 and Wells #1 and #2	Organics (40 CFR 141.12, .24, .40, and .61)[c]	1, as required (quarterly or annually)[b]
	638	Metals, inorganics, and secondary drinking water standards	1, as required every 3 years

Table 4-1. (continued).

Facility	Sample Point	Parameters	Sample Frequency
RWMC	Selected buildings	Bacteriological	1 quarterly[a] 3 monthly[b]
	604, point-of-entry to distribution system after treatment	Nitrate	1 annually[a]
	604	Metals, inorganics, 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, and tritium	1 quarterly[a]
		Organics as listed in Table 5 (40 CFR 141.12, .24, .40, and .61)[c]	1, as required (quarterly and annually)[a]
TRA	Selected buildings	Bacteriological	1 quarterly[a] 4 monthly[b]
		Total trihalomethanes	1 quarterly[b]
	608, point-of-entry to distribution system after treatment	Nitrate	1 annually[a]
		Gross alpha, beta, and tritium	1 quarterly[a]
	608 and Wells #1, #3, and #4	Organics (40 CFR 141.12, .24, .40, and .61)[c]	1, as required (quarterly or annually)[a]
	608	Metals, inorganics, and secondary drinking water standards	1, as required every 3 years
TSF	Selected buildings	Bacteriological Total trihalomethanes	1 quarterly[a] 3 monthly[b] 1 quarterly[b]
	610, point-of-entry to distribution system after treatment	Nitrate	1 annually[a]
		Gross alpha, beta, and tritium	1 quarterly[a]
	610 #1 and #2 Wells	Organics as listed in Table 5 (40 CFR 141.12, .24, .40, and .61)[c]	1, as required (quarterly or annually)[a]
	610	Metals, inorganics, 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.

4.1.2 Data Summary and Assessment by Facility

During 1999, a total of 641 routine samples were collected and analyzed from CFA, EBR-I, Gun Range, Idaho Nuclear Technology and Engineering Center (INTEC), Main Gate, Power Burst Facility (PBF), RWMC, TAN (Contained Test Facility [CTF] and 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 clean before it is put back into service. The Drinking Water Program received 69 requests for nonroutine sampling.

Analytical results that approached or exceeded a maximum contaminant level in 1999 are presented in Table 4-2 and are discussed in the following subsections. EBR-I, Gun Range, Main Gate, PBF, TAN/CTF, and TRA were well below drinking water limits for all regulatory parameters and are therefore not discussed.

4.1.2.1 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 3-1) through injection wells and infiltration ponds. The practice of using injection wells and infiltration ponds for tritium disposal was discontinued. These wastewaters migrated south-southwest and are the suspected source of tritium contamination in the CFA water supply wells.

Table 4-2. Parameters monitored that approached or exceeded a maximum contaminant level in 1999.

Parameter[a]	Location	Results (4-Quarter Average)	MCL
Trichloroethylene	TSF #1 Well	4.35 µg/L[b]	NA
	TSF #2 Well	2.0 µg/L	NA
	TSF Dist.	1.2 µg/L	5 µg/L
Tritium	CFA Dist.	12,786 pCi/L	20,000 pCi/L
	CFA #1 Well	13,391 pCi/L	NA
	CFA #2 Well	10,910 pCi/L[c]	NA
Carbon tetrachloride	RWMC Well	4.65 µg/L	NA
	RWMC Dist.	2.70 µg/L	5 µg/L
Trichloroethylene	RWMC Well	1.98 µg/L	NA
	RWMC Dist.	1.35 µg/L	5 µg/L
Bacteriological (total coliform)	INTEC Dist.	Presence[d]	Absence
	TRA Dist.	Presence[d]	Absence

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

b. Sampled only twice (Oct/Nov) during the year. The compliance point is after the sparger system (air stripping process); the compliance result is 1.2 µg/L for the four-quarter average.

c. Due to construction activities, the well was out of service during the third quarter; therefore, this value was averaged over three quarters.

d. Total coliform bacteria was detected in the INTEC distribution system in May and in the TRA distribution system in August.

In 1999, water samples were collected quarterly from CFA #1 well (located at CFA-651), CFA #2 well (located 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. Figure 4-1 illustrates the variation of tritium concentrations since 1990. The Radiological and Environmental Sciences Laboratory analyzed groundwater samples for surveillance and hydrologic studies of tritium. Additional samples analyzed by other laboratories were analyzed for compliance purposes. Both are included in Figure 4-1 to show trends in tritium concentrations over time. In general, tritium concentrations in groundwater have been decreasing due to changes in disposal rates, disposal techniques, recharge conditions, and radioactive decay.

4.1.2.2 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 were disposed at the RWMC prior to 1970, including carbon tetrachloride, trichloroethylene, tetrachloroethylene, toluene, benzene, 1,1,1-trichloroethane, and lubricating oil. 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, located at WMF-604.

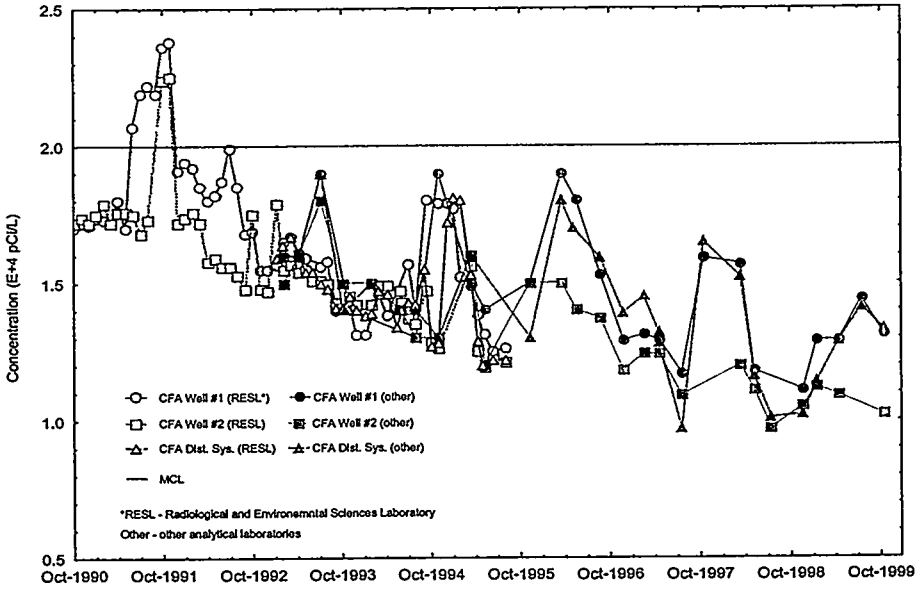


Figure 4-1. Tritium concentrations in Central Facilities Area drinking water.

Since monitoring began at RWMC in 1988, there has been an upward trend in carbon tetrachloride concentrations (Figure 4-2). In October 1995, the carbon tetrachloride concentrations increased to 5.48 μg/L at the well. This was the first time the concentrations in the well 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 4-3 presents the carbon tetrachloride concentrations at the RWMC drinking water well and distribution system for 1999. The mean concentration at the well for 1999 was 4.65 μg/L, and the maximum concentration was 5.2 μg/L. The mean concentration at the distribution system was 2.7 μg/L, and the maximum concentration was 2.9 μg/L. Increased sampling is being implemented to monitor carbon tetrachloride concentrations.

4.1.2.3 Test Area North/Technical Support Facility. The inactive TSF injection well (TSF-05) is believed to be the principal source of trichloroethylene contamination at the TSF. In 1987, TCE was detected at both TSF #1 and #2 wells, which supply drinking water to approximately 100 employees at TSF daily. 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.

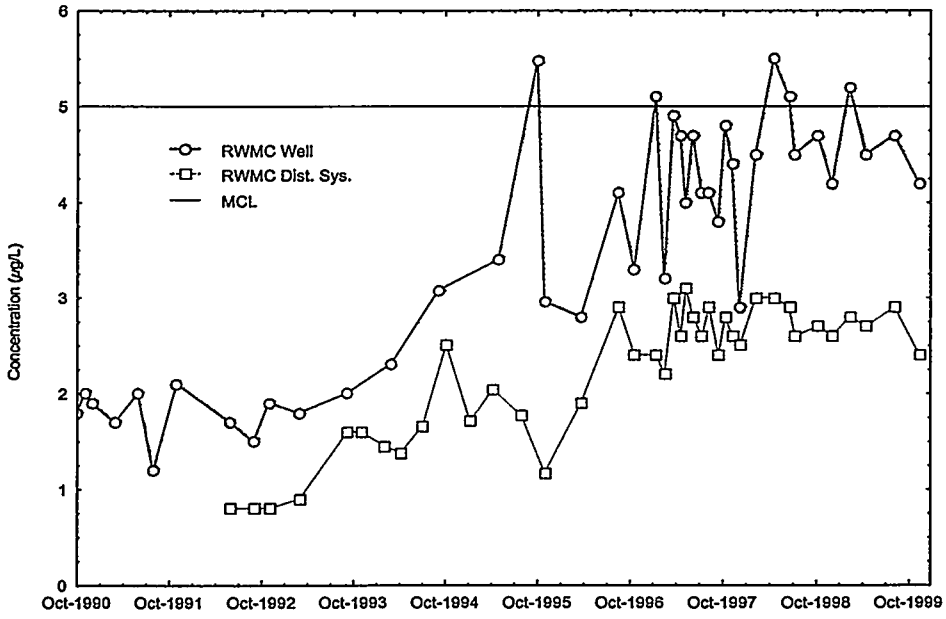


Figure 4-2. Carbon tetrachloride concentrations in Radioactive Waste Management Complex drinking water well and distribution system.

Table 4-3. Carbon tetrachloride concentrations at Radioactive Waste Management Complex drinking water well and distribution system (1999).

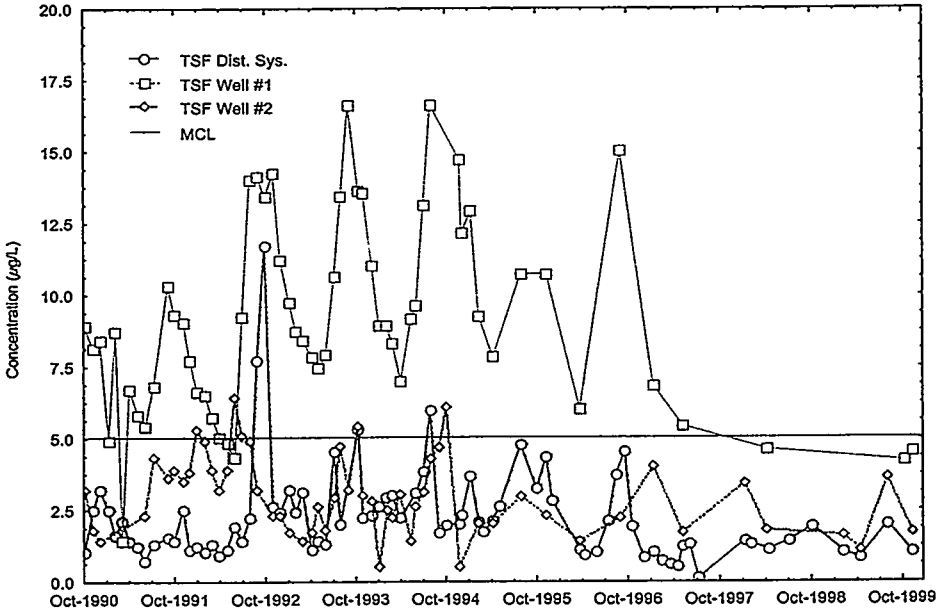
Well/Dist.	Number of Samples	Carbon Tetrachloride Concentration (μg/L) Minimum	Maximum	Mean	MCL
RWMC WMF-603 Well	4	4.2	5.2	4.65	NA
RWMC WMF-604 Dist.	4	2.4	2.9	2.70	5.0

During the third quarter of 1997, TSF #1 was taken off line, and TSF #2 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 is used as a backup to TSF #2. If TSF #1 must be used, the sparger system must be activated to treat the water. The mean concentration of trichloroethylene at the distribution system for 1999 was 1.2 μg/L.

Table 4-4 presents the trichloroethylene concentrations at the TAN/TSF wells and distribution system. Figure 4-3 illustrates the concentrations of trichloroethylene in both TSF wells and the distribution system from 1990 through 1999. The distribution system sample exceedances are attributed to preventive maintenance activities interrupting operation of the sparger system. The decreasing concentration at TSF #1 is attributed to the plume shifting in response to the greatly reduced pumping at TSF #1.

Table 4-4. Trichloroethylene concentrations at Test Area North/Technical Support Facility wells and distribution system (1999).

Well/Dist.	Number of Samples	Trichloroethylene (μg/L) Minimum	Maximum	Mean	MCL
TSF #1 (612)	2	4.2	4.5	4.35	NA
TSF #2 (613)	4	1.1	3.6	2.0	NA
TSF Dist. (610)	4	0.8	2.0	1.2	5.0



NOTE: During 1998, Well #1 was out of service.

Figure 4-3. Trichloroethylene concentrations in Technical Support Facility drinking water wells and distribution system.

4.1.3 Quality Assurance/Quality Control

Only approved drinking water methods as listed in 40 CFR 141-143 were used for drinking water analyses. All laboratories that performed analyses were certified by or had reciprocity with the State of Idaho.

During calendar year 1999, 641 samples were collected. Ten percent of the samples submitted each calendar year are quality assurance/quality control samples (splits, duplicates, trip blanks, field blanks, and blind spikes). Included in this section are the laboratory quality assurance/quality control results. In 1999, the results from the quality assurance/quality control samples and laboratory were within the acceptable range except for the following.

One semivolatile organic compound blind spike (June 29, 1999) was outside the acceptable range; two parameters (methoxyclor and simazine) were outside the performance acceptance limits. There were no detections of these parameters in the associated samples.

Samples that were collected on June 23–24, 1999, for organic analysis (Methods 549.1, 515.1 and 525.2) were not preserved correctly. The bottles were supplied by the laboratory without sodium thiosulfate as required for use with chlorinated water systems. This would result in a high bias. Even though the results were nondetects, they were flagged as estimates because of improper preservation techniques.

During the fall quarter, quality control sample results associated with the samples to be analyzed for total trihalomethanes were questioned during validation since no parameters were detected in a spiked sample. The quality control results were rejected during validation, with no impact to the associated sample results.

Samples collected on August 10, 1999 that were submitted to the laboratory for volatile organic compound analysis were improperly preserved at a pH greater than 2. The associated results were flagged as estimates.

4.2 Liquid Effluent Monitoring Program

The Liquid Effluent Monitoring Program provides environmental monitoring 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 regulatory requirements.

4.2.1 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 found in Chapter 1, Section 8, of the Municipal Code of the City of Idaho Falls.[23] 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.[24] 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 BBWI and Department of Energy Idaho Operation Office-operated facilities that discharge to the city sewer system. Permits include general requirements applicable to all facilities

and specific monitoring requirements for the INEEL Research Center and the Willow Creek Building due to the nature of activities at these two facilities.

The State of Idaho regulates the discharge of liquid effluent under IDAPA 16.01.02, "Water Quality Standards and Wastewater Treatment Requirements."[25] 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 16.01.17, "Wastewater Land Application Permits."[5] The management and operating contractor operates six facilities that require Wastewater Land Application Permits at the INEEL. The following four of the six facilities have been issued Wastewater Land Application Permits:

- CFA Sewage Treatment Plant
- INTEC Percolation Ponds
- INTEC Sewage Treatment Plant
- TAN/TSF Sewage Treatment Plant.

Wastewater Land Application Permit applications have been submitted to the Idaho Division of Environmental Quality for the following remaining two of the six facilities:

- Water Reactor Research Test Facility (WRRTF) process and sewage ponds
- TRA Cold Waste Pond.

The Wastewater Land Application Permits generally require compliance with the Idaho groundwater quality standards[25] in specified downgradient groundwater monitoring wells. Annual discharge volume and application rates and effluent quality limits are specified in the permits.

The *1999 Annual Wastewater Land Application Permit Performance Reports for the Idaho National Engineering Laboratory*[26] 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 in 1998 were reviewed in 1999 to accommodate 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 that fall under 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.[27] 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 4-5 lists effluent streams that were sampled during 1999 and the parameters and frequency of monitoring for each stream. The specific day during the period was randomly selected. Monitoring for permit-required parameters was conducted according to the frequencies specified in permits for applicable streams.

Twenty-four-hour composite samplers were used at all accessible locations. Grab sampling was conducted 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 use of analytical methods for the analysis of pollutants listed in 40 CFR 136, Subchapter N, "Effluent Guidelines and Standards."[28]

4.2.2 Data Summary and Assessment by Facility

During 1999, a total of 13 effluent discharge points were routinely monitored for nonradiological parameters and five for radiological parameters at the following five areas:

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

Approximately 470 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, upper (Level 2) and lower (Level 1) statistical control limits are calculated based on past monitoring data. These control limits are not regulatory limits, rather comparisons to these control limits are made to monitor a given effluent for changes from expected levels. The calculation of the control limits is discussed in Appendix B. The INTEC Sewage Treatment Plant (Section 4.2.2.1) and TAN/TSF effluent to the Disposal Pond (Section 4.2.2.3) were the only streams for which parameters repeatedly exceeded Level 2 control limits. All other Level-2-exceeded parameters 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 limits set in applicable permits. Any detections above regulatory limits were addressed with facility representatives and regulatory agencies, and if required, actions were taken based upon these 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 several total nitrogen samples at the INTEC Sewage Treatment Plant and one total nitrogen exceedance at TAN/TSF, which exceeded Wastewater Land Application Permit limits, all results were within regulatory limits.

Table 4-5. 1999 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 and characterization	Wastewater Land Application Permit parameters	Monthly (when pivot operating)
			Cl, F, SO_4, total dissolved solids (TDS), total recoverable metals,[c] and radiological parameters[d]	Quarterly (when pivot operating)
CFA-696,[c] Transportation Complex oil and water separator	Water associated with the floor drains and vehicle maintenance areas in the new 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 and characterization	Wastewater Land Application Permit parameters	Monthly
			NH_3-N, NNN, TKN	Weekly nitrogen study upon request
CPP-771[c], effluent from Cell No. 2	Treated wastewater from aeration lagoons	Characterization	NNN, NH_3 N, TKN	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 and characterization	Wastewater Land Application Permit parameters	Monthly
			Total recoverable metals	
			Radiological parameters	Quarterly
			NNN, NH_3 N, TNK	Weekly nitrogen study upon request
TRA-608,[c] effluent from Reverse Osmosis Unit	Water treatment process at the TRA demineralizer facility	Characterization	Total recoverable metals Cl, F, SO_4, TDS, and NNN	Quarterly
			Radiological parameters	Quarterly

Table 4-5. (continued).

Location	Discharge Description	Type of Monitoring	Parameters[a]	Frequency
TRA-764, effluent to Cold Waste Pond	Nonradioactive, nonsanitary drains throughout TRA	Surveillance	Total recoverable metals, Cl, F, SO_4, TDS, and radiological parameters	Quarterly
TAN-655, effluent to Sewage Treatment Plant pond	Combination of process water from TAN-607 and treated sewage	Wastewater Land Application Permit and surveillance	Wastewater Land Application Permit parameters Radiological parameters	Monthly Quarterly
WRRTF-1,[c] Sewage Lagoon sump	Treated effluent from the sanitary system at WRRTF	Surveillance	Total recoverable metals, 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	Total recoverable metals, 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	RCRA metals[f] + Cu, Ni, Zn, CN	Semiannually
IFF-616, WCB effluent	Sanitary sewage and wastewater from WCB	Industrial Wastewater Acceptance Form	RCRA metals + Cu, Ni, Zn, CN	Semiannually

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. Total recoverable 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 collected as grab samples. Other samples are 24-hour composites.

f. RCRA metals include arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver.

Additionally, levels 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).[29,30] 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).

Historical and 1999 summary statistical data for effluent streams are in Environmental Monitoring Program files. In 1999, concentrations were below corresponding limits at the following facilities: CFA-LSI, CFA-STF, 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 1999. Effluent monitoring of the INTEC percolation ponds (CPP-797) is conducted by INTEC Operations. Therefore results are not included in this report.

4.2.2.1 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 and CPP-773 (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 of 100 mg/L averaged monthly
- Total nitrogen (nitrate + nitrite + total Kjeldahl nitrogen) of 20 mg/L averaged monthly
- Flow to rapid infiltration trenches of 30 million gallons annually.

For 1999, CPP-773 Sewage Treatment Plant effluent did not exceed the 100 mg/L total suspended solids or the flow limit set forth in the permit. However, the total nitrogen limit of 20 mg/L was exceeded in 6 of the 12 months of sampling. The 1999 annual average concentration was 20.5 mg/L. Total nitrogen concentrations in effluent exceeded the permit limit for the first time in December 1997. Figure 4-4 shows influent and effluent total nitrogen concentrations from September 1995 through December 1999. Although elevated nitrogen concentrations occur during warmer months, the highest concentrations of total nitrogen typically occur during colder months, when biological activity of microorganisms decreases from the colder temperatures. There was an anomously high total nitrogen concentration (196 mg/L) in December 1999. This was an influent sample. The result is suspected to be a laboratory error. The laboratory was contacted, but no cause for the high concentration could be determined.

Collection of additional monthly samples for nitrogen (more than required by the permit) began in June 1998. 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). The extra samples were taken as part of a nitrogen study to gain a better understanding of what processes were occurring to remove nitrogen during treatment of the wastewater.

From the sample results (Table 4-6), it was determined that as the wastewater enters the lagoon system, it is mainly composed of total Kjeldahl nitrogen. The majority of the total Kjeldahl nitrogen is in the form of ammonia. Approximately 50 to 60% of the total nitrogen in the influent is removed as ammonia in lagoon Cell Nos. 1 and 2. The aerators in lagoon Cell Nos. 1 and 2 remove the ammonia 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 in the form of ammonia. Adding aeration to these two cells is being considered, and several tests have indicated that air stripping additional ammonia is possible.

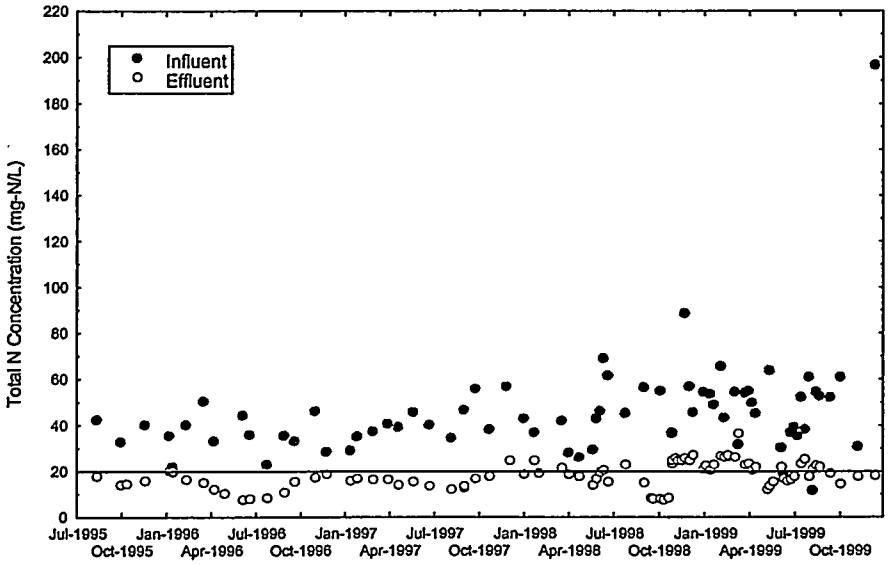


Figure 4-4. Total nitrogen concentrations at the Idaho Nuclear Technology and Engineering Center Sewage Treatment Plant from 1995 through 1999.

Table 4-6. Idaho Nuclear Technology and Engineering Center Sewage Treatment Plant average nitrogen concentrations.

		CPP-769		CPP-771		CPP-773	
Parameter	Units	1998	1999	1998	1999	1998	1999
Ammonia as N	mg/L	36.79	33.63	14.92	19.82	16.09	15.99
Nitrate + nitrite as N	mg/L	0.26	0.13	1.43	1.30	1.10	1.40
total Kjeldahl nitrogen	mg/L	46.33	48.97	16.15	22.72	17.09	19.11
Total nitrogen	mg/L	46.59	49.10	17.55	24.03	18.18	20.51

Annual average influent total nitrogen has been steadily increasing from 35.18 mg/L in 1996 to 49.10 mg/L in 1999. Total nitrogen in the effluent has continued to increase from an annual average of 13.37 mg/L in 1996 to 20.51 mg/L in 1999.

Influent (CPP-769) concentrations repeatedly exceeded Level 2 statistical control limits for the following parameters: biological oxygen demand (three samples), nitrate + nitrite (seven samples), total Kjeldahl nitrogen (five samples), and total suspended solids (six samples). Effluent (CPP-773) concentrations exceeded Level 2 control limits for total Kjeldahl nitrogen in one sample. These results were significantly higher than concentrations expected based on historical data. Increasing trends over time were found for total suspended solids and total Kjeldahl nitrogen in influent and total Kjeldahl nitrogen in effluent. The increasing trend for total Kjeldahl nitrogen in influent was evident even when the anomously high value from the December 1999 sample (196 mg/L) was excluded. As part of the ongoing nitrogen study, an in-depth inventory of sources contributing to INTEC sewage will be conducted. The inventory will be evaluated to determine the cause of these increasing concentrations.

Maintenance and operational corrective actions identified in an engineering study[31] have been mostly completed and continue to be evaluated to determine the effectiveness in reducing nitrogen concentrations. If these corrective actions do not reduce the nitrogen to acceptable concentrations, additional operational and plant modifications will be implemented.

4.2.2.2 Effluent to the Cold Waste Pond (TRA-764)—Effluent to the Cold Waste Pond (TRA-764) is from nonradioactive, cold waste drains within TRA. 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.

Data collected in 1999 met all applicable limits except for total dissolved solids. The average total dissolved solids concentration in 1999 (671 mg/L) and the historical average (565 mg/L) exceeded the risk-based release level of 560 mg/L. Total dissolved solids concentrations of samples collected during reactor operation differ significantly from those collected during reactor outages (Figure 4-5). This difference is 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 inhibitor. This discharge occurs when the reactor is operating and during the first day of the outage and results in total dissolved solids concentrations two to three times the concentration discharged during outages. The average concentrations slightly exceed the concentrations predicted to result in degradation of groundwater quality in excess of drinking water standards.

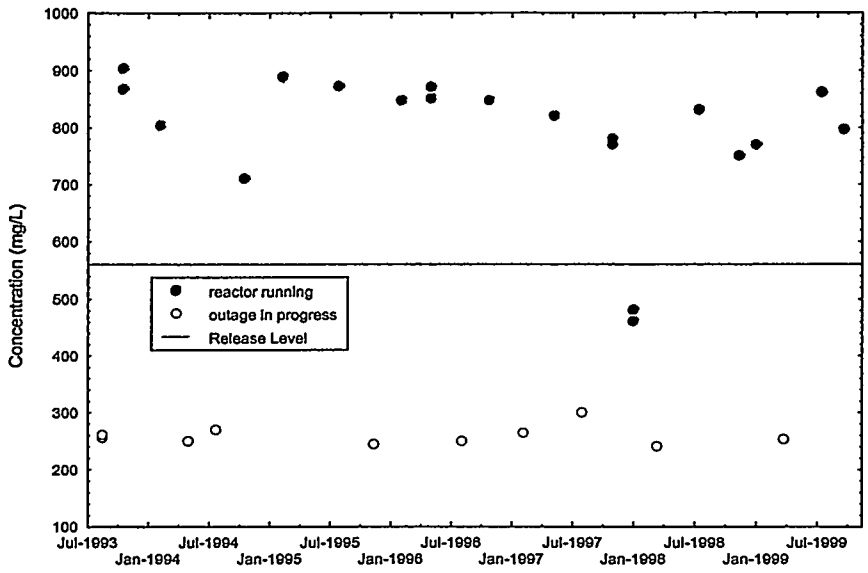


Figure 4-5. Test Reactor Area-764 total dissolved solids concentrations.

4.2.2.3 ***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.

The process 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 permit for the TAN/TSF Sewage Treatment Plant sets concentration limits for total suspended solids 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 concentrations of total suspended solids were below the permit limits throughout the year, with an annual average of 10.63 mg/L. The permit limit for total nitrogen (20 mg/L) was exceeded in a June sample, with a concentration of 52.4 mg/L. This concentration was over seven times higher than the historical average (7.4 mg/L) and appears to be an anomaly (Figure 4-6). An investigation was conducted; however, no cause for the excessive nitrogen was identified. Concentrations decreased to less than 20 mg/L for the remainder of the reporting period.

Effluent concentrations repeatedly exceeded Level 2 statistical control limits for several parameters (Table 4-7). These results were significantly higher than concentrations expected based on historical data. However, the Mann-Kendall nonparametric test for trends identified an increasing trend over time for ammonia concentrations but no trends for the other parameters. An increasing trend in ammonia could cause the Wastewater Land Application Permit total nitrogen limit to be exceeded if concentrations continue to increase. Ammonia concentrations are being evaluated using real-time sensors, as well as extra sampling, to determine the cause.

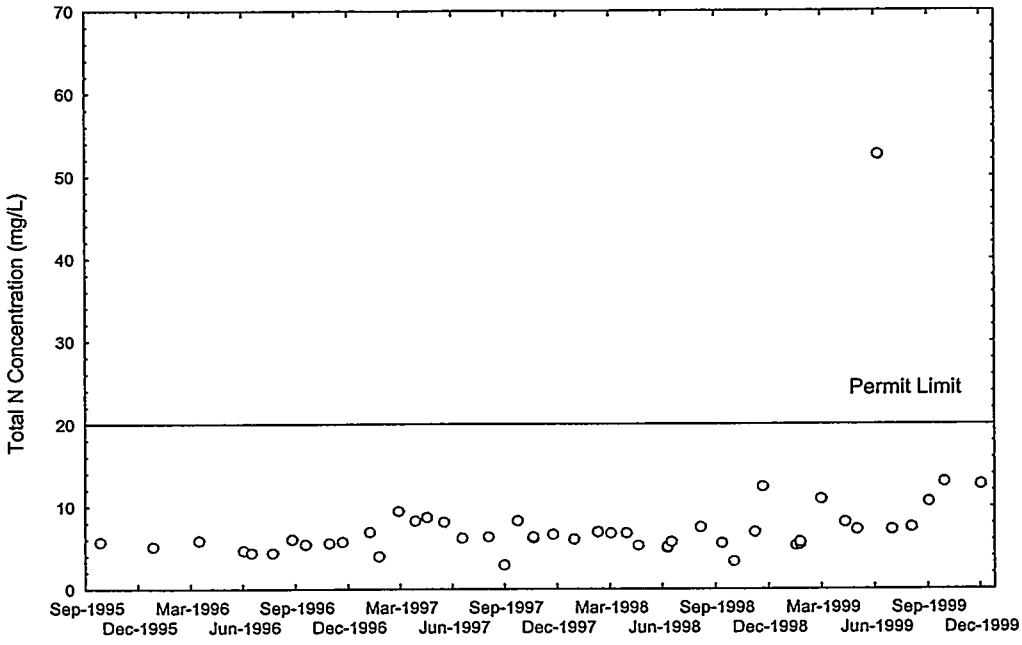


Figure 4-6. Total nitrogen concentrations for effluent to the Test Area North/Technical Support Facility Disposal Pond.

Table 4-7. Data repeatedly exceeding Level 2 control limits for TAN/TSF Disposal Pond (TAN-655).

Parameter	Sample Date	Concentration (mg/L)	Level 2 Limit (mg/L)
Sodium	01/27/99	139	98.03
	02/03/99	143	98.03
	03/11/99	177	98.03
	04/21/99	176	98.03
	05/12/99	128	98.03
	11/17/99	270	98.03
Chloride	01/27/99	194	112
	02/03/99	159	112
	03/11/99	365	112
	05/12/99	184	112
	06/17/99	143	112
	11/17/99	453	112
	12/08/99	130	112
Fluoride	04/21/99	0.330	0.33
	06/17/99	12.1	0.33
	07/08/99	0.740	0.33
	08/12/99	0.440	0.33
	09/09/99	0.330	0.33
	10/06/99	0.40	0.33
Nitrogen, as ammonia	03/11/99	2.77	2.34
	06/17/99	45.2	2.34
	10/06/99	3.60	2.34
	11/17/99	2.88	2.34
	12/08/99	9.0	2.34
Sulfate	01/27/99	92.65	47.54
	04/21/99	47.68	47.54
	05/12/99	53.0	47.54
	12/08/99	68.5	47.54
Total dissolved solids	01/27/99	588	566
	03/11/99	813	566
	04/21/99	710	566
	05/12/99	580	566
	11/17/99	991	566
Nitrogen, total Kjeldahl	06/17/99	38.7	5.44
	10/06/99	5.89	5.44

4.2.3 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 irrigation area. These results are reported in the Annual Wastewater Land Application Permit Site Performance Reports.[26] 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 irrigation area) and to determine the implications on the long-term ecological health of the area. This study will measure soil chemistry for the same constituents as those required for the Wastewater Land Application Permit (except phosphorous) inside the irrigation area, and compare them to similar measurements made immediately outside the irrigation 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) were placed adjacent to five neutron probes within the irrigation 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. Soils were sampled at the same depths and areas in the spring at the same time as the soil pore-water sampling, and again in the fall at the same time as the soil sampling for the Wastewater Land Application Permit compliance.

Compared to the adjacent control area (outside the irrigation area), there is an increase in soluble salts inside the irrigation area. Electrical conductivity is elevated in the 30- and 60-cm depths (compared to the control area); however it is most pronounced in the surface interval (Figure 4-7). Electrical conductivity results indicate that soil salinity levels are within acceptable ranges. Soil salinity levels between 0–2 mmhos/cm are generally accepted to have negligible effects on plant growth. Although slightly elevated, electrical conductivity remains near preirrigation levels.

Sodium adsorption ratio results were low throughout the permit period (Figure 4-8). However, sodium adsorption ratios were slightly elevated on the surface relative to preirrigation levels and appear to be increasing over time. The sodium adsorption ratio is an indicator of the exchangeable sodium levels in the soil. Soils with high exchangeable sodium levels tend to crust badly or disperse, which greatly decreases soil hydraulic conductivity. A low sodium adsorption ratio indicates little danger to soil structure from sodium. Although there is some soluble salt buildup (and sodium adsorption ratio increase) near the surface, it is well below levels considered detrimental to plant growth and soil permeability. Soils with sodium adsorption ratios below 15 are generally classified as not having sodium problems.[32]

Ammonia, nitrogen and total Kjeldahl nitrogen concentrations within the soil profile remain very low; however, data over several more years are required to determine if there is a statistical difference in nitrogen levels between the irrigation and the control area. It is likely that most of the ammonia is volatilized to the atmosphere upon application, and plants quickly utilize the remaining ammonia. In addition, it is possible that increased nutrients available to the plants as a result of wastewater application are actually stimulating plant growth, resulting in rapid utilization of plant-available nitrogen and ammonia.

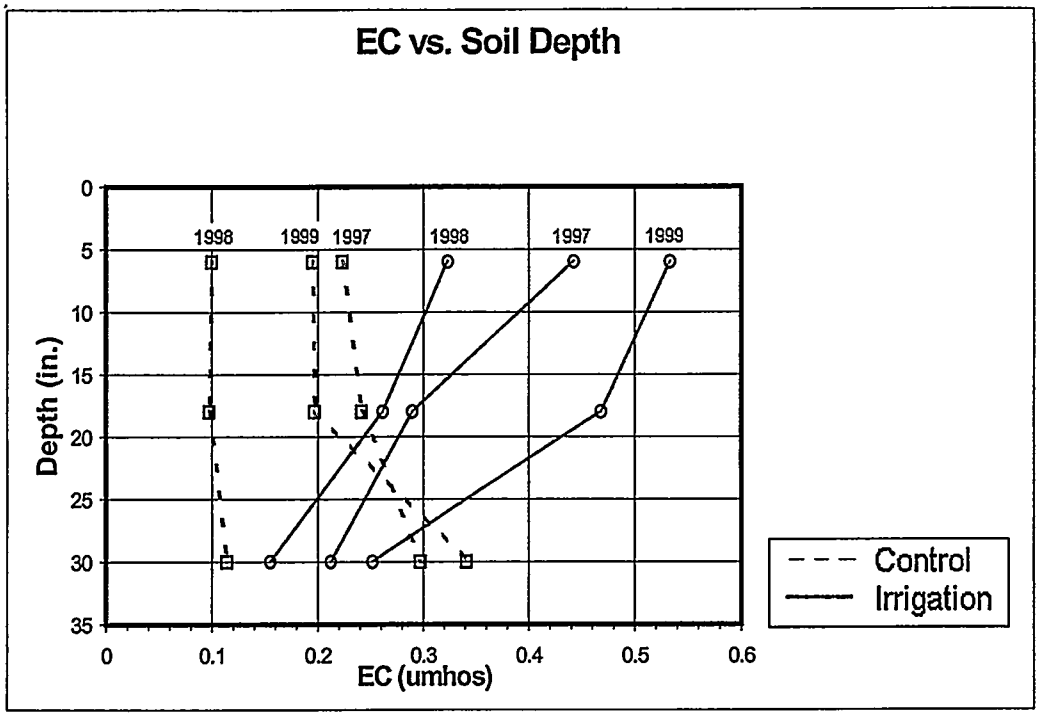


Figure 4-7. Electrical conductivity vs. depth (fall sampling only).

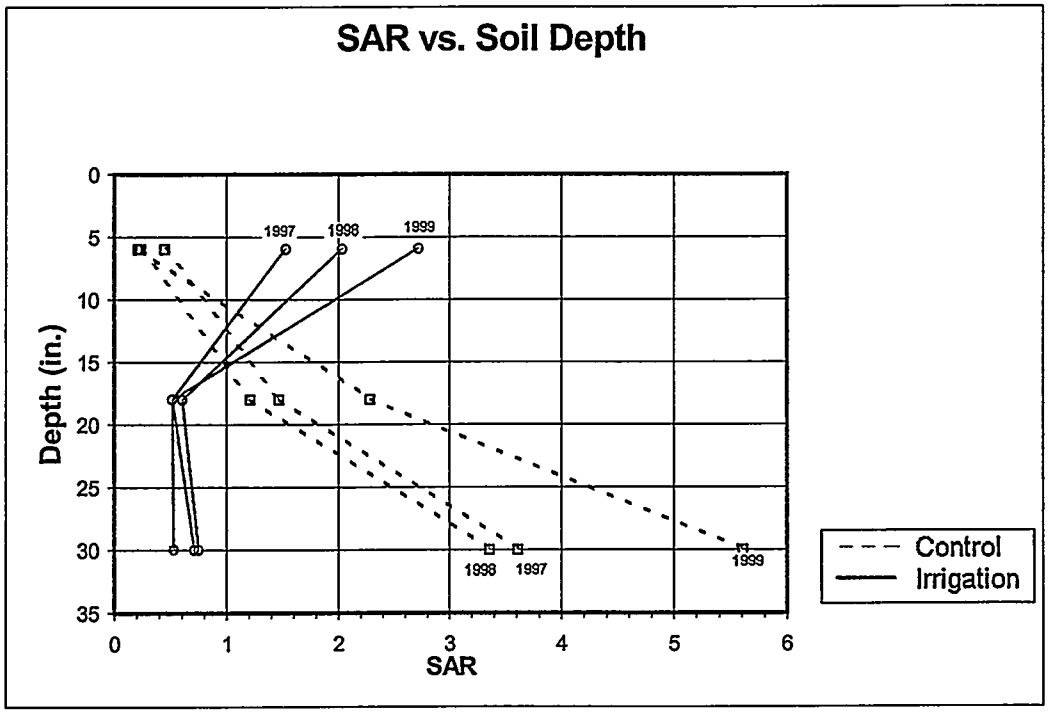


Figure 4-8. Sodium adsorption ratio vs. depth (fall sampling only).

Organic matter amounts did not change significantly within the irrigation area. Significant changes in the percentage of organic matter 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 the application of wastewater.

Soil pore water samples were collected in May 1999 concurrently with the soil samples. However, it was difficult to extract sufficient water to meet laboratory minimum volumes for analyses. Several factors contributed to this, including: (a) a relatively dry spring limited snowmelt and/or rain available for infiltration into the soil profile, (b) low soil moisture content typical of desert soil, and (c) relatively high pore-water tension typical of soils with moderate to high clay content. The limited data obtained from the lysimeters are thus far consistent with the data obtained from soil sampling (that is, elevated salt concentrations in the irrigation area); however there are insufficient data to make definitive conclusions.

As more data are obtained, statistical analyses will be performed to better determine effects of nitrogen and salt loading on the overall soil profile and implications this may have on the long-term ecological health of the area.

4.2.4 Quality Assurance/Quality Control

Effluent field replicates or duplicate samples are collected approximately once per year per sampling location. The goal is to achieve less than or equal to 35% relative percent difference between any pair of duplicate samples. For metals, 91% of the duplicate pairs of results had relative percent differences less than 35%. For inorganics, 85% of the duplicate pairs had relative percent differences less than 35%. Of the six pairs that exceeded the 35% relative percent difference, only one had concentrations that were below detection limits. No duplicate pairs of radiological samples were taken. In many instances, the effluent samples collected are either nondetected for various analytes or contain 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.

Blind standards (quality assurance/quality control field blind spikes) are submitted quarterly; however in 1999, five sets of blind standards were submitted. Blind standard sample solutions are purchased from a National Institute of Standards and Testing certified supplier of laboratory quality control standards. The samples are prepared by the supplier of the standards using bottles and labels supplied by the Liquid Effluent Monitoring Program. After preparing the blind standards, the supplier ships the prepared samples back to Liquid Effluent Monitoring Program personnel, who repackages and ships them to the analytical laboratory along 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.

June blind standards sent to the analytical laboratory consisted of nitrate + nitrite as N, biological oxygen demand, chemical oxygen demand, total Kjeldahl nitrogen, total cyanide, total dissolved solids, total suspended solids, chloride, fluoride, sulfate, ammonium as N, and total phosphorous. These samples were shipped along with samples from the INTEC Sewage Treatment Plant. Total suspended solids were not detected, fluoride results were slightly above performance acceptance limits, and total phosphorous results were below performance acceptance limits.

The total suspended solids discharge limit is 100 mg/L at CPP-773; the result was 16 mg/L. This result is consistent with past results for total suspended solids (5–20 mg/L); therefore it is speculated that there may have been an error in the blind spike analyses only. The permit does not specify limits for fluoride and total phosphorus.

October blind spikes consisted of trace metals and cyanide (sent with samples for City of Idaho Falls), nitrate + nitrite as N, ammonium as N, and total Kjeldahl nitrogen (sent with INTEC samples). Acceptable results were achieved for all analytes except nitrate + nitrite as N, which was slightly below the low end of the performance acceptance limits. The reporting limit for total nitrogen (nitrate + nitrite as N + total Kjeldahl nitrogen) at CPP-773 is 20 mg/L, and the result for this sample was 14.1 mg/L. Since nitrate + nitrite as N is barely below the low end of the performance acceptance limits, the reporting level for total nitrogen would still not be exceeded even if the actual value was slightly higher than the reported value.

November blind spikes consisted of nitrate + nitrite as N and total Kjeldahl nitrogen, and were sent to the laboratory with INTEC samples. Total Kjeldahl nitrogen results were within performance acceptance limits; however nitrate + nitrite as N was well below the low end of the performance acceptance limits, indicating that actual results may be higher than the reported value. The certified value for the nitrate + nitrite as N standard was 23.7 mg/L, and the reported value was 5.91 mg/L, approximately one-fourth the true value. If it is assumed that the reported concentration of nitrate + nitrite as N at CPP-773 is also low by a factor of four, then the value may be closer to 14 mg/L rather than the reported 3.54 mg/L, and would result in an exceedence of total nitrogen. However, a nitrate + nitrite as N result of 14 mg/L is inconsistent with results that typically occur at this location (0.2–4 mg/L).

December blind spikes consisted of nitrate + nitrite as N, ammonium-N, total Kjeldahl nitrogen, inductively coupled metals + mercury, total dissolved solids, total suspended solids, total phosphorous, chloride, fluoride, sulfate, and biological oxygen demand, and were sent to the laboratory with INTEC samples. Nitrate + nitrite as N and total Kjeldahl nitrogen were both slightly above the high end of the performance acceptance limits, and total suspended solids were significantly above the high end of the performance acceptance limits. Therefore, actual values for the INTEC samples taken in December may be lower than the reported values.

Low bias in analytical results performed on blind quality control standards for October and November may indicate that the results of effluent samples collected in the same time period are also biased low. For the Liquid Effluent Monitoring Program, the majority of the analytical results are several times lower than any specified limits. In other words, analytical results could be, in most instances, several times higher than they are and still be less than the discharge limits. Data remain usable as long as this possibility is taken into account.

December blind quality control standard results were biased high. If it is assumed that the results of the samples sent in with the blind spikes are also biased high, then the actual concentration may be lower than the reported concentration.

Letters regarding the blind standard quality control results have been submitted to the Sample Management Office requesting that they evaluate these data and make the appropriate recommendations.

The primary contract laboratories used by the Liquid Effluent Monitoring Program include Oak Ridge National Laboratory (inorganics), Wastren (metals only), Southwest Labs of Oklahoma (inorganics), Paragon Analytics (radiological), and Environmental Health Laboratories (organics). In addition to the quality assurance/quality control blind standards sent by the Liquid Effluent Monitoring Program, all laboratories participate in additional external performance evaluation programs. These programs include: (a) the DOE Mixed Analyte Performance Evaluation Program, (b) the DOE Environmental Measurements Laboratory Quality Assessment Program, (c) the United States Environmental Protection Agency Water Pollution and Water Supply Programs, (d) the United States Environmental Protection Agency Las Vegas Performance Evaluation Program, and (e) the United States Environmental Protection Agency Quarterly Blind Studies. Not all laboratories participate in all

programs. These programs send blind quality control spikes to participating laboratories in order to evaluate their performance. All participating laboratories have consistently demonstrated acceptable accuracy and precision for the majority of analytical parameters; results are available in program files.

4.3 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 4-9).

A Storm Water Monitoring Program was implemented in 1993. The program was modified as 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 October 1, 1998, the Environmental Protection Agency issued the National Pollutant Discharge Elimination System Multi-Sector General Permit for Industrial Activities.[8] The INEEL implemented the analytical monitoring requirements of the permit starting in January 1999. The INEEL Storm Water Pollution Prevention Plan for Industrial Activities[33] was prepared to meet the requirements of the permit. The Storm Water Pollution Prevention Plan for Industrial Activities applies to certain industrial facilities and includes:

- Pollution prevention teams
- Descriptions of potential sources of pollution
- 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.

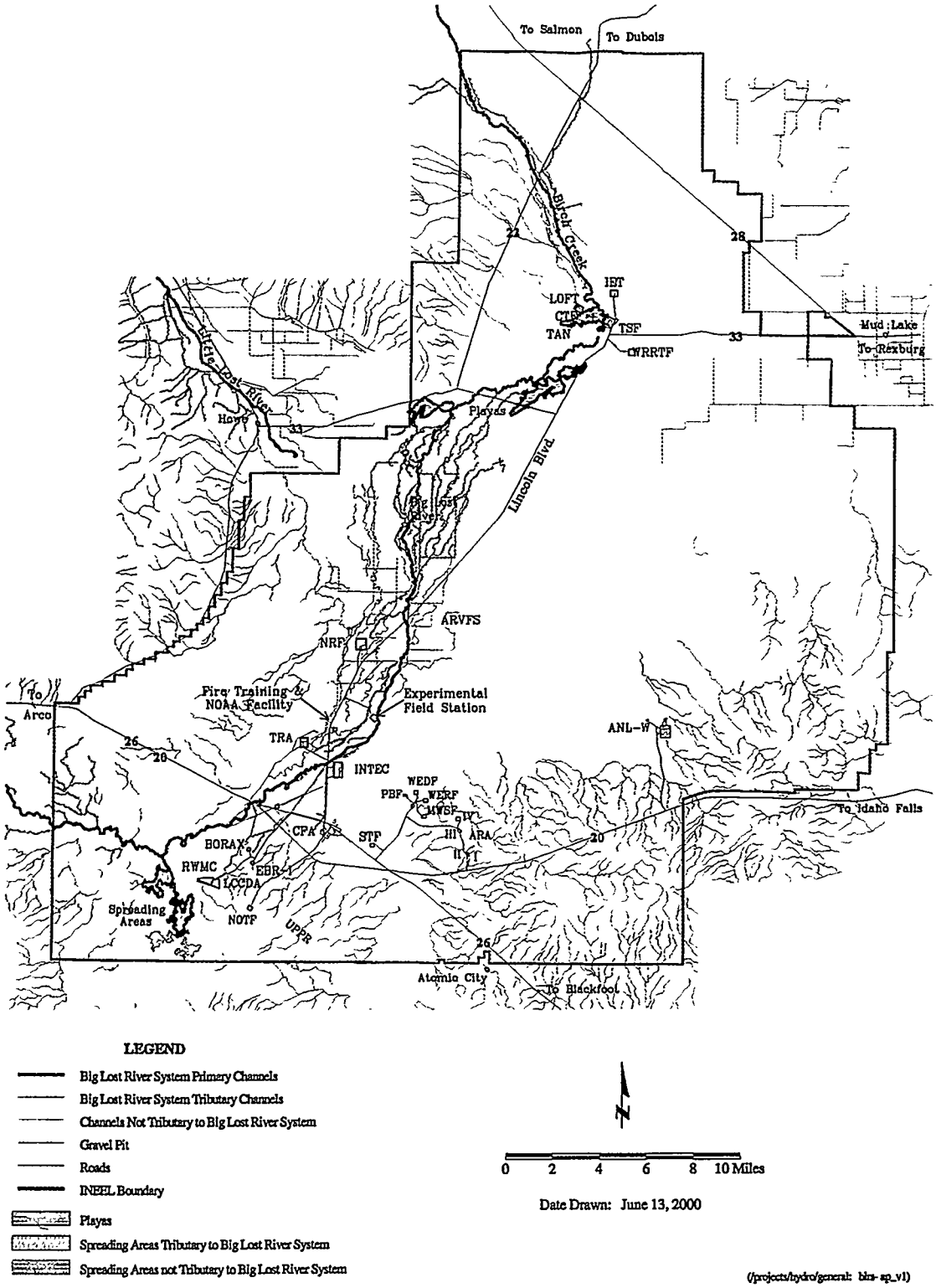


Figure 4-9. Big Lost River System.

4.3.1 Program Design Basis

The Storm Water Monitoring Program meets the National Pollutant Discharge Elimination System Multi-Sector General Permit[8] requirements by conducting permit-required monitoring. In addition, the program monitors storm water runoff to deep injection wells to comply with State of Idaho Injection Well Permits.[6] National Pollutant Discharge Elimination System Multi-Sector General Permit-required data are submitted to the Environmental Protection Agency in a Discharge Monitoring Report.[34] Additionally, National Pollutant Discharge Elimination System data are summarized in the annual updates to the 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 1999, a total of 24 sites (Table 4-8) at five INEEL areas (Appendix A) were designated as storm water monitoring locations based upon drainage patterns and proximity to potential sources of pollutants. Seventeen locations met the conditions for quarterly monitoring required by the National Pollutant Discharge Elimination System Multi-Sector General Permit when discharges occur to the Big Lost River System. The National Pollutant Discharge Elimination System Permit requires visual examinations of storm water runoff for obvious indications of storm water pollution. These visual samples were collected for surveillance purposes whether or not storm water discharged to the Big Lost River System. In addition, at permit-specified locations, storm water runoff was collected for laboratory analysis when runoff discharged to the Big Lost River System. Seven deep injection wells are monitored as required by the Injection Well Permits[6] when storm water discharges to those wells.

The National Pollutant Discharge Elimination System Multi-Sector General Permit requires that samples be collected from rain storms that accumulated at least 0.25 cm (0.1 in.) of precipitation preceded by at least 72 hours without measurable precipitation to allow pollutants to build up and then be flushed from the drainage basin. It also requires quarterly sampling from the 17 locations that are subject to the permit requirements. Because of unique meteorological conditions, not all sites may be sampled every year. Therefore, additional samples may be collected from snow melt runoff or from storms that do not meet permit requirements. The Storm Water Monitoring Program attempts to sample locations as required and as runoff allows.

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, total discharge volume is also measured as required by the National Pollutant Discharge Elimination System Multi-Sector General Permit.

Storm water monitoring results are compared to a number of criteria to evaluate the quality of storm water discharges. The National Pollutant Discharge Elimination System Multi-Sector General Permit does not have numeric limitations for the required analytical parameters, except for the runoff from coal piles. The pH of runoff from the coal pile at INTEC must be within the range of 6 to 9. This is the only applicable regulatory limit; all other criteria were used for comparison purposes only. Concentrations were compared to Environmental Protection Agency benchmarks (see Appendix D) from the 1995 National Pollutant Discharge Elimination System Storm Water Multi-Sector General Permit. The benchmarks are pollutant concentrations above which the Environmental Protection Agency determined represent a level of concern. The level of concern is a level at which a storm water discharge could potentially impair or contribute to impairing water quality or affect human health by ingesting water or fish. The Environmental Protection Agency has used Environmental Protection Agency benchmarks to determine if a storm water discharge from any given facility merits further monitoring to ensure that the facility has been successful in implementing a storm water pollution prevention plan. Injection well sample data are compared to primary drinking water maximum contaminant levels from 40 CFR 141.[21]

Table 4-8. 1999 storm water monitoring locations and frequencies.

Site ID	Site Description	Parameters[a]	Number of Sampling Events in 1999	
			Analytical	Visual[b]
CFA-MP-2	CFA Landfill #3 east side	Total suspended solids, iron	0	0
CFA-MP-3[c]	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	TKN, total P	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[c]	SPERT Disposal 1	Drinking water metals, drinking water organics, inorganics, coliform, radiological parameters	0	0
PBF-MP-3[c]	SPERT Disposal 2	Drinking water metals, drinking water organics, inorganics, coliform, radiological parameters	2	4
PBF-MP-4[c]	SPERT Disposal 3	Drinking water metals, drinking water organics, inorganics, coliform, radiological parameters	1	1
WMC-MP-2	Outflow from the SDA at the sump by Culvert C-12	Total suspended solids, iron, NNN, zinc, visual	2	2
WMC-MP-1	East culvert off Ops. Area	CN, chemical oxygen demand, ammonia, total suspended solids, metals,[d] dissolved magnesium, NNN, visual	3	4
WMC-MP-4	West culvert off Ops. Area	CN, chemical oxygen demand, ammonia, metals, total suspended solids, dissolved magnesium, NNN, visual	3	4
SMC-MP-1	West side of Specific Manufacturing Capability (SMC) on Taylor Creek Road	Visual inspection only	0	3
SMC-MP-2	North side of SMC	Visual inspection only	0	3
CTF-MP-1	South of SMC 631 off of Snake Ave.	Visual inspection only	0	3
TSF-MP-1[c]	TAN Drainage Disposal 1, corner of Lincoln and Nile	Drinking water metals, drinking water organics, inorganics, coliform, radiological parameters	0	0
TSF-MP-2[c]	TAN Drainage Disposal 2, discharge to basin TAN-782	Drinking water metals, drinking water organics, inorganics, coliform, radiological parameters	0	0

Table 4-8. (continued).

Site ID	Site Description	Parameters[a]	Number of Sampling Events in 1999	
			Analytical	Visual[b]
TSF-MP-3[c]	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	1	1
TAN-MP-2	T-28 N. Borrow Source outflow	NNN, total suspended solids, visual	1	1
TGP-MP-11	T-28 S. Borrow Source	NNN, total suspended solids, visual	0	0
RGP-MP-11	T-12 Borrow Source	NNN, total suspended solids, visual	0	0
BGP-MP-11	Adams Blvd. Borrow Source	NNN, total suspended solids, visual	0	0
LGP-MP-11	Lincoln Blvd. Borrow Source	NNN, total suspended solids, visual	0	0
TRP-MP-11	Monroe Blvd. Borrow Source	NNN, total suspended solids, visual	0	0

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

b. 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.

c. Injection well permit monitoring.

d. Metals are: silver, arsenic, cadminum, iron, mercury, manganese, lead, selenium.

4.3.2 Data Summary and Assessment by Facility

During 1999, approximately 145 storm water samples (defined as types of analyses performed) were collected from 13 locations. Forty-three of the 145 storm water samples were collected from discharges to the Big Lost River System from the RWMC monitoring points in 1999 in compliance with the National Pollutant Discharge Elimination System Multi-Sector General Permit. Table 4-9 shows sampling dates and locations for the storm water events in 1999. No rainfall or snowmelt runoff was observed during 1999 at 10 monitoring points and five injection wells; therefore, no samples were collected at those locations.

Historical and 1999 summary data are available in Environmental Monitoring Program files. Table 4-10 summarizes the analytical results that exceeded the comparison levels during 1999. No permit or regulatory limits were exceeded. Visual examinations of runoff samples indicate that a small amount of suspended solids is usually present. No other obvious indicators of storm water pollution were observed. Of the contaminants that exceeded the Environmental Protection Agency benchmarks in 1999, aluminum, iron, zinc, and total suspended solids were the most frequent.

Table 4-9. 1999 storm water sampling events, with analytical monitoring.

Monitoring Point	Date	Event	Precipitation[a] (cm)	Discharge to Big Lost River System	Flow Rate (L/sec)
WMC-MP-1	01/20/99	Snow melt	NA	Yes	1.019
WMC-MP-1	06/02/99	Rain runoff	0.28	Yes	0.227
WMC-MP-1	08/30/99	Rain runoff	0.13	Yes	0.311
WMC-MP-2	03/22/99	Snow melt	NA	Yes	25
WMC-MP-2	06/02/99	Rain runoff	4.01	Yes	25
WMC-MP-4	01/20/99	Snow melt	NA	Yes	0.340
WMC-MP-4	06/02/99	Rain runoff	0.28	Yes	0.028
WMC-MP-4	08/30/99	Rain runoff	0.13	Yes	0.113
TAN-MP-1[b]	03/31/99	Snow melt	NA	Yes	1,416[c]
TAN-MP-2[b]	03/31/99	Snow melt	NA	Yes	1,416[c]

a. NA = precipitation amounts are not applicable to snow melt events.

b. Samples were of Birch Creek inflow and outflow from gravel pit rather than from actual runoff.

c. Flow is based on long-term estimate since water flowed for more than 1 day.

Table 4-10. 1999 storm water/snow melt data exceeding comparison levels.

Monitoring Point	Parameter (Units)	Sample Date	Result	Comparison Level
	Results Exceeding Safe Drinking Water Act Guideline[a]			
PBF-MP-3	Iron	02/18/99	0.504	0.300
PBF-MP-3	Iron [F][b]	03/04/99	0.371	0.300
PBF-MP-4	pH	02/18/99	6.49	6.5–8.5
PBF-MP-4	Iron	02/18/99	0.917	0.300
PBF-MP-4	Iron [F]	02/18/99	0.309[a]	0.300
PBF-MP-4	Aluminum	02/18/99	1.09	.05–0.2
	Results Exceeding Environmental Protection Agency Benchmarks[c]			
WMC-MP-1	Chemical oxygen demand	08/30/99	140	120
WMC-MP-1	Nitrogen, nitrate + nitrite	08/30/99	1.56	0.68
WMC-MP-1	Total suspended solids	01/20/99	155	100
WMC-MP-1	Aluminum	01/20/99	6.61	0.75
WMC-MP-1	Aluminum	06/02/99	1.74	0.75
WMC-MP-1	Aluminum	08/30/99	0.965	0.75
WMC-MP-1	Iron	01/20/99	7.48	1.00
WMC-MP-1	Iron	06/02/99	2.00	1.00
WMC-MP-1	Zinc	01/20/99	0.123	0.117
WMC-MP-2	Total suspended solids	03/22/99	107	100
WMC-MP-2	Aluminum	03/22/99	4.11	0.75
WMC-MP-2	Iron	03/22/99	4.41	1.00
WMC-MP-2	Iron	06/02/99	3.96	1.00
WMC-MP-4	Chemical oxygen demand	08/30/99	522	120
WMC-MP-4	Nitrogen, nitrate + nitrite	08/30/99	4.62	0.68
WMC-MP-4	Total suspended solids	01/20/99	554	100
WMC-MP-4	Aluminum	01/20/99	28.9	0.75
WMC-MP-4	Aluminum	06/02/99	6.38	0.75
WMC-MP-4	Aluminum	08/30/99	3.57	0.75
WMC-MP-4	Iron	01/20/99	33.3	1.0
WMC-MP-4	Iron	06/02/99	7.34	1.0
WMC-MP-4	Iron	08/30/99	3.52	1.0
WMC-MP-4	Zinc	01/20/99	2.68	0.117
WMC-MP-4	Zinc	06/02/99	0.249	0.117
WMC-MP-4	Zinc	08/30/99	0.188	0.117

a. Injection well comparison levels are Safe Drinking Water Act maximum contaminant levels/secondary maximum contaminant levels.

b. F = Filtered sample.

c. Environmental Protection Agency benchmarks are from the 1995 National Pollutant Discharge Elimination System Storm Water Multi-Sector General Permit.

Suspended solids are considered a pollutant when they exceed natural concentrations to the extent that they have a detrimental effect on water quality. Total suspended solids concentrations are a good indicator of pollutant removal efficiency and are used to evaluate storm water pollution prevention practices. Instances of high concentrations of total suspended solids may indicate that erosion control is not adequate.

Although Environmental Protection Agency benchmark concentrations were exceeded in several samples, the Environmental Protection Agency has stressed that exceeded concentrations do not imply that an actual violation of standards will exist in the receiving water body in question. This is particularly relevant at the INEEL, where in 1999, RWMC was the only location that discharged to a man-made channel that is considered a tributary of the Big Lost River. Runoff did not reach the Big Lost River, and so there were no discharges to a "receiving water body." At the TAN T-28 North Gravel Pit, a small amount of snowmelt discharged into Birch Creek from the abovegrade stockpiles. Analytical results indicate that the water quality in Birch Creek was not affected.

In 1999, monitoring results were below comparison levels at INTEC and the TAN gravel pits. The following sections discuss only the monitoring locations where National Pollutant Discharge Elimination System Multi-Sector General Permit results exceeded comparison levels in 1999.

4.3.2.1 Power Burst Facility. There are three monitoring locations at PBF (PBF-MP-2, -3, and -4; Figure A-17). These are storm water runoff injection well basins. PBF-MP-2 was not sampled during 1999.

Snow melt events were sampled twice at the PBF-MP-3 and once at PBF-MP-4 (Special Power Excursion Reactor Test [SPERT]-II and –III) injection well basins. Water discharged to the SPERT-II injection well on March 3, 1999, but not to the SPERT–III injection well. All parameters met drinking water standards, with the exception of iron at SPERT-II, and pH, iron, and aluminum at SPERT-III. Iron, aluminum, and pH are secondary drinking water standards and do not have permit limits.

4.3.2.2 Radioactive Waste Management Complex. The RWMC has three National Pollutant Discharge Elimination System Multi-Sector General Permit-required monitoring locations (Figure A-12): one at the Subsurface Disposal Area (WMC-MP-2) and two at the Operations Area (WMC-MP-1, and WMC-MP-4).

Runoff samples were collected from the Subsurface Disposal Area (WMC-MP-2) during one snow melt and one rainfall event in 1999. Storm water from the March and June events was discharged to the man-made channel that is part of the Big Lost River System. Therefore, these samples are considered permit-required samples. The total suspended solids, aluminum, and iron benchmarks were exceeded in samples collected from the Subsurface Disposal Area in 1999. The 1999 average total suspended solids concentration was significantly lower than the historical average concentration of 621 mg/L, which indicates that erosion control may be improving. Soil stabilization efforts will continue to be monitored and assessed for improvement. Water quality in the Big Lost River was not impacted because these discharges infiltrated in the man-made channel within a short distance of the discharge point and never reached the Big Lost River.

Runoff samples were collected from the Operations Area (WMC-MP-1, -4) during one snow melt event and two rainfall events in 1999. Storm water from these events (January, June, and August) was discharged to the channel. Therefore, these samples are considered permit-required samples. Aluminum, iron, zinc, total suspended solids, nitrate + nitrite as nitrogen, and chemical oxygen demand exceeded the benchmarks in runoff from the Operations Area. Water quality in the Big Lost River was not impacted

because these discharges infiltrated in the man-made channel within a short distance of the discharge point and never reached the Big Lost River.

4.3.3 Quality Assurance/Quality Control

Due to the nature of storm water discharges and the inability to schedule sampling events, duplicate and blind standards were not submitted with storm water samples. The Storm Water Monitoring Program used the same laboratories and similar sampling techniques as the Liquid Effluent Monitoring Program (see section 4.2.4) for those samples collected under the National Pollutant Discharge Elimination System Permit. However, the Liquid Effluent Monitoring Program blind standard results varied. Therefore no correlation or general conclusion could be applied to storm water data.

Injection well samples for organic and radiological analyses were submitted to the same laboratories used by the Drinking Water Program. Blind spikes were submitted quarterly by the Drinking Water Program and found to be acceptable. Therefore, it is assumed that the organic and radiological results obtained for the Storm Water Monitoring Program during the same time period were also acceptable. Trip blanks were sent with injection well samples collected for volatile organic compound analysis. Trip blanks results did not indicate any volatile organic compound contamination during shipping.

4.4 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 1999 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 Waste Area Groups.

4.4.1 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 discharges of liquid effluent to the 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 observed in the monitoring wells are compared to the maximum allowable concentrations and secondary maximum contaminant levels specified in the Idaho Groundwater Quality Standards[25] as the limits for those wells designated as "points of compliance." (An exception to the maximum allowable concentration and secondary maximum contaminant level 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 4-11 lists the monitoring wells sampled during 1999, the sampling frequency, and the analyses performed.

4.4.2 Data Summary and Assessment by Facility

The following sections discuss significant trends observed at the INTEC Percolation Ponds, the INTEC Sewage Treatment Plant, and the TAN/TSF Sewage Treatment Plant.

Table 4-11. 1999 Groundwater Monitoring Program sampling locations for INEEL Wastewater Land Application Permit facilities.

Permit	Monitoring Well	Well Description	Sampling Frequency	Analysis Parameters
INTEC Percolation Pond 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, biological 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, biological 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		

4.4.2.1 Idaho Nuclear Technology and Engineering Center Percolation Pond Compliance Monitoring.

During the 1999 reporting period, groundwater sampling was conducted at the INTEC Percolation Pond Wastewater Land Application Permit monitoring wells in April and October (see Figure A-8 for well locations). The 1999 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 at elevated levels downgradient of the Percolation Ponds; and concentrations were nondetectable for most of the remaining analytical parameters. Chloride 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, and sodium concentrations continue to exceed the maximum allowable concentration standard. The maximum allowable concentration standard for sodium serves as a "suggested optimum" and does not represent a regulatory or permit limit. These elevated concentrations are the result of the continued operation of the 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 Pond 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. This has not been the case in recent years as reported in the *1998 Annual Wastewater Land Application Permit Performance Reports for the Idaho National Engineering and Environmental Laboratory*,[26] where an increasing total dissolved solids and chloride trend is noted for USGS-112. A statistical analysis of all data since 1995 shows that the increasing trends at USGS-112 are no longer evident. Figures 4-10 and 4-11 show the chloride and total dissolved solids concentrations for the Percolation Pond effluent, USGS-112, and USGS-113.

Also similar to previous years, iron concentrations fluctuated in multiple wells. USGS-112 fluctuated the most, though USGS-048 and USGS-113 also fluctuated in 1999. These fluctuations are not believed to be related to Percolation Pond operation since iron concentrations increased in wells both upgradient and downgradient of the ponds over the past few years, and iron concentrations in the effluent are well below those in the groundwater. Rather, based on a 1999 study[35] of wells of similar ages at TAN, corrosion of the riser pipes is suspected to be the cause of the increased iron levels. One notable difference in the 1999 groundwater monitoring results for the INTEC Percolation Pond Wastewater Land Application Permit wells was a total dissolved solids concentration of 990 mg/L for USGS-048 in October. Inconsistent with historical results (concentrations ranged from 267 mg/L to 311 mg/L between 1995 and 1998 for this well), this result is believed to be an anomaly and not representative of actual groundwater conditions. Because this well is not a "point of compliance" monitoring well, no special actions or notifications were required. Contaminant concentrations in this, and all other wells in the INTEC Percolation Pond Wastewater Land Application Permit network, will continue to be monitored as part of the semiannual sampling routine.

4.4.2.2 Idaho Nuclear Technology and Engineering Center Sewage Treatment Plant Compliance Monitoring.

Groundwater sampling was conducted 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 1999. Similar to 1998 and 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.

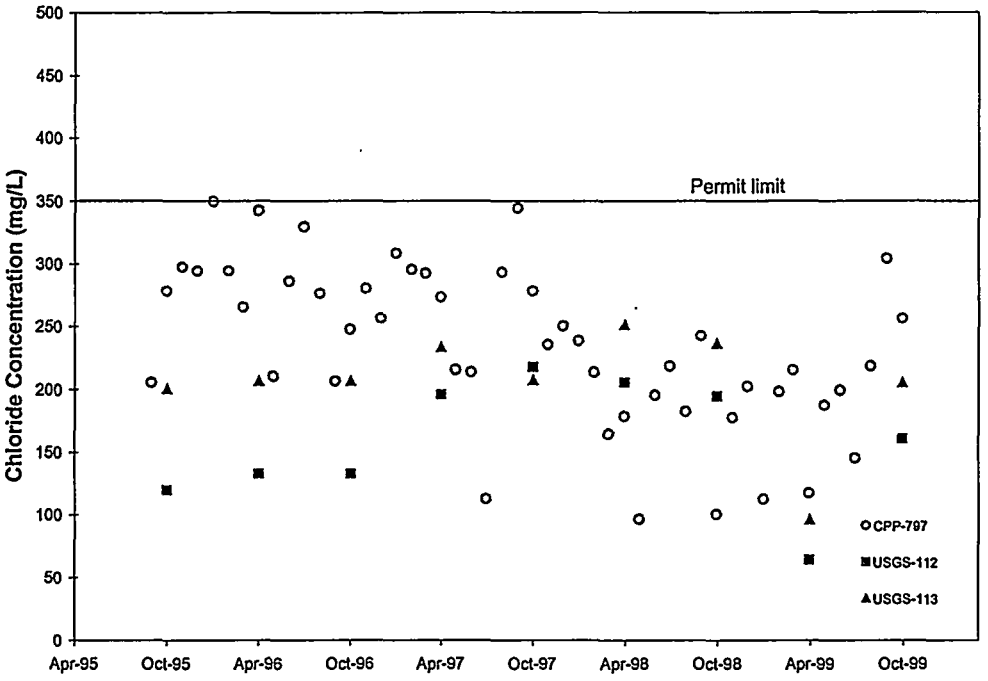


Figure 4-10. Chloride data from Idaho Nuclear Technology and Engineering Center Percolation Pond wells and effluent (CPP-797).

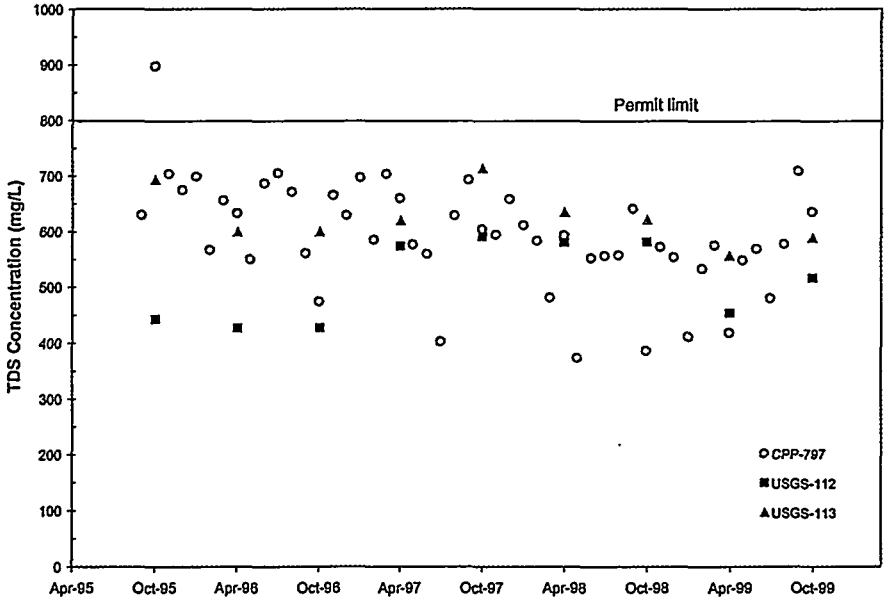


Figure 4-11. Total dissolved solids data from Idaho Nuclear Technology and Engineering Center Percolation Pond wells and effluent (CPP-797).

In addition, results for ICPP-MON-PW-024, a perched water well completed approximately 21 m (70 ft) below the surface of the infiltration trenches, also were largely unchanged from 1998. 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 reduced in the perched water compared to the effluent. Total nitrogen (the sum of total Kjeldahl nitrogen, nitrate-nitrogen, and nitrite-nitrogen) is also present in the perched water at reduced concentrations. This reduction (Figure 4-12) may be partly due to the increased trench rotation frequency that has been in place since March 1997. The current trench rotation schedule will be continued, and contaminant trends in the perched water and aquifer will be observed and tracked.

4.4.2.3 Test Area North/Technical Support Facility Sewage Treatment Plant Compliance Monitoring. Groundwater samples were collected at the TAN Sewage Treatment Plant Wastewater Land Application Permit monitoring wells in April and October (see Figure A-14 for well locations). Total coliform concentrations exceeded permit limits in TANT-MON-A-001 in October, and elevated iron levels approached or exceeded permit limits in all four wells in April and October. Sodium concentrations also continue to exceed the maximum allowable concentration standard "suggested optimum" in TAN-10A, but are not considered permit exceedances. The coliform bacteria in TANT-MON-A-001 was speciated as Serratia liquifaciens, which is a relatively free-living bacteria found in natural water bodies and soils. The elevated iron concentrations (Figure 4-13) 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[35] performed late in 1999 on several TAN monitoring wells of similar construction and age. Plans to mitigate the galvanic corrosion are underway.

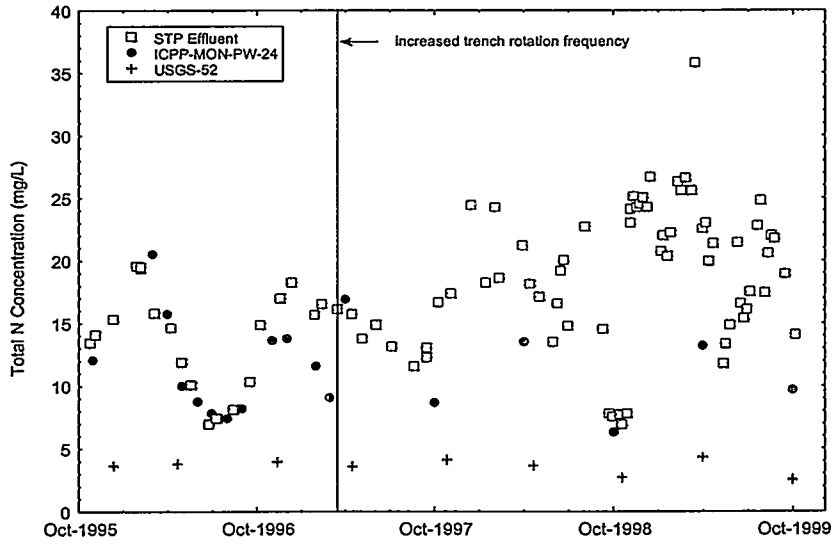


Figure 4-12. Total nitrogen concentrations in Sewage Treatment Plant effluent, ICPP-MON-PW-024, and USGS-052.

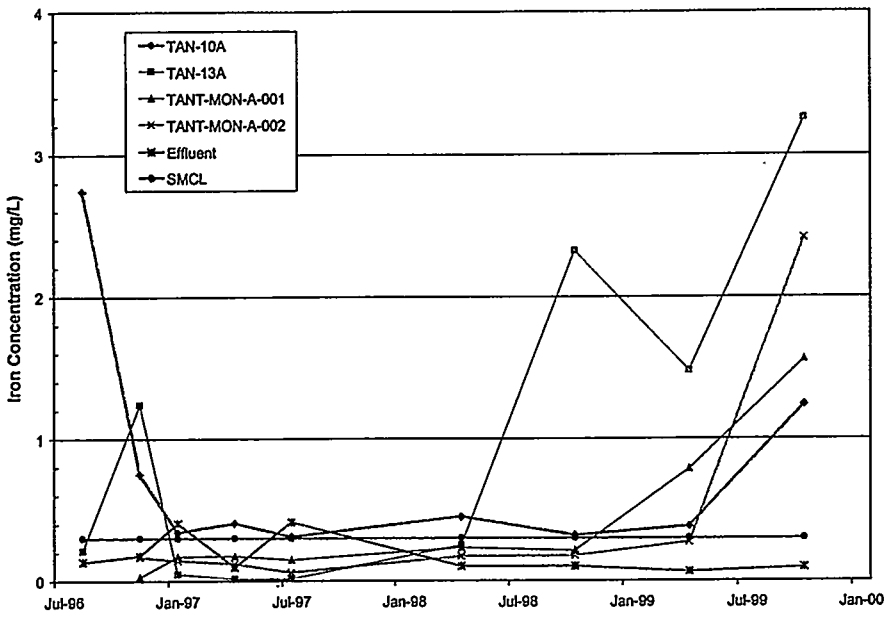


Figure 4-13. Iron concentrations in Test Area North Wastewater Land Application Permit monitoring wells and effluent.

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 have substantial impact on groundwater quality. Second, groundwater remediation now underway near the former injection well have a significant influence on local hydraulic gradients and contaminant concentrations.

4.4.3 Quality Assurance/Quality Control

The groundwater sampling activities associated with Wastewater Land Application Permit compliance sampling follow established procedures and analytical methodologies. Field measurements such as pH, temperature, turbidity, and specific conductivity are collected using portable water quality instruments calibrated in accordance with manufacturer's instructions. Water quality parameters for pH, temperature, and specific conductivity are monitored during well purging to ensure stable concentrations of the water source prior to sample collection. After the calculated purge volume is met and the final three collected water quality readings are within ±0.1 standard units for pH, ≤0.5°C for temperature, and ≤10 μS/cm for specific conductance, samples are collected. The stability of the water quality parameters ensures the samples collected represent the water quality of the groundwater source. To prevent cross-contamination, all sampling equipment contacting the samples are decontaminated between each groundwater well.

During 1999, 163 groundwater samples were collected from the INTEC and TAN Wastewater Land Application Permit monitoring wells, and an additional 72 quality control samples were collected. Laboratory analysis of the 163 groundwater samples provided 382 data points, yielding information on groundwater quality at INTEC and TAN. One hundred percent of the samples required for permit

compliance were collected (meeting project data completeness goals), and only three data points (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) are 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 a regular groundwater sample. 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 nonmetal analyses, 97% of the duplicate pairs had relative percent differences less than 35% (56 out of 58 total pairs). This high percentage of acceptable duplicate results indicates little problem with laboratory contamination and good overall precision. For metal analyses, 75% of the duplicate pairs had relative percent differences less than 35% (21 out of 28 total pairs). Of the seven pairs that exceeded the 35% relative percent difference, all reported concentrations that 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. However, there were positive results in some of these samples for sodium, chloride, fluoride, and total dissolved solids. The cause of these positive detections was traced to the deionized water source. (All quality control samples using water obtained from a source other than the deionized water showed nondetectable contaminant concentrations.) 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.

5. 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 DOE Order 5400.5 "Radiation Protection of the Public and Environment."[10] Section 5.1 presents the air surveillance results, Section 5.2 presents the surface water runoff surveillance results, Section 5.3 presents the soil surveillance results, Section 5.4 presents the biota surveillance results, and Section 5.5 presents the direct radiation surveillance results.

The management and operating contractor conducts environmental surveillance at INEEL facilities and selected off-Site locations. This surveillance is conducted in conjunction with the Environmental Science and Research Foundation for compliance with DOE Order 5400.5. The Environmental Science and Research Foundation 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 (RWMC and Waste Experimental Reduction Facility [WERF]) for compliance with DOE Order 435.1.[11] The basis for the Waste Management Surveillance Program is somewhat different 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 5-1 and 5-2, respectively. A total of 3,505 samples were collected and analyzed for the Environmental Surveillance Program in 1999.

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 Environmental Science and Research Foundation. The Environmental Science and Research Foundation compiles an annual Idaho National Engineering and Environmental Laboratory Site environmental report, 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.

5.1 Air Surveillance

The Waste Management Surveillance Program collects particulate material on 10-cm (4-inch) membrane filters using two types of air monitors: particulate matter with a nominal size of 10 μm (PM_{10}) and 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 size range of particle sizes that can be suspended in air for long periods and therefore readily transported to off-Site locations by wind. Filters are collected and analyzed semimonthly for gross alpha and gross beta activity, and monthly composites of each location are analyzed quantitatively for gamma-emitting

Table 5-1. 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 Semimonthly Monthly Quarterly	Gross alpha Gross beta Gamma spectrometry Radiochemistry[a]
	• Suspended particulate	1 air monitor operated at 0.113 m^3/min	Semimonthly Semimonthly Monthly Quarterly	Gross alpha Gross beta Gamma spectrometry Radiochemistry[a]
	• Atmospheric moisture	1 monitor @ 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 Gross beta Gamma spectrometry 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 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 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 Semimonthly Monthly Quarterly	Gross alpha Gross beta Gamma spectrometry Radiochemistry[a]
	• Suspended particulate	2 air monitors operated at 0.113 m^3/min	Semimonthly Semimonthly Monthly Quarterly	Gross alpha Gross beta Gamma spectrometry 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 Gross beta Gamma spectrometry Radiochemistry[a]
	Soil	9 locations sampled (plus 1 control area)	Triennially	Gamma spectrometry Radiochemistry[a]

Table 5-1. (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 Semimonthly Monthly	Gross alpha Gross beta Gamma spectrometry
	• Suspended particulate	1 air monitor operated at 0.113 m^3/min	Semimonthly Semimonthly Monthly	Gross alpha Gross beta 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 Semimonthly Monthly	Gross alpha Gross beta Gamma spectrometry
Test Area North (TAN)	**Air**			
	• Suspended particulate	5 air monitors operated at 0.113 m^3/min	Semimonthly Semimonthly Monthly Quarterly	Gross alpha Gross beta Gamma spectrometry 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 5-2. Summary of site surveillance activities.

Sample Type	Analyses	Collection Frequency	Locations	
			Distant Communities	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 is included.

b. NA—not applicable.

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

d. TLD—thermoluminescent dosimetry.

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. Each low-volume air monitor maintains an average airflow of about 57 L/min (2 cfm) through a set of filters consisting of a five-cm (two-inch) 1.2-μm pore membrane filter followed by a charcoal cartridge. These filters are analyzed weekly for gross alpha and gross beta screening 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.*[36] This monitoring fulfills one of the conditions specified in the "Permit to Construct, Idaho Chemical Processing Plant Nitrogen Oxide Sources."[37]

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 downwind from the Idaho Nuclear Technology and Engineering Center (INTEC) 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 is passed through a column of molecular sieve. The molecular sieve absorbs water vapor in the air; columns are changed when the molecular sieve absorbs sufficient moisture to obtain a sample. Tritium concentrations are then determined by liquid scintillation counting of the water extracted from the molecular sieve columns.

5.1.1 Data Summary and Assessment for Waste Management Surveillance

Gross alpha data provide rapid detection of significant changes in airborne alpha activity. The gross alpha data are also used as a criteria to screen samples for immediate radiochemical analyses for specific alpha emitters. Results of gross beta analysis of the air filters are evaluated to determine any significant increases in the radioactivity that may require more immediate or more in-depth analysis by gamma spectrometry or radiochemistry. Gross beta data are evaluated by comparing results with historical and background data to identify trends using a log concentration-versus-time plot. Each plot is compared against control concentrations, detection limits (Appendix C), and alert levels. Alert levels are 25% of the most restrictive Derived Concentration Guides for the public. Comparisons are made between stations and control monitors using statistical analysis methods (Appendix B). Also, specific radionuclide concentrations are compared to applicable Derived Concentration Guides for the public (Appendix D).

Figures 5-1 and 5-2 summarize the 1998 and 1999 gross alpha and gross beta data by facility and monitor type and illustrate short-term changes in levels. Tables 5-3 and 5-4 summarize corresponding statistics for all 1998 and 1999 data.

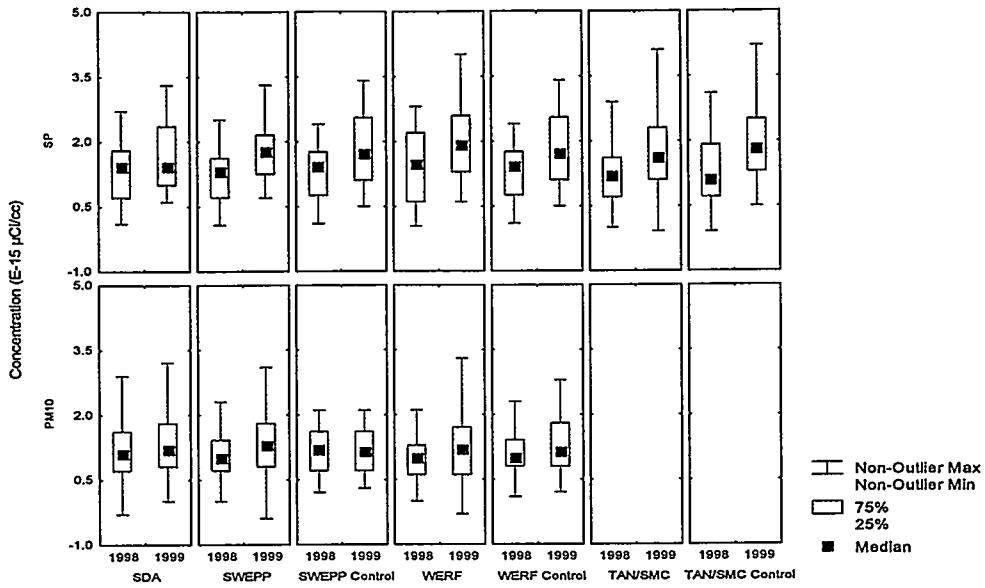


Figure 5-1. Gross alpha concentrations by year, facility, and monitor type.

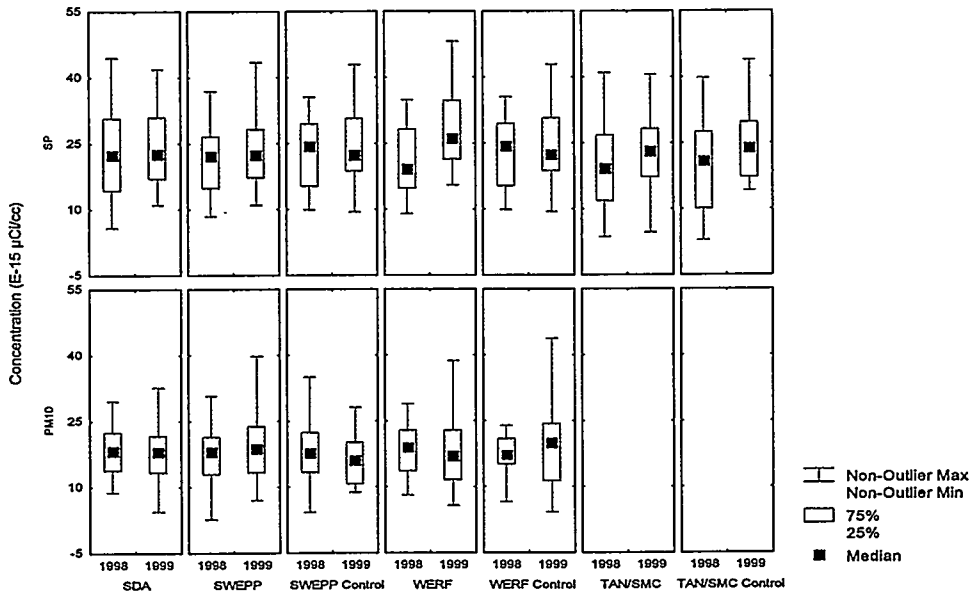


Figure 5-2. Gross beta concentrations by year, facility, and monitor type.

Table 5-3. 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)	98	23	1.3	1.4	0.1	2.7
		99	24	1.7	1.4	0.6	4.5
	SWEPP	98	41	1.3	1.3	0.07	3.0
		99	48	1.8	1.7	0.7	4.1
	Control[a]	98	24	1.4	1.4	0.1	3.6
		99	24	1.8	1.7	0.5	3.4
	WERF	98	18	1.4	1.5	0.04	2.8
		99	23	2.0	1.9	0.6	4.0
	TAN/SMC	98	92	1.2	1.2	0.0	3.1
		99	93	1.7	1.6	-0.08	4.1
	Control[b]	98	24	1.3	1.1	-0.1	3.1
		99	24	2.0	1.8	0.5	4.2
PM_{10}	SDA	98	140	1.2	1.1	-0.3	3.2
		99	129	1.4	1.2	0.0	4.4
	SWEPP	98	135	1.1	1.0	0.0	2.8
		99	138	1.4	1.3	-1.0	5.3
	Control[c]	98	21	1.2	1.2	0.2	2.1
		99	24	1.1	1.1	0.3	2.1
	WERF	98	65	1.0	1.0	-0.5	2.1
		99	59	1.2	1.2	-0.3	3.3
	Control[d]	98	22	1.1	1.0	-0.7	2.3
		99	20	1.4	1.1	0.2	2.8

a. SDA/SWEPP/WERF.

b. TAN/SMC.

c. SDA/SWEPP.

d. WERF.

Table 5-4. 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	98	23	22.0	22.3	5.7	44.4
		99	24	24.2	22.5	10.9	41.8
	SWEPP	98	41	21.4	22.1	8.3	36.8
		99	48	23.6	22.2	10.9	43.4
	Control[a]	98	24	23.2	24.3	9.8	35.5
		99	24	24.4	22.2	9.3	42.8
	WERF	98	18	20.7	19.0	9.0	34.8
		99	23	27.6	26.0	15.5	48.1
	TAN/SMC	98	92	20.0	19.2	3.6	40.9
		99	93	24.4	23.0	4.6	70.8
	Control[b]	98	24	19.5	20.9	2.8	39.8
		99	24	26.3	23.7	14.1	75.1
PM_{10}	SDA	98	140	18.1	18.1	8.6	38.9
		99	129	18.5	17.8	4.3	44.1
	SWEPP	98	135	17.9	17.9	2.6	45.6
		99	138	20.1	18.6	6.9	61.7
	Control[c]	98	21	18.2	17.7	4.2	35.0
		99	24	16.5	15.9	8.7	37.0
	WERF	98	65	18.0	18.9	8.0	28.8
		99	59	17.7	16.9	5.7	38.6
	Control[d]	98	22	18.2	17.1	6.5	36.3
		99	20	19.2	19.8	4.2	43.7

a. SDA/SWEPP/WERF.

b. TAN/SMC.

c. SDA/SWEPP.

d. WERF.

Similar to the 1998 analyses of gross alpha concentrations, the gross alpha concentrations varied little among facility groupings during 1999 (Figure 5-1). Median suspended particulate monitor concentrations increased slightly from 1998 to 1999 for all facility groupings except the Subsurface Disposal Area (SDA), where the median concentration did not change. The median PM_{10} monitor concentrations also increased for all groupings, except for the Stored Waste Examination Pilot Plant (SWEPP) control group, which showed a slight increase. The changes in median values from 1998 to 1999 for the gross alpha PM_{10} monitors located at the SWEPP and the suspended particulate monitors at Test Area North/Specific Manufacturing Capability (TAN/SMC) and TAN/SMC control locations were found to be statistically significant. For the remaining facility/monitor type groupings, the changes in gross alpha median concentrations from 1998 and 1999 were not significant.

Median gross beta concentrations for suspended particulate monitors increased from 1998 to 1999 for all location groupings except the SWEPP control, which decreased. Median gross beta concentrations

from PM_{10} monitors decreased for the SDA, SWEPP control, and WERF location groupings, while the median concentrations increased for the SWEPP and WERF control groupings. For suspended particulate monitors, these changes were significant for the WERF and TAN/SMC location groupings, while none of changes in PM_{10} monitor gross beta concentrations from 1998 to 1999 were found to be significant. Quarterly averages of RWMC and WERF gross beta activity (Cesium-137 equivalent) since 1989 are shown in Figures 5-3 and 5-4, respectively.

Cesium-137 was the only man-made, gamma-emitting radionuclide detected that could be attributed to waste management facility operations. Cesium-137 was found in one sample collected in June. This concentration was 7.0 ± 2.0E-16 microcuries per cubic centimeter (μCi/cc), which is near the stated detection limit and represents 0.0002% of the Derived Concentration Guide.

There were no man-made alpha and beta-emitting radionuclides above the laboratory-stated detection limits for 1999.

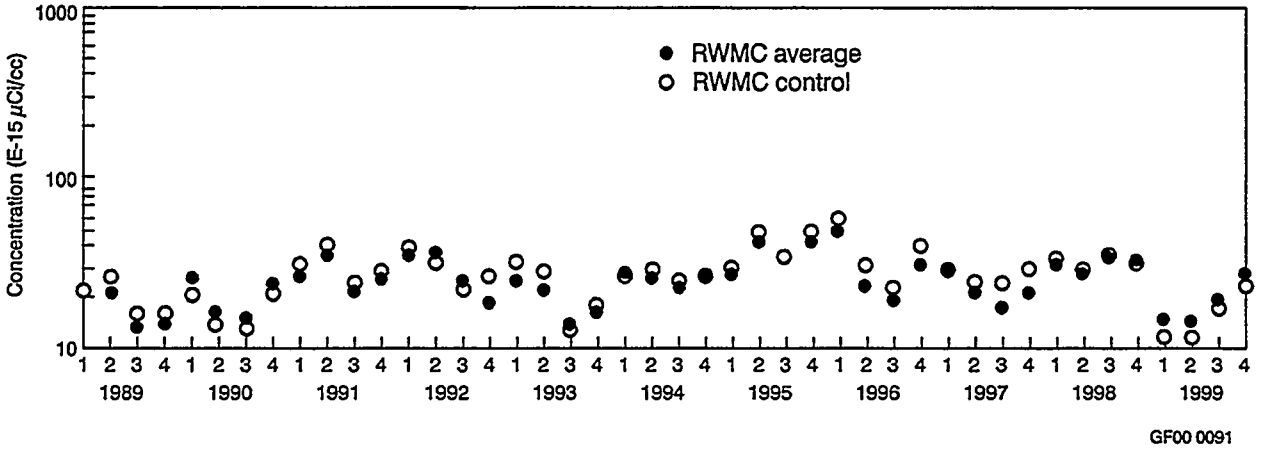


Figure 5-3. Quarterly average of gross beta air concentrations (cesium-137 equivalent) measured at Radioactive Waste Management Complex for the past 10 years (GF00 0091).

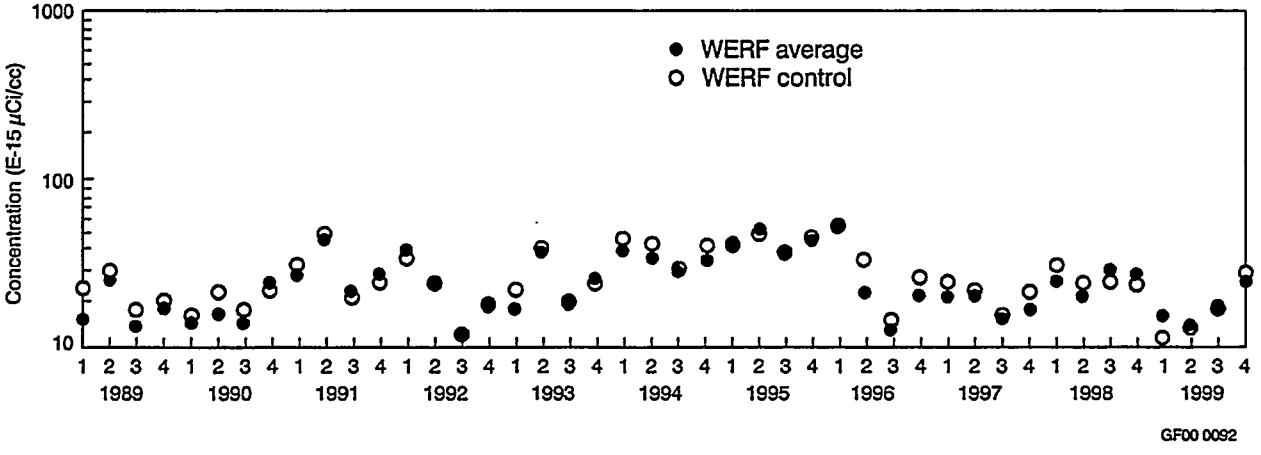


Figure 5-4. Quarterly average of gross beta air concentrations (cesium-137 equivalent) measured at Waste Experimental Reduction Facility for the past 10 years (GF00 0092).

5.1.2 Data Summary and Assessment for Site Surveillance

The maximum gross alpha concentration for each location is shown in Table 5-5. Gross alpha concentrations for 1999 were, in general, typical of those measured previously. The mean gross alpha concentrations are shown in Table 5-6.

Table 5-5. Maximum gross alpha concentrations for 1999 per location.

Location	Date	Maximum Concentration[a] (E-15 μCi/cc)
ANL-W	12/22	2.7 ± 1.4
ARA	06/16	3.4 ± 1.2
CFA	08/11	2.3 ± 0.8
EBR-I	11/17	3.1 ± 1.3
EFS	07/14	3.5 ± 1.1
INTEC	08/11	2.4 ± 1.1
NRF	11/17	3.5 ± 1.4
PBF	06/30	5.0 ± 1.2
RWMC	12/01	2.4 ± 1.1
TAN	10/06	3.0 ± 0.8
TRA	04/28	2.9 ± 1.4
VANB	07/21	4.3 ± 1.6
Off-Site	09/22	5.0 ± 2.0

a. Uncertainties shown are the associated 2 sigma.

Table 5-6. Mean gross alpha concentrations for 1999 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)	Concentration (E-15 μCi/cc)	% of DCG[a]
ANL-W	-0.03	0.2	1.3	0.6	0.5	2.5
ARA	0.3	0.8	1.2	0.5	0.7	3.5
CFA	-0.1	0.5	1.0	0.2	0.4	2.1
EBR-I	-0.7	1.0	1.5	0.7	0.6	3.2
EFS	0.8	0.8	1.3	0.3	0.8	4.0
INTEC	0.04	0.6	1.2	0.6	0.6	2.8
NRF	0.08	0.7	1.3	1.2	0.9	4.4
PBF	0.4	0.9	1.4	0.1	0.7	3.5
RWMC	0.08	0.4	1.0	0.9	0.6	2.9
TAN	0.1	1.0	1.0	0.6	0.7	3.4
TRA	0.2	1.0	0.9	1.1	0.8	4.0
VANB	0.8	1.1	1.7	1.5	1.2	6.2
Off-Site	1.0	1.4	1.7	1.7	1.4	7.0

a. DCG—Derived Concentration Guide.

The highest mean concentrations of gross beta were detected in the third and fourth quarters of 1999 (Table 5-7). The higher values generally occur during winter inversion conditions. The maximum quarterly gross beta concentration was measured at the Power Burst Facility (PBF) in the third quarter and represents 0.4% of the Derived Concentration Guide for strontium-90 (most restrictive).

Cesium-137 was the only gamma-emitting radionuclide detected in the quarterly composite 5-cm (2-in.) low-volume filter samples submitted for analyses during 1999. The sample was collected from the Auxiliary Reactor Area (ARA) in the second quarter, and the concentration was 1.07 ± 0.18 E-15 μCi/cc. There were no positive detections of I-131 from the charcoal cartridges submitted for analyses in 1999.

Strontium-90 was the only radionuclide detected by radiochemical analysis; all positive detections were in the fourth quarter (Table 5-8). The maximum strontium-90 concentration was collected from PBF and was 1.8 ± 0.8 E-16 μCi/cc and represents 0.002% of the Derived Concentration Guide. These concentrations were at or near background.

The 1999 annual mean suspended particulate concentrations are shown in Table 5-9. Higher particulate concentrations were found at the distant and boundary locations rather than on the INEEL. The largest source of airborne particulates in the vicinity of the INEEL is considered to be resuspended dust from local agricultural operations.

Table 5-7. Mean gross beta concentrations for 1999 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)	Mean Concentration (E-15 μCi/cc)	% of DCG[a]
ANL-W	18	18	28	27	23	0.3
ARA	17	21	28	27	23	0.3
CFA	16	16	25	26	21	0.2
INTEC	17	18	29	28	23	0.3
EBR-I	18	19	29	28	23	0.3
EFS	19	17	28	31	24	0.3
NRF	16	17	25	28	22	0.2
PBF	17	19	37	26	25	0.3
RWMC	12	14	23	22	17	0.2
TAN	15	16	24	26	20	0.2
TRA	19	22	29	29	25	0.3
VANB	17	19	31	28	23	0.3
Off-Site	17	18	28	27	22	0.2

a. DCG—Derived Concentration Guide.

Table 5-8. Site surveillance radiochemistry detections for air.

Location	Quarter	Analyses Type	Concentration (E-15 μCi/cc)[a]	% of DCG[b]
EFS	4th	Sr-90	0.12 ± 0.06	0.001
Location B (TRA)	4th	Sr-90	0.15 ± 0.08	0.002
PBF	4th	Sr-90	0.18 ± 0.08	0.002

a. Uncertainties shown are the associated 2 sigma.

b. DCG—Derived Concentration Guide.

Table 5-9. 1999 annual mean for suspended particulate concentrations.

Location	Annual Mean Concentration ($\mu g/m^3$)	Number of Samples
ANL-W	14	51
ARA	5	51
CFA	9	50
EBR-I	10	50
EFS	9	49
INTEC	10	51
NRF	12	49
PBF	9	46
RWMC	10	50
TAN	11	50
TRA	14	50
VANB	30	51
Blackfoot	27	50
Craters of the Moon	10	50
Idaho Falls	20	47
Rexburg	27	50

There were no tritium concentrations above the laboratory-stated detection limits.

Ambient nitrogen dioxide measurements were obtained on a continuous basis 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 approximately 4 months during 1999. The mean nitrogen dioxide concentrations for 1999 at VANB and EFS were 2.4 $\mu g/m^3$ (1.3 parts per billion [ppb]) and 3.2 $\mu g/m^3$ (1.7 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). Figure 5-5 shows quarterly mean concentrations of nitrogen dioxide in 1999.

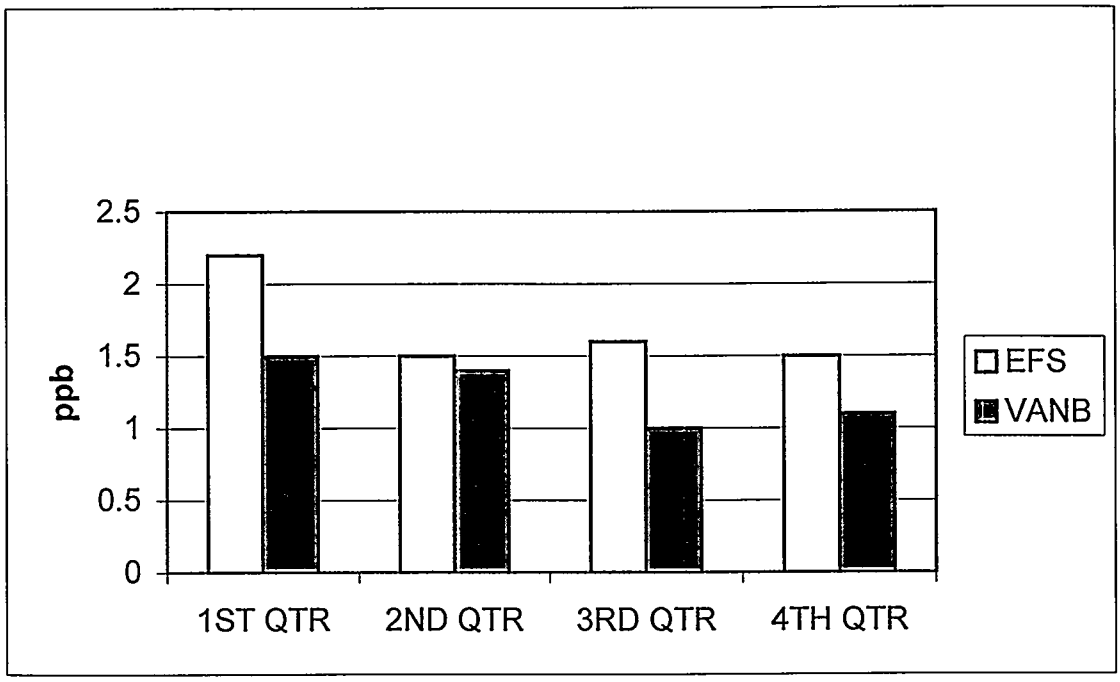


Figure 5-5. Quarterly mean concentration of nitrogen dioxide for 1999.

Ambient sulfur dioxide was continuously monitored at VANB during 1999 (Figure A-1). The mean sulfur dioxide concentration was 3.7 $\mu g/m^3$ (1.4 ppb) or 4.6% of the annual primary air quality standard. The maximum daily concentration of 16.0 $\mu g/m^3$ (3.2 ppb) was 4.4% 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.

5.2 Surface Water Runoff

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

Radionuclides could be transported outside the boundaries of the RWMC via surface water runoff. Surface water runoff occurs 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 enhance subsurface migration of radionuclides.

Beginning in 1994, quarterly surface water runoff samples were collected at the WERF seepage basins to provide an indication of contamination releases from stored waste. 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.

5.2.1 Data Summary and Assessment for Waste Management Surveillance

Surface water runoff samples were collected during all quarters of 1999 at the RWMC. Cesium-137 was the only man-made, gamma-emitting radionuclide detected in RWMC samples and was collected from TSA-3 (Figure A-12). The maximum cesium-137 concentration was collected during the fourth quarter and was 3.7 ± 3.4 E-10 μCi/mL. Cesium-137 is commonly detected in environmental samples collected at the RWMC. This concentration represents 0.01% of the Derived Concentration Guide for releases of cesium-137 to the public.

Second-quarter samples were analyzed for alpha- and beta-emitting radionuclides. Strontium-90, americium-241 and plutonium-239/240 were detected in one sample collected from the Subsurface Disposal Area. The americium-241 concentration was 1.12 ± 0.4 E-10 μCi/mL. This concentration represents 0.37% of the Derived Concentration Guide. The plutonium-239/240 concentration was 2.04 ± 1.50 E-11 μCi/mL. This concentration represents 0.07% of the appropriate Derived Concentration Guide. The strontium-90 concentration was 6.95 ± 2.72 E-10 μCi/mL and represents 0.07% of the Derived Concentration Guide. These concentrations are consistent with those typically seen in waters collected from areas with higher volumes of suspended particulates.

Samples were collected from the WERF seepage basins during the first and second quarters in 1999. Cesium-137 was detected in samples collected during the first quarter at WERF. The maximum concentration was 3.7 ± 0.6 E-9 μCi/mL collected at the south basin. This concentration represents 0.12% of the Derived Concentration Guide and is comparable to historical concentrations.

5.3 Soil Surveillance

Soil is sampled at both waste management facilities (RWMC and WERF) and site surveillance locations. The samples are analyzed by gamma spectrometry. Based on sample results, selected samples are submitted for radiochemistry analysis.

5.3.1 Data Summary and Assessment for Waste Management Surveillance

During 1999, 16 soil samples were collected from waste management facilities (four seepage basin soil samples and 12 soil samples). Cesium-137 was the only man-made gamma radionuclide detected.

The maximum cesium-137 concentration was at the WERF control location and was 6.8 ± 1.2 E-1 picocuries per gram (pCi/g), which represents 11.3% of the Environmental Concentration Guide (see Table D-4).

The maximum americium-241, plutonium-239/240, and strontium-90 concentrations were also detected in the control location sample. Americium-241 was detected at a concentration of 8.50 ± 4.76 E-3 pCi/g. This concentration is 0.02% of the Environmental Concentration Guide. Plutonium-239/240 was detected at a concentration of 1.02 ± 0.72 E-2 pCi/g. This concentration is 0.01% of the Environmental Concentration Guide. Strontium-90 was detected at a concentration of 1.69 ± 0.84 E-1 pCi/g. This concentration is 2.82% of the Environmental Concentration Guide. These concentrations are within the range attributable to fallout.

5.3.2 Data Summary and Assessment for Site Surveillance

5.3.2.1 Radioactive Waste Management Complex. During 1999, 29 soil samples were collected from outside the RWMC and analyzed by gamma spectroscopy. The maximum cesium-137 sample concentration was 1.02 ± 0.18 E-1 pCi/g (1.7% of Environmental Concentration Guide), which was collected at location RW 6-4.

Sixteen 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 ± .038 E-1 pCi/g and represents 0.39% of the Environmental Concentration Guide. The maximum plutonium-239/240 detection was 2.65 ± 0.62 E-1 pCi/g and represents 0.33% of the Environmental Concentration Guide. The americium-241 and plutonium-239/240 detections were all within the background range for the INEEL and surrounding areas and is attributable to past fallout. The maximum strontium-90 concentration was 5.49 ± 0.80 E-1 pCi/g and represents 9.15% of the Environmental Concentration Guide. The strontium-90 detections were above background for the INEEL but are consistent with historical concentrations at RWMC.

5.3.2.2 Power Burst Facility. During 1999, eleven soil samples were collected from outside the Power Burst Facility (PBF) and analyzed by gamma spectroscopy. The maximum cesium-137 sample concentration was 9.6 ± 0.8 E-1 pCi/g (16.0% of Environmental Concentration Guide) and was measured at location PBF-2. This concentration is also within the range attributed to fallout.

5.4 Biotic Surveillance

Biotic surveillance is conducted at waste management facilities (RWMC and WERF). Plant uptake of radionuclides at the RWMC has been documented by the Radiological and Environmental Sciences Laboratory.[38]

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. Vegetation sample collection from WERF began in 1984 and is normally performed every 3 years. 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.

5.4.1 Data Summary and Assessment for Waste Management Surveillance

5.4.1.1 Crested Wheatgrass. Crested wheatgrass samples were collected in each of the five major areas from the RWMC in 1999. Control samples were collected near Frenchman's cabin, located approximately 11 km (6.8 mi) south of the Subsurface Disposal Area at the base of the Big Southern Butte. No gamma-emitting radionuclides were detected in any of the samples. Perennials were also scheduled to be collected during 1999. 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 perennial samples were collected during 1999.

Six selected crested wheatgrass samples were analyzed for specific alpha- and beta-emitting radionuclides. Americium-241 was detected in two samples: one from the previously flooded area and the other from Pad A, which had the maximum concentration of 1.54 ± 0.60 E-3 pCi/g. Strontium-90 was detected in four samples: one from the previously flooded area, one from the inactive area, one from Pad A, and the other from the control location near Frenchman's cabin, which had the maximum

concentration of 3.82 ± 0.64 E-2 pCi/g. Plutonium-239/240 was detected in four samples: one from the inactive area (Area 3), one from the previously flooded area (Area 4), one from the control, and one from Pad A (Area 2), which had the maximum concentration of 1.5 ± 0.58 E-3 pCi/g. All concentrations were within the range of historical concentrations at the RWMC.[38]

5.4.1.2 Sagebrush. Sagebrush samples were collected from all sampling locations at WERF during 1999. Control samples were collected from the Tractor Flats area, located adjacent to U.S. Highway 20, which is approximately 8 km (5 mi) east of the Argonne National Laboratory-West entrance. Cesium-137 was the only gamma-emitting radionuclide detected in 1999 and was found at the control location (Tractor Flats). The sample concentration was 1.2 ± 0.5 E-1 pCi/g and was comparable to historical concentrations for that area.

5.5 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 1999 were from November 1998 through May 1999 (spring) and from May through November 1999 (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.

5.5.1 Data Summary and Assessment for Waste Management Surveillance

5.5.1.1 Thermoluminescent Dosimeters. Thermoluminescent dosimeter cumulative 6-month exposure data for 1989 through 1999 from RWMC (that is, Subsurface Disposal Area and Transuranic Storage Area) and WERF are presented in Figure 5-6. (Data from the distant communities are excluded from the trend chart.) To provide an indication of 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

depict the trends better. Although there has been some cycling of values, the general trend in the graph indicates a gradual decline in TLD exposures over time.

Table 5-10 summarizes statistics (that is, means, medians, maximum, and minimum values) for 1998 and 1999 TLD exposures by facility. Figure 5-7 provides box and whisker plots of the TLD exposure by facility (including the distant communities) for both 1998 and 1999. The 1998 TLD exposures are included to indicate short-term changes in levels.

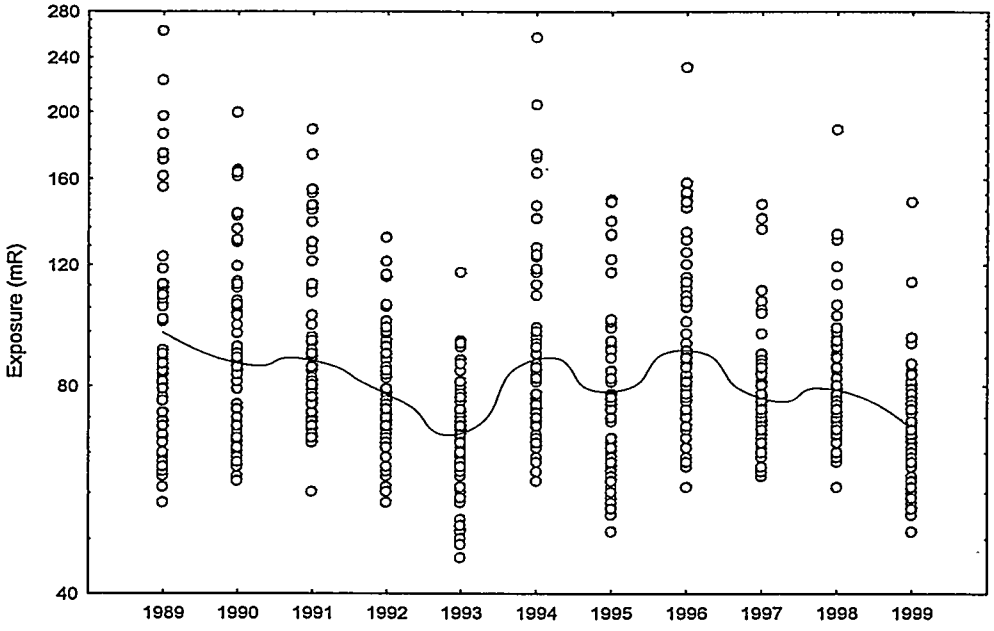


Figure 5-6. 1989–1999 RWMC and WERF thermoluminescent dosimeter exposures using negative exponential smoothing.

Table 5-10. Thermoluminescent dosimeter summary statistics by facility.

Location	Number of Samples	Mean (mR)	Median (mR)	Minimum (mR)	Maximum (mR)
		1998			
Subsurface Disposal Area	38	82	74	63	188
Transuranic Storage Area	24	76	72	57	130
WERF	22	77	72	62	133
Distant Communities	14	64	63	54	87
		1999			
Subsurface Disposal Area	38	67	65	49	94
Transuranic Storage Area	24	71	63	52	148
WERF	22	71	67	59	113
Distant Communities	14	58	58	50	70

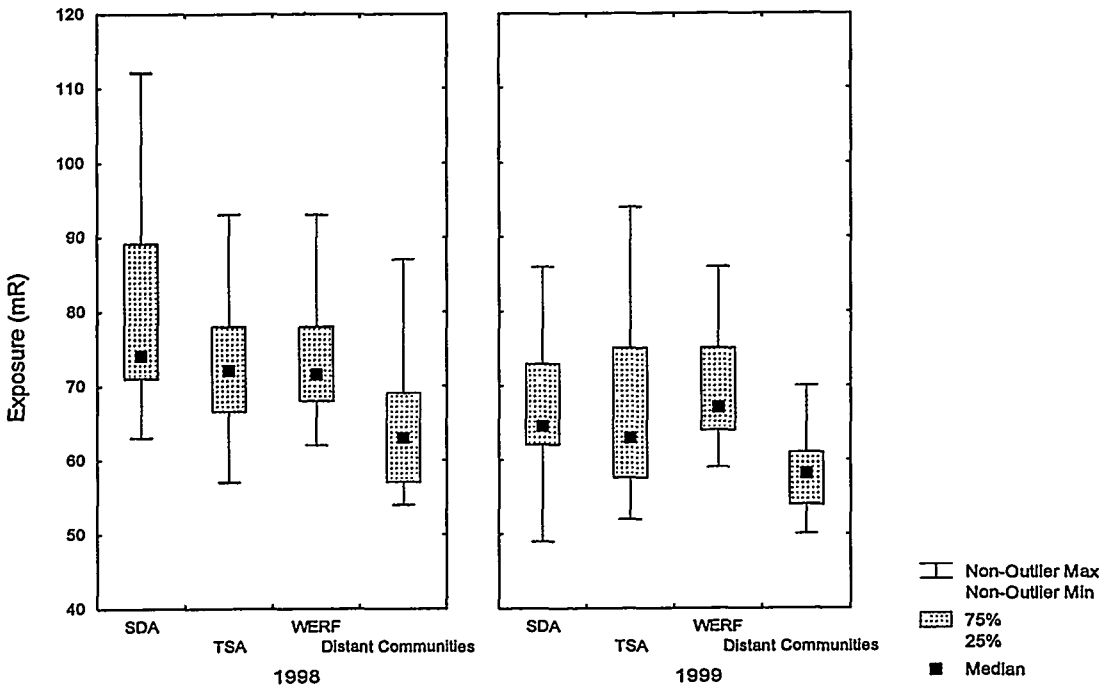


Figure 5-7. Comparison of 1998 and 1999 thermoluminescent dosimeter exposure by facility.

When comparing the median exposure values from 1999 to the previous year, they decreased for all groupings (Waste Experimental Reduction Facility, Subsurface Disposal Area, Transuranic Storage Area, and the distant communities). The differences in median exposure values for both the Subsurface Disposal Area and Transuranic Storage Area were found to be statistically significant (at the 0.05 level), using the Kruskal-Wallis test for differences in medians. For WERF and the distant communities, the differences were not significant.

Table 5-11 presents the summary statistics for thermoluminescent dosimeter results for 1998 and 1999 by season. The thermoluminescent dosimeter exposure data by season (including all facilities and the distant communities) are graphically presented in a box and whisker plot in Figure 5-8 for both 1999 and 1998. (The 1998 data are provided for comparison purposes.) From 1998 to 1999, both the overall spring and fall median measurements decreased. For 1999, the overall median exposure value for the spring measurement period (ending May 1999) was 64 mR, while the fall measurement period (ending November 1999) was 65 mR. The Kruskal-Wallis test for differences in medians indicated that the difference in the seasonal median exposure level during 1999 was not statistically significant (at the 0.05 level).

Figure 5-9 shows the exposure levels measured at Stations 40 and 41 (located along the east and northeast borders of the Transuranic Storage Area). Although the exposure levels increased slightly compared to the 1998 data, the increased exposures for Station 41 will probably 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 an area where waste is temporarily stored. Exposures measured at Station 8 have changed over the past few years due to periodic movement of waste and are shown in Figure 5-10.

Table 5-11. Thermoluminescent dosimeter summary statistics by season.

Location	Season	Number of Samples	Mean (mR)	Median (mR)	Minimum (mR)	Maximum (mR)
			1998			
SDA	Spring	19	79	75	63	112
SDA	Fall	19	84	73	64	188
TSA	Spring	12	75	72	57	130
TSA	Fall	12	77	73	63	101
WERF	Spring	11	74	69	62	119
WERF	Fall	11	80	75	66	133
Distant Communities	Spring	7	65	59	54	87
Distant Communities	Fall	7	63	64	54	70
1998 Overall	Spring	49	75	72	54	130
1998 Overall	Fall	49	78	73	54	188
			1999			
SDA	Spring	19	69	66	58	94
SDA	Fall	19	65	64	49	86
TSA	Spring	12	69	64	57	113
TSA	Fall	12	72	63	52	148
WERF	Spring	11	68	65	59	92
WERF	Fall	11	75	70	63	113
Distant Communities	Spring	7	57	58	53	61
Distant Communities	Fall	7	59	59	50	70
1999 Overall	Spring	49	67	64	53	113
1999 Overall	Fall	49	68	65	49	148

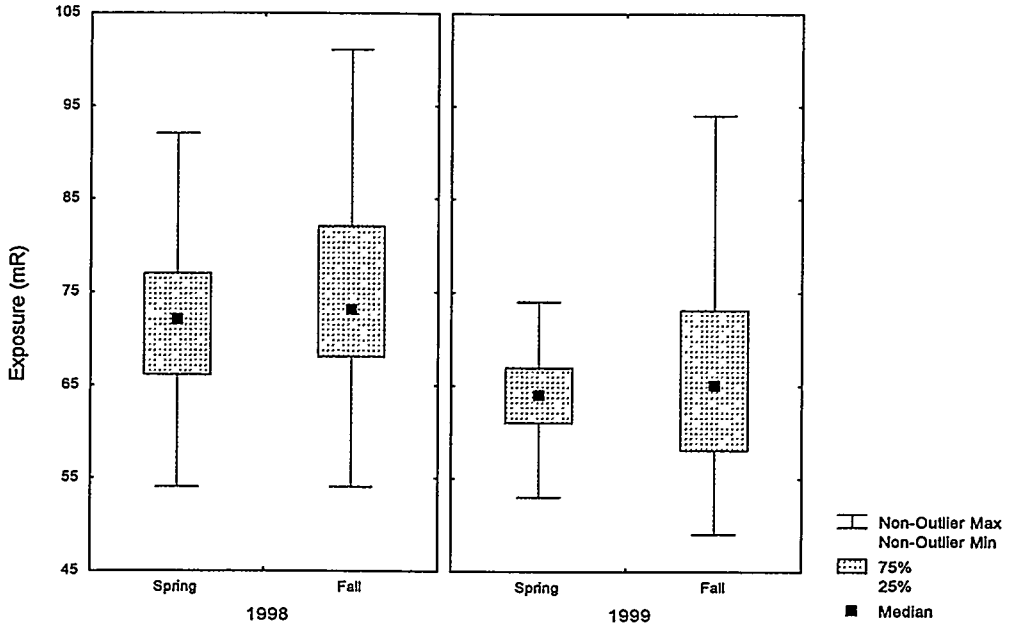
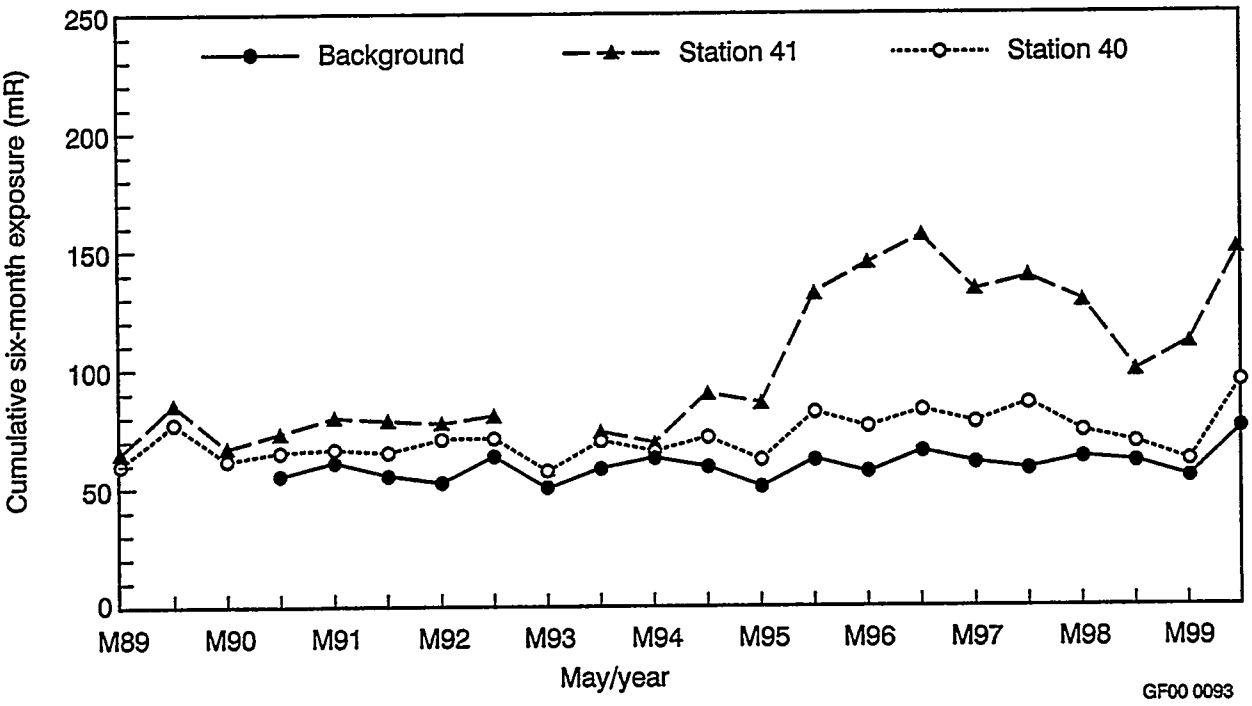


Figure 5-8. Comparison of 1998 and 1999 thermoluminescent dosimeter exposure by season.



NOTE: TLD missing or destroyed in May 1993.

Figure 5-9. Six-month exposures measured by thermoluminescent dosimeters on the east and northeast borders of Transuranic Storage Area (GF000093).

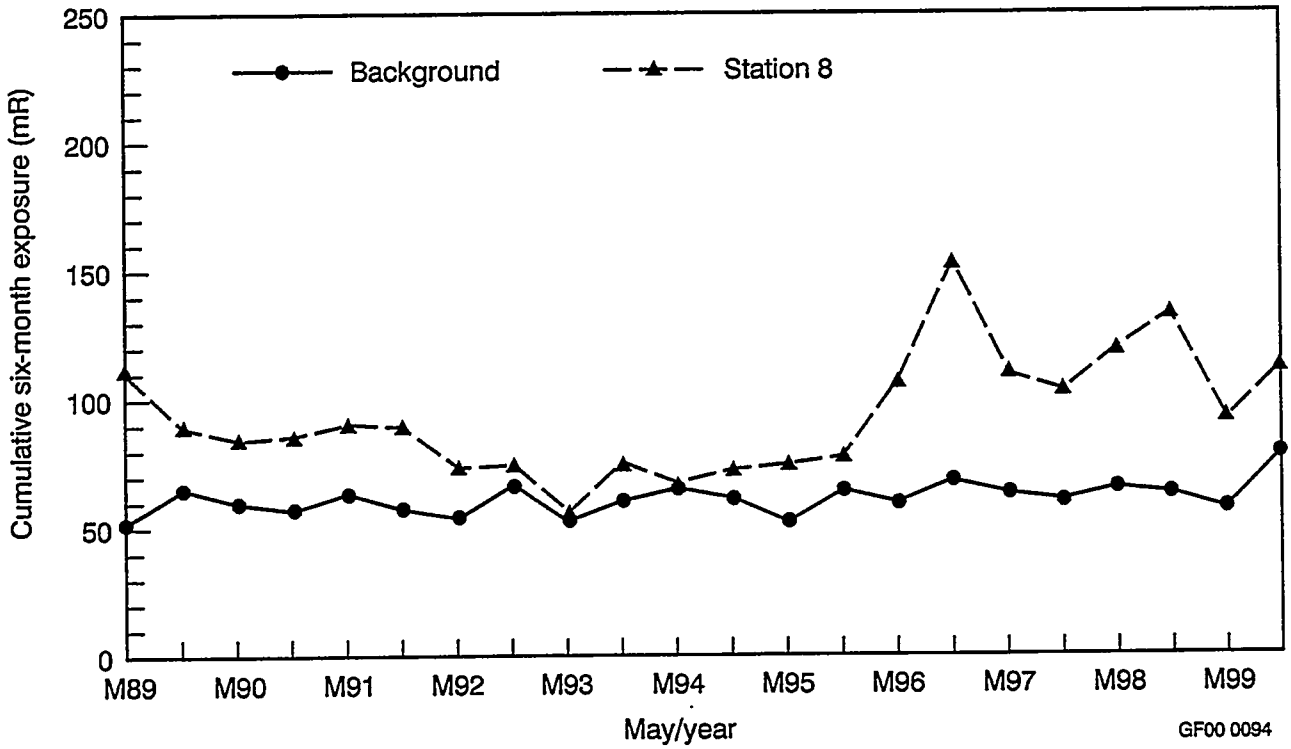


Figure 5-10. Six-month exposures measured by thermoluminescent dosimeters of the 50-m perimeter around Waste Experimental Reduction Facility (GF000094).

5.5.1.2 Surface Radiation. Figure 5-11 shows the radiation readings from the 1999 RWMC spring survey, and Figure 5-12 shows the radiation readings from the 1999 RWMC fall survey.

The readings around the active pit for both of these surveys were comparable to or lower than historical measurements for that area. In the spring survey, the maximum activity, excluding the operating low-level waste pit, was 461 microR/hr and located along Soil Vault Row #18. No new elevated areas were identified during either survey. The maximum activity, excluding the operating low-level waste pit, for the fall survey was 728 microR/hr and identified along Soil Vault Row #18. This reading is comparable to measurements taken at the same location last year. Pad A cannot be surveyed via the global positioning radiometric scanner because of driving restrictions. Therefore, it was traversed with a hand-held HHD-440. No elevated areas were noted on Pad A during either survey.

5.5.2 Data Summary and Assessment for Site Surveillance

5.5.2.1 Thermoluminescent Dosimeters. Table 5-12 shows the maximum TLD value data from the site surveillances and includes historical data.

The ARA 3 TLD is adjacent to a temporary storage area, and 1999 TLD data is comparable to past data.

The ICPP 9 TLD is located in a controlled access area, which used to be a contaminated soil area. The exposure measured at ICPP 9 in 1999 is comparable to past exposure levels. ICPP 20 is also in the vicinity of a radioactive material storage area, and 1999 exposures are also comparable to past exposure levels. INTEC Tree Farm 1 exposure levels are also comparable to historical exposures.

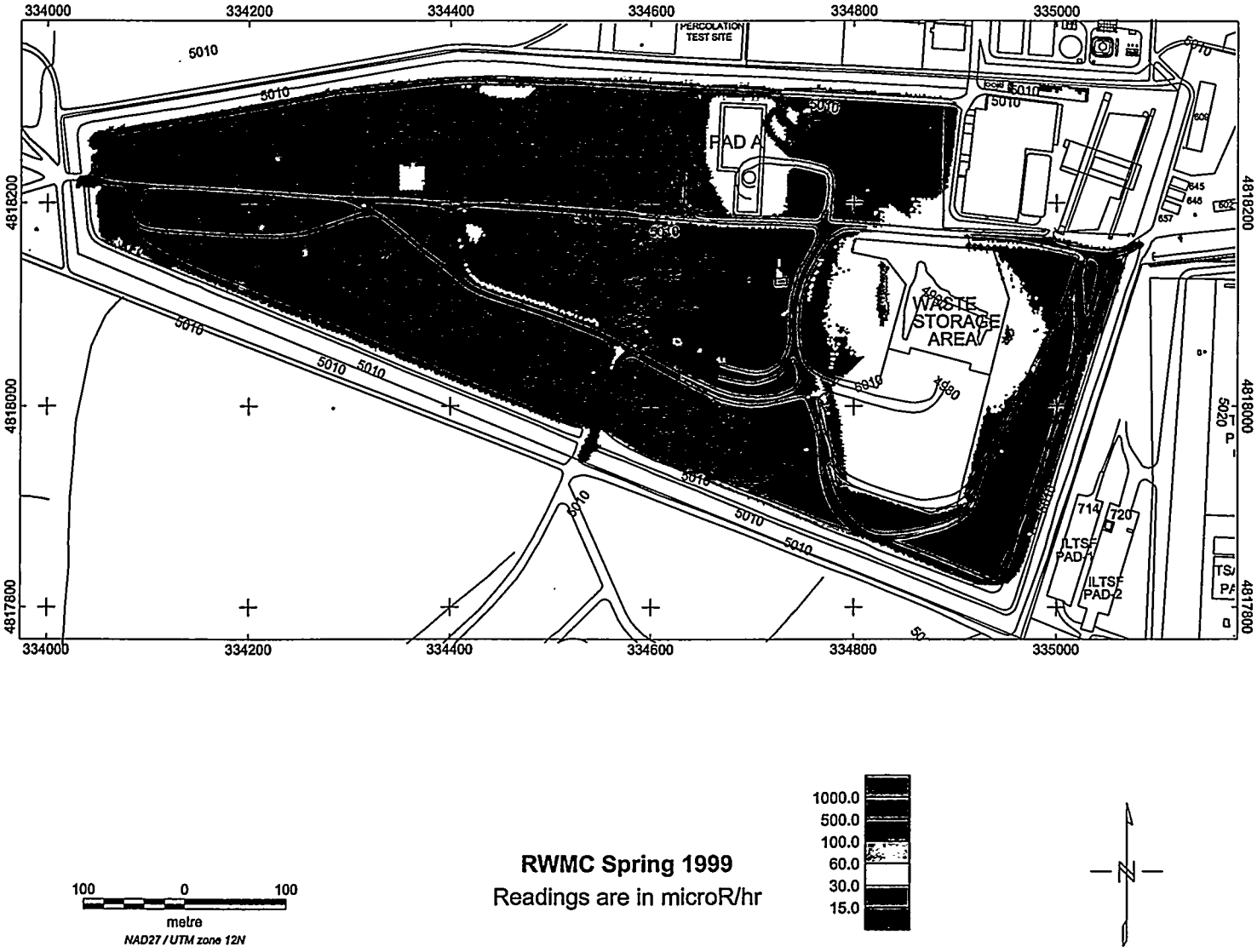


Figure 5-11. Spring 1999 Radioactive Waste Management Complex surface radiation survey.

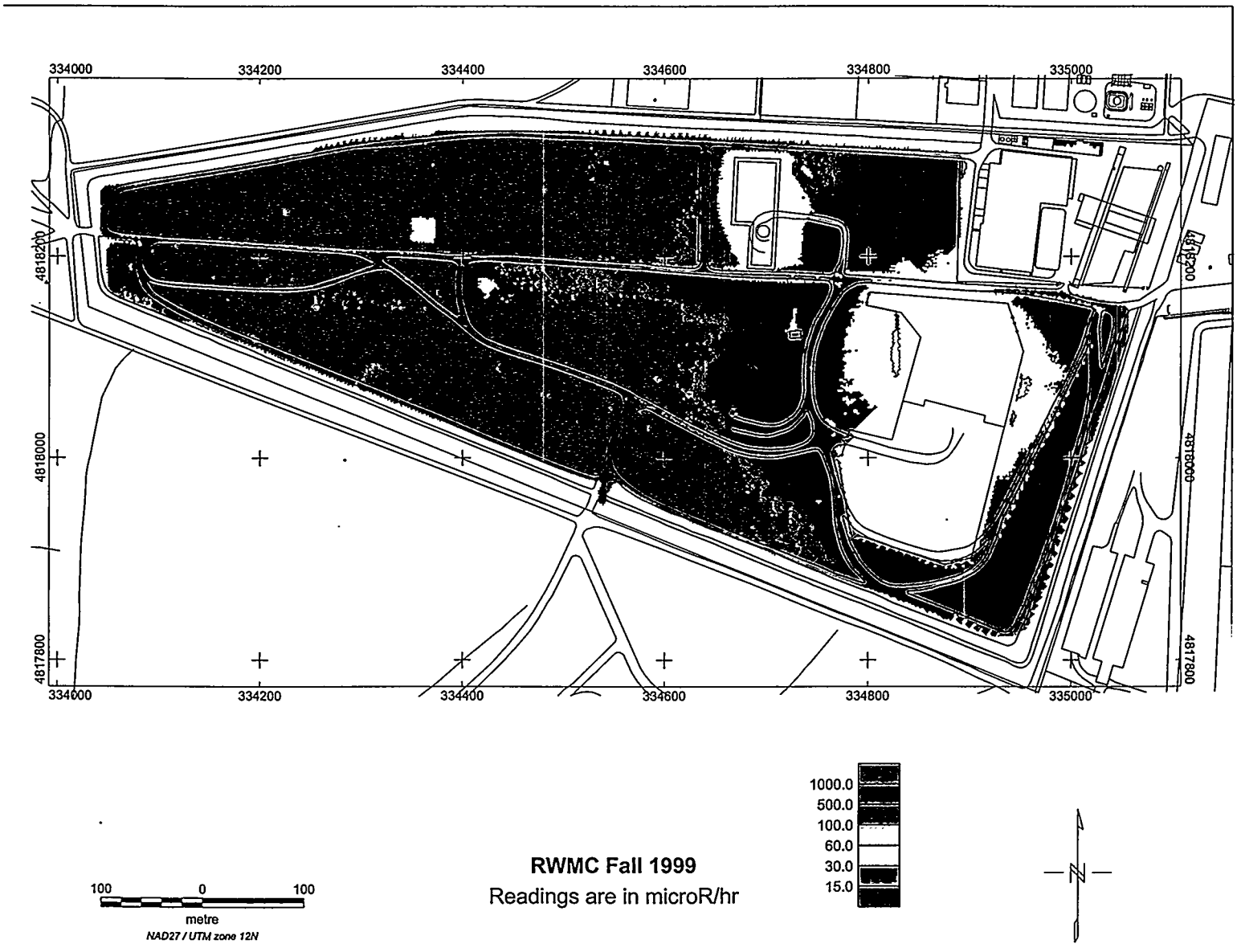


Figure 5-12. Fall 1999 Radioactive Waste Management Complex surface radiation survey.

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 468 ± 42 mR. This location is the closest to the radioactive storage area, where the amount of material temporarily stored increased. The other exposures were comparable to historical exposures.

Table 5-12. Comparison of the site surveillance 1999 thermoluminescent dosimeter exposures to past data.

	Annual Exposure[a] (mR)				
Location	1995	1996	1997	1998	1999
ARA 3	207 ± 26	198 ± 16	167 ± 16	225 ± 16	188 ± 22
ICPP 9	83 ± 8	283 ± 36	196 ± 16	200 ± 16	172 ± 22
ICPP 20	236 ± 18	251 ± 26	245 ± 20	233 ± 18	229 ± 32
INTEC Tree Farm 1	191 ± 14	214 ± 30	208 ± 24	214 ± 24	163 ± 18
TRA 2	261 ± 26	270 ± 20	257 ± 18	293 ± 24	254 ± 32
TRA 3	295 ± 22	345 ± 32	328 ± 28	574 ± 116	468 ± 42
TRA 4	252 ± 22	255 ± 20	246 ± 24	250 ± 12	215 ± 22

a. Uncertainties shown are the associated 2 sigma.

5.6 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 INEEL Site Environmental Report. The laboratories met the performance objectives specified by the Environmental Measurements Laboratory and Environmental Measurements Systems Laboratory. The Environmental Surveillance Program submitted duplicate, blank, and control samples with routine samples submitted 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

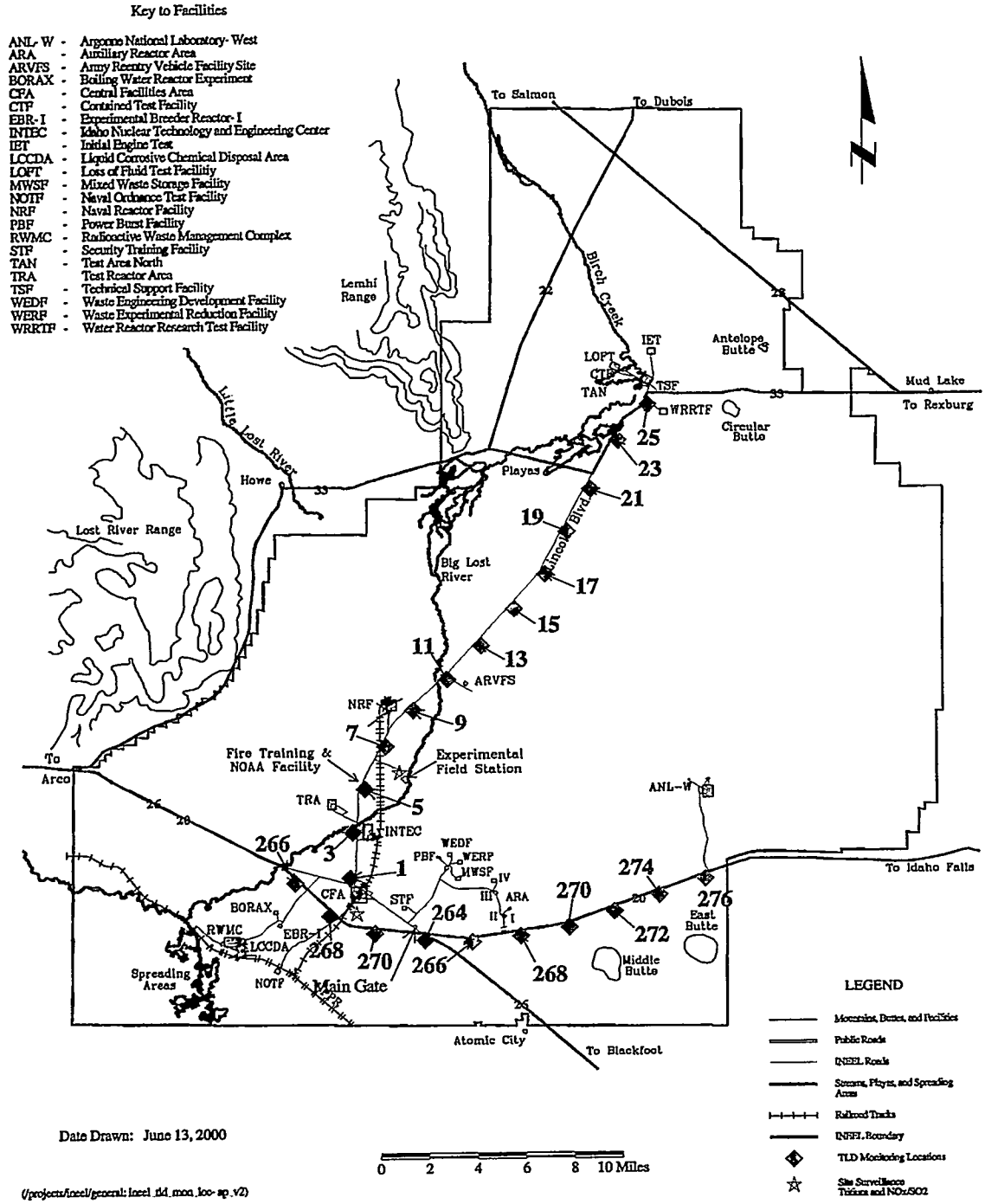

Figure A-1. Thermoluminescent dosimeter, tritium, and nitrogen dioxide/sulfur dioxide monitoring locations.

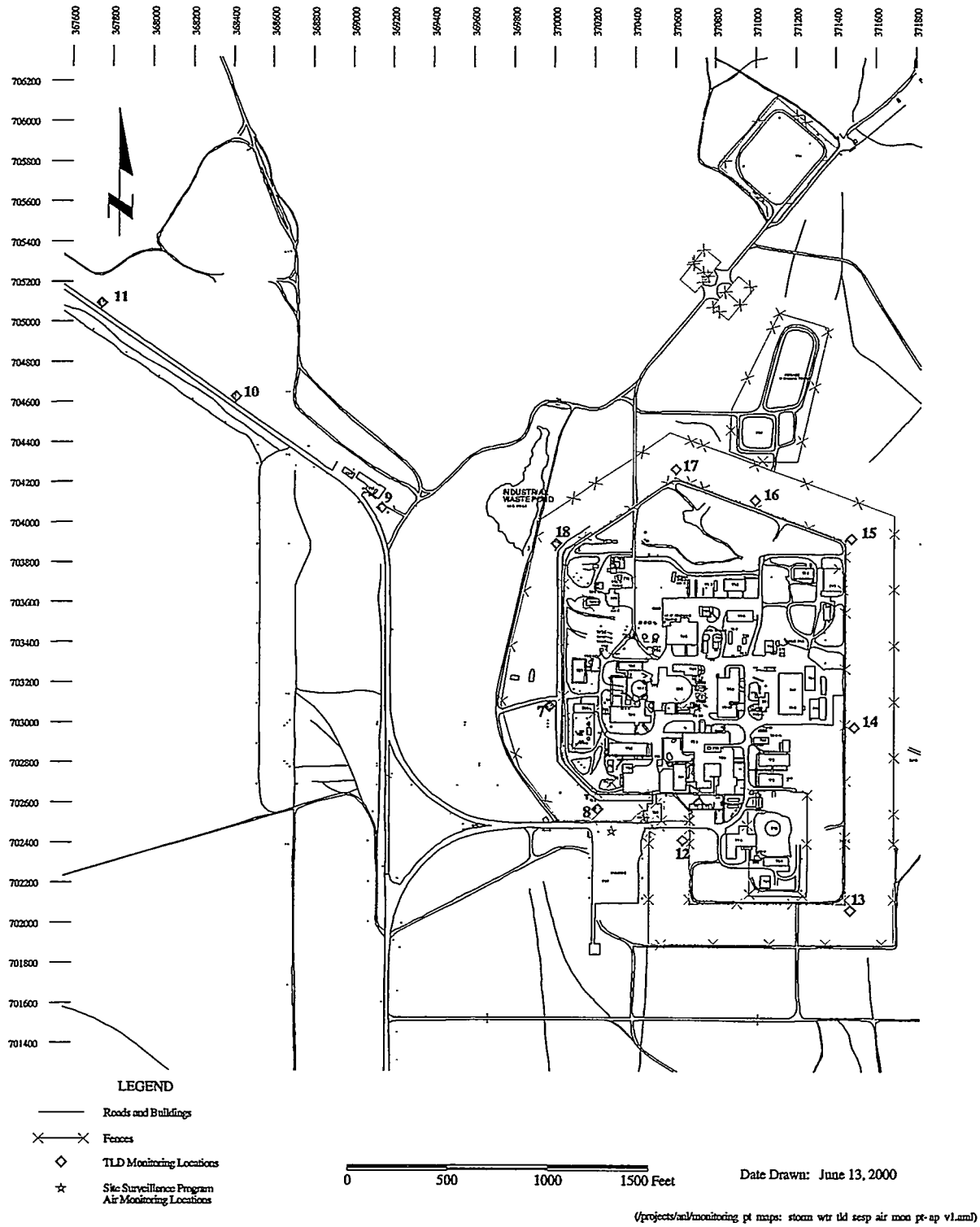

Figure A-2. Argonne National Laboratory-West monitoring locations.

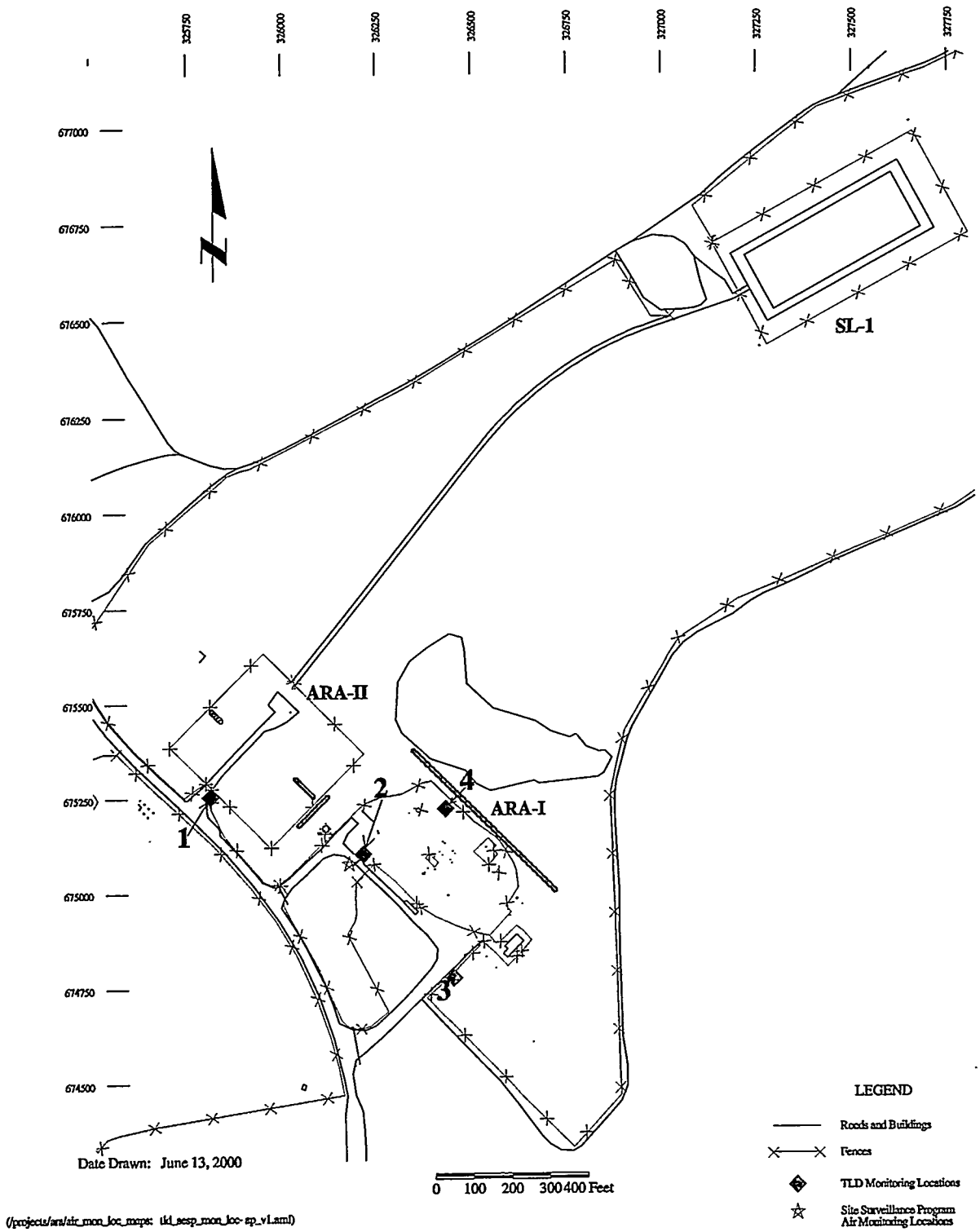

Figure A-3. Auxiliary Reactor Area monitoring locations.

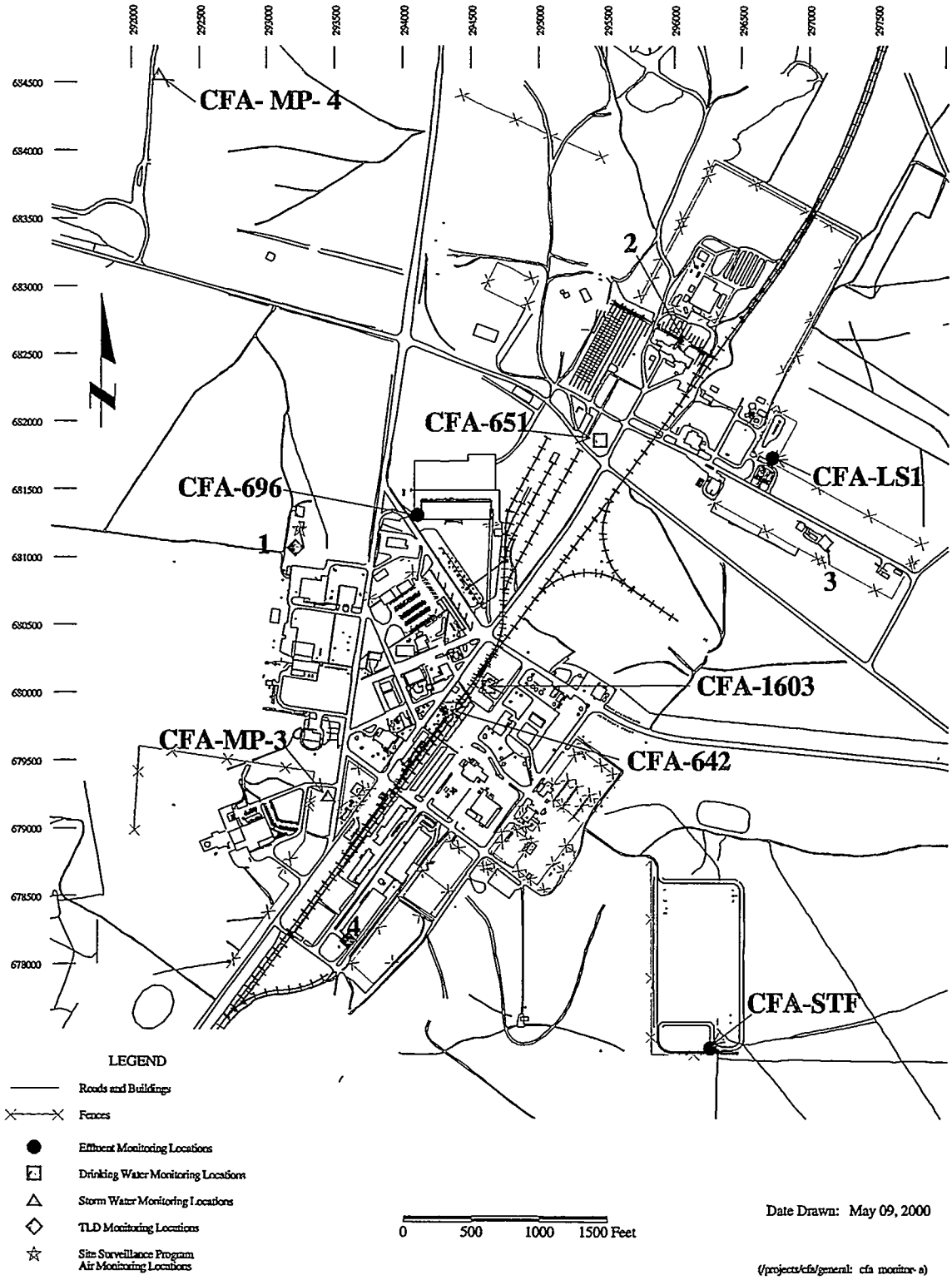

Figure A-4. Central Facilities Area monitoring locations.

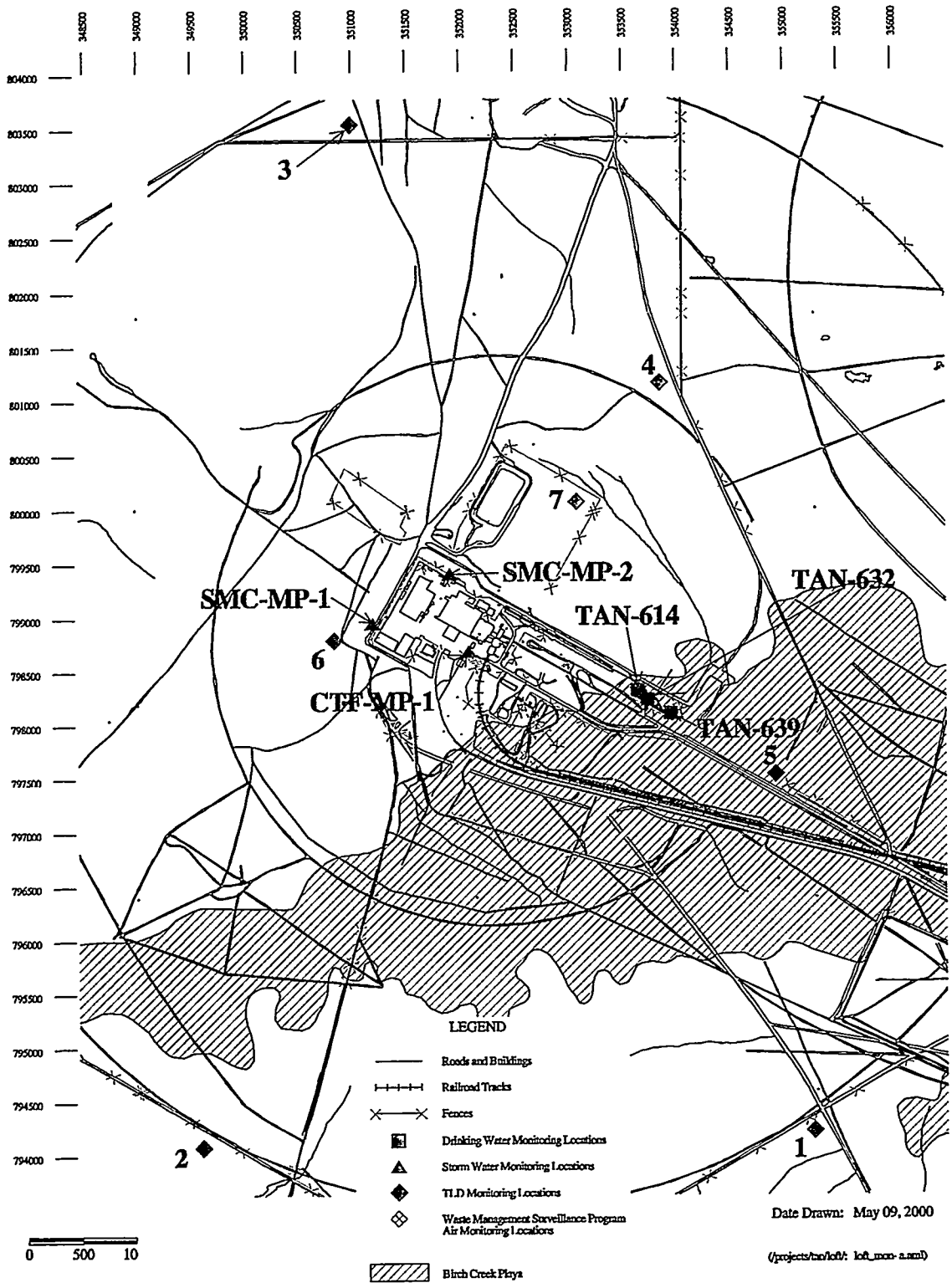

Figure A-5. Test Area North/Specific Manufacturing Capability monitoring locations.

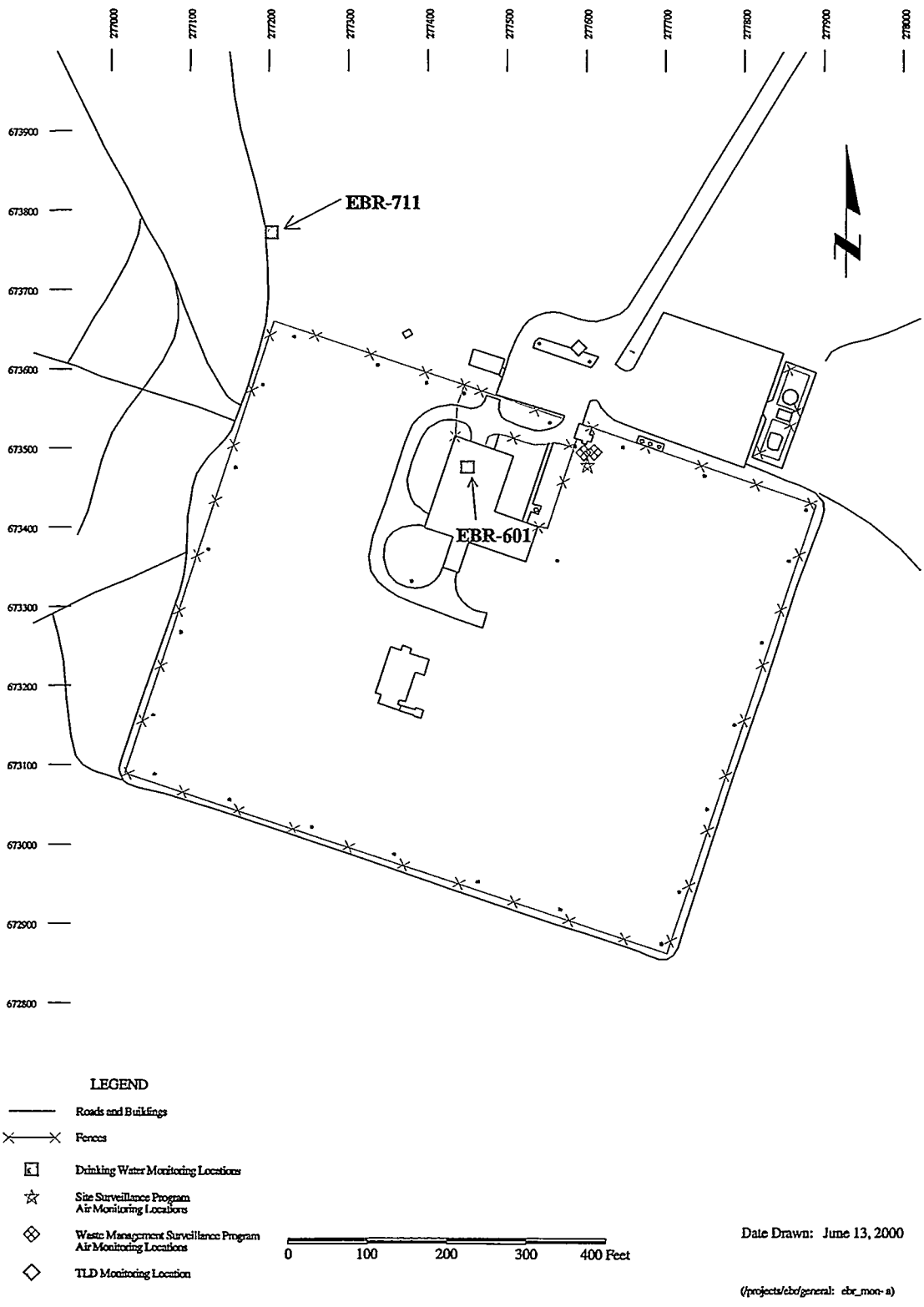

Figure A-6. Experimental Breeder Reactor-I monitoring locations.

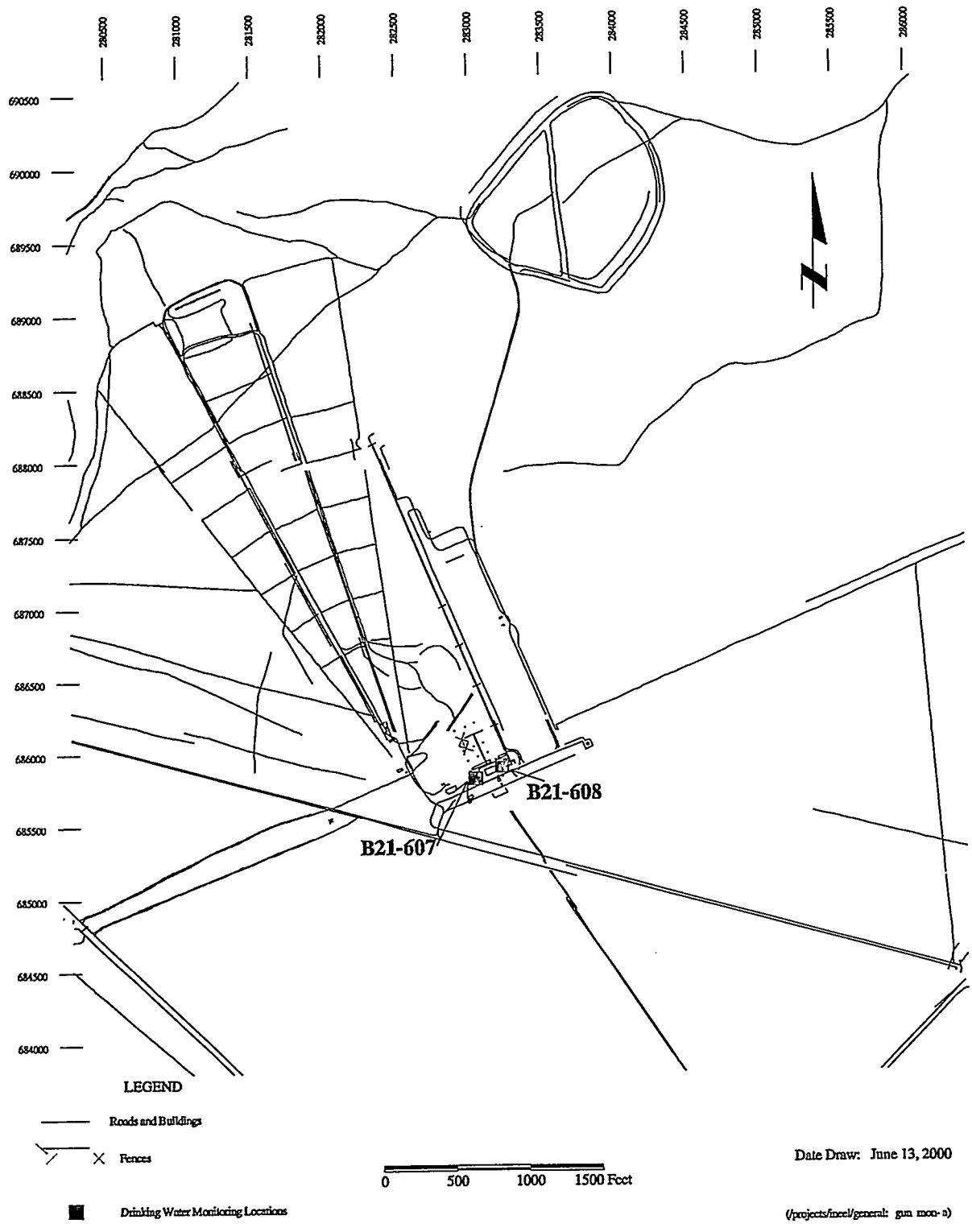

Figure A-7. Gun Range monitoring locations.

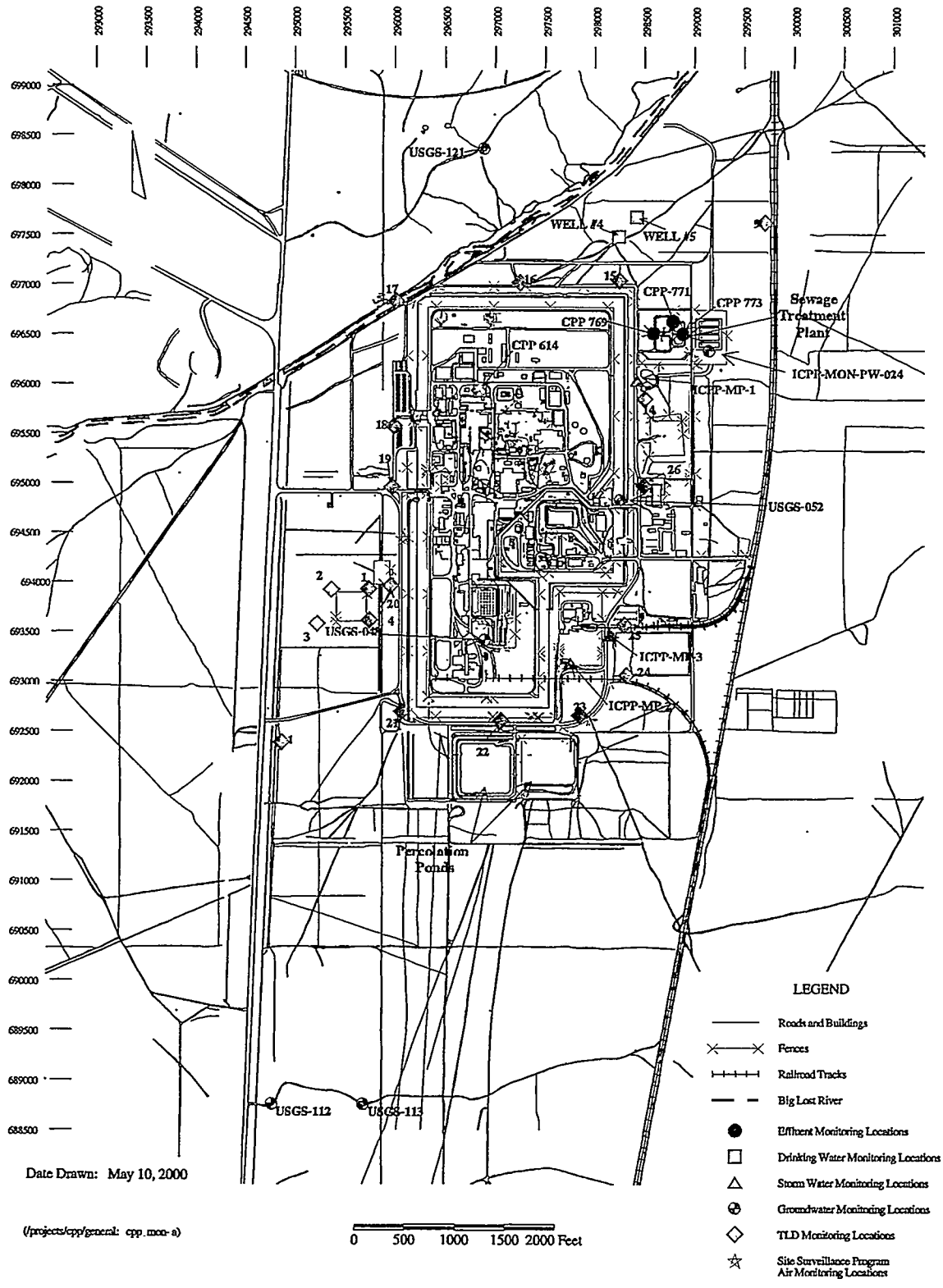

Figure A-8. Idaho Nuclear Technology and Engineering Center monitoring locations.

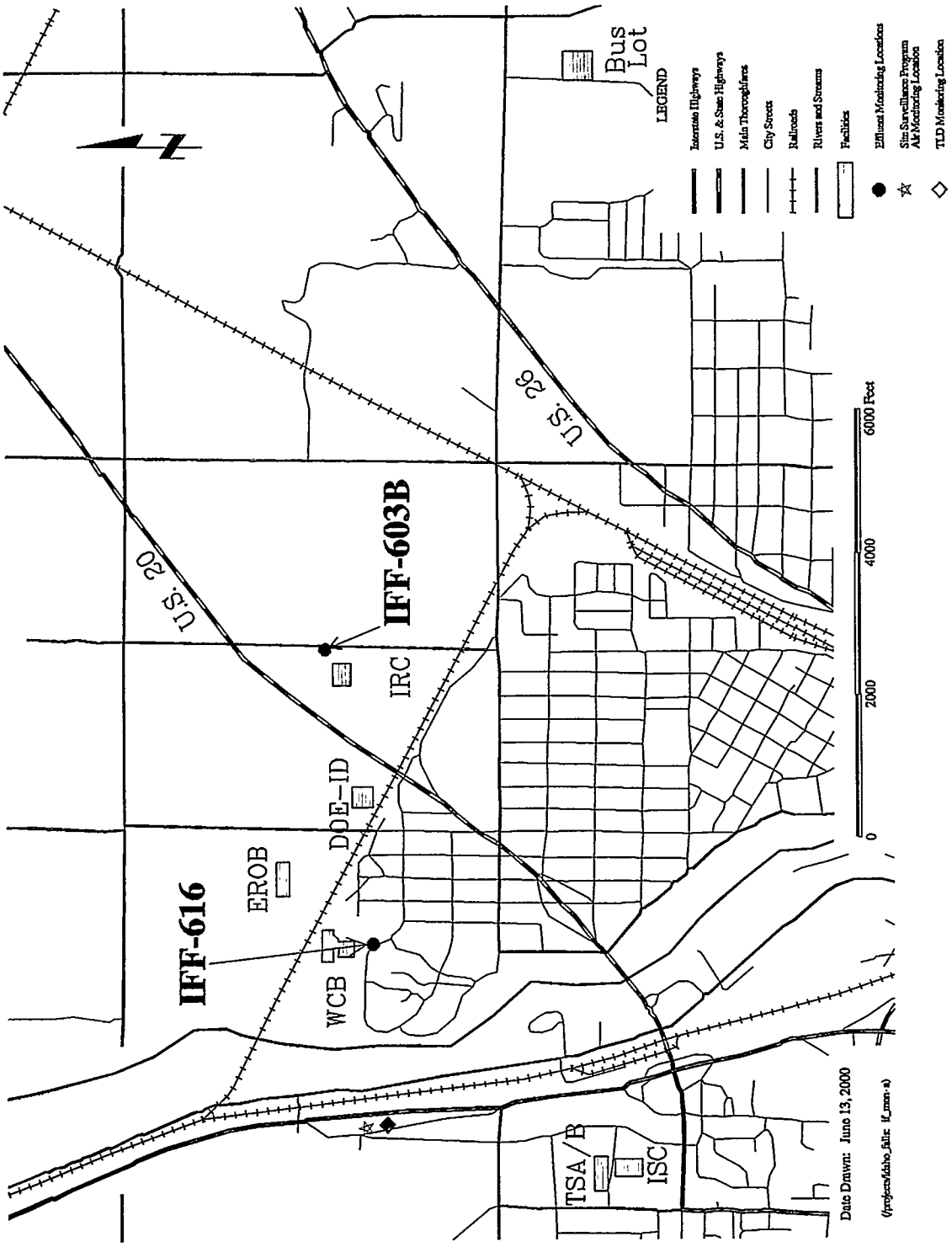

Figure A-9. Idaho Falls monitoring locations.

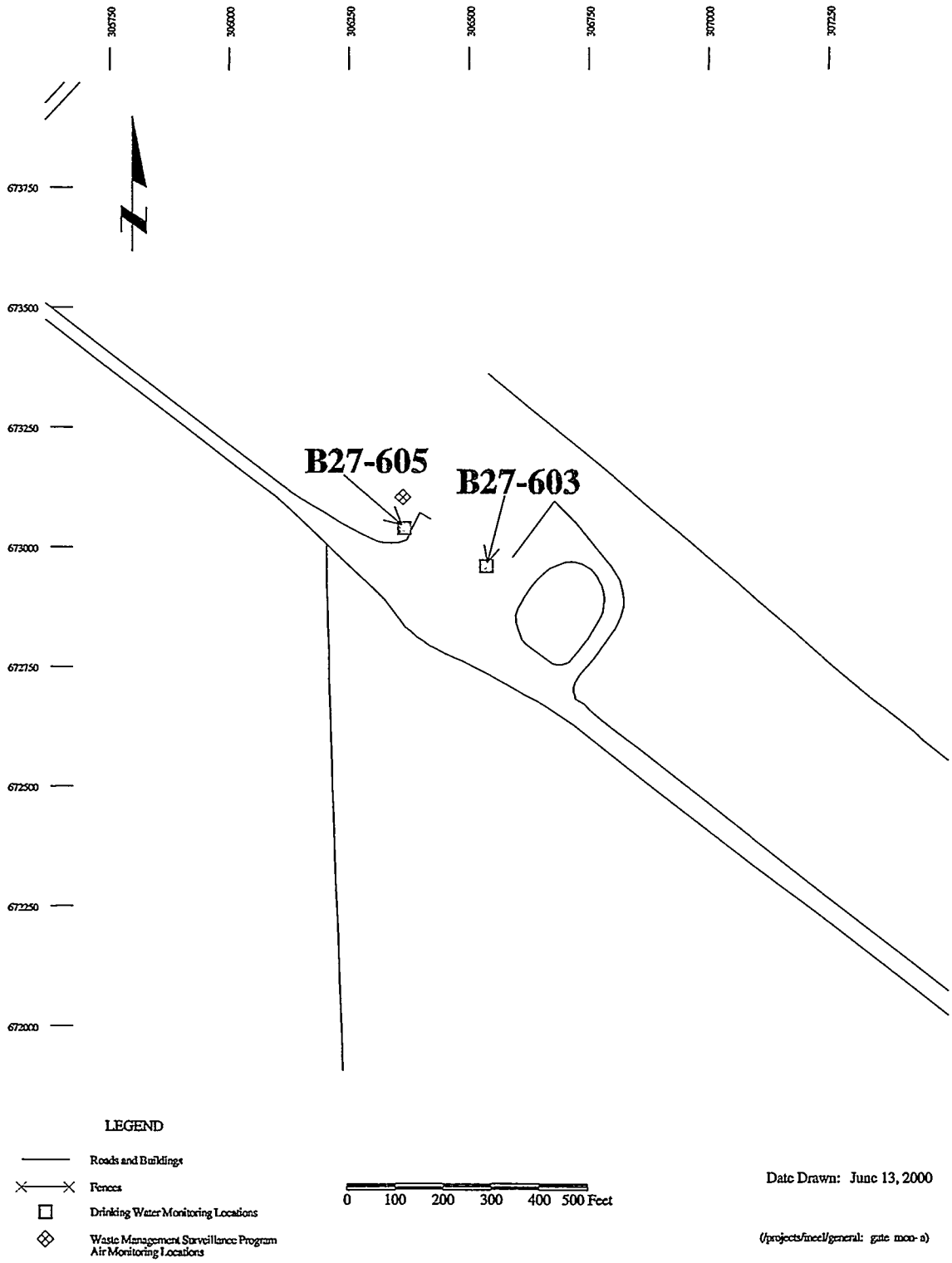

Figure A-10. Main Gate monitoring locations.

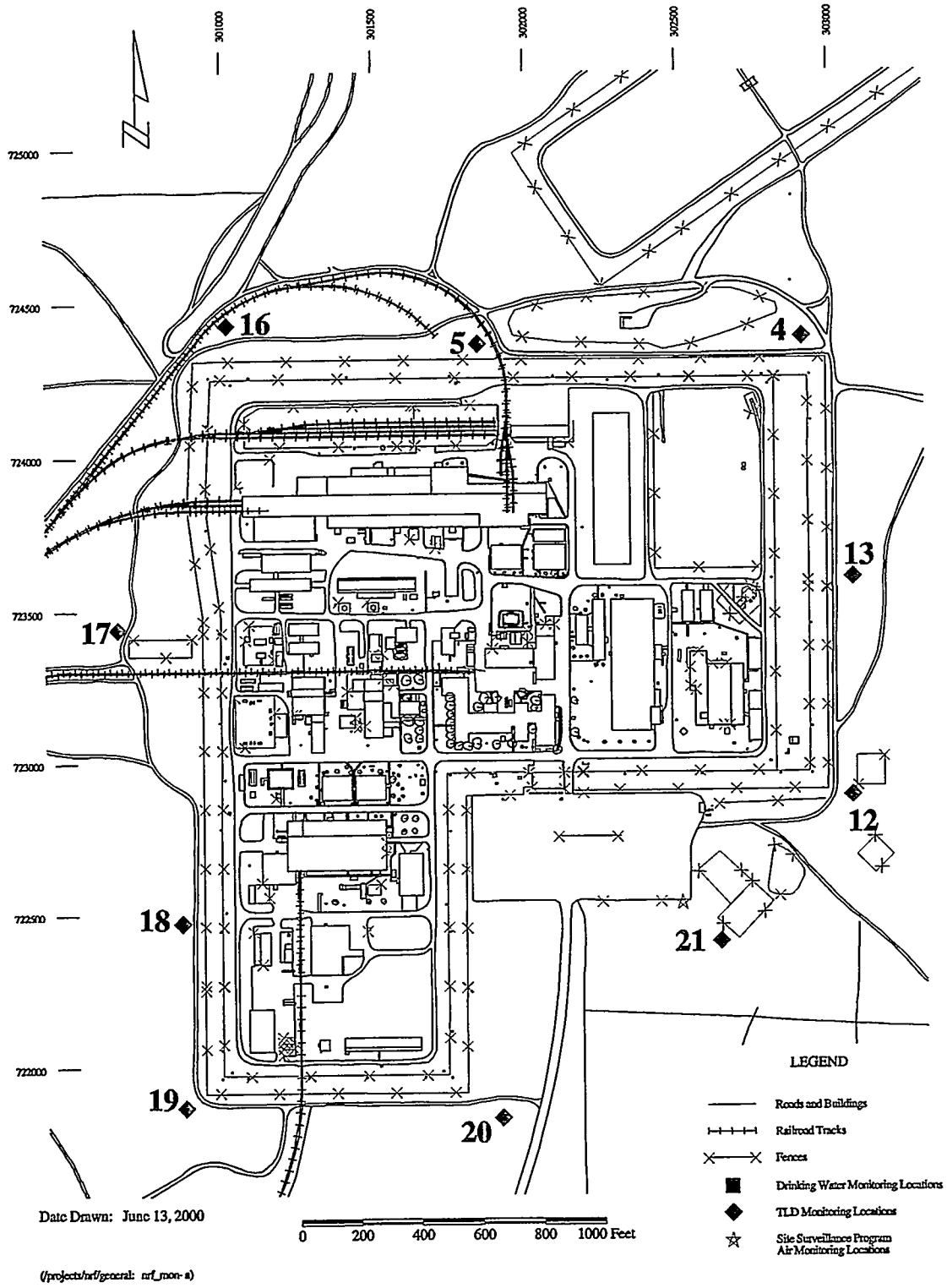

Figure A-11. Naval Reactors Facility monitoring locations.

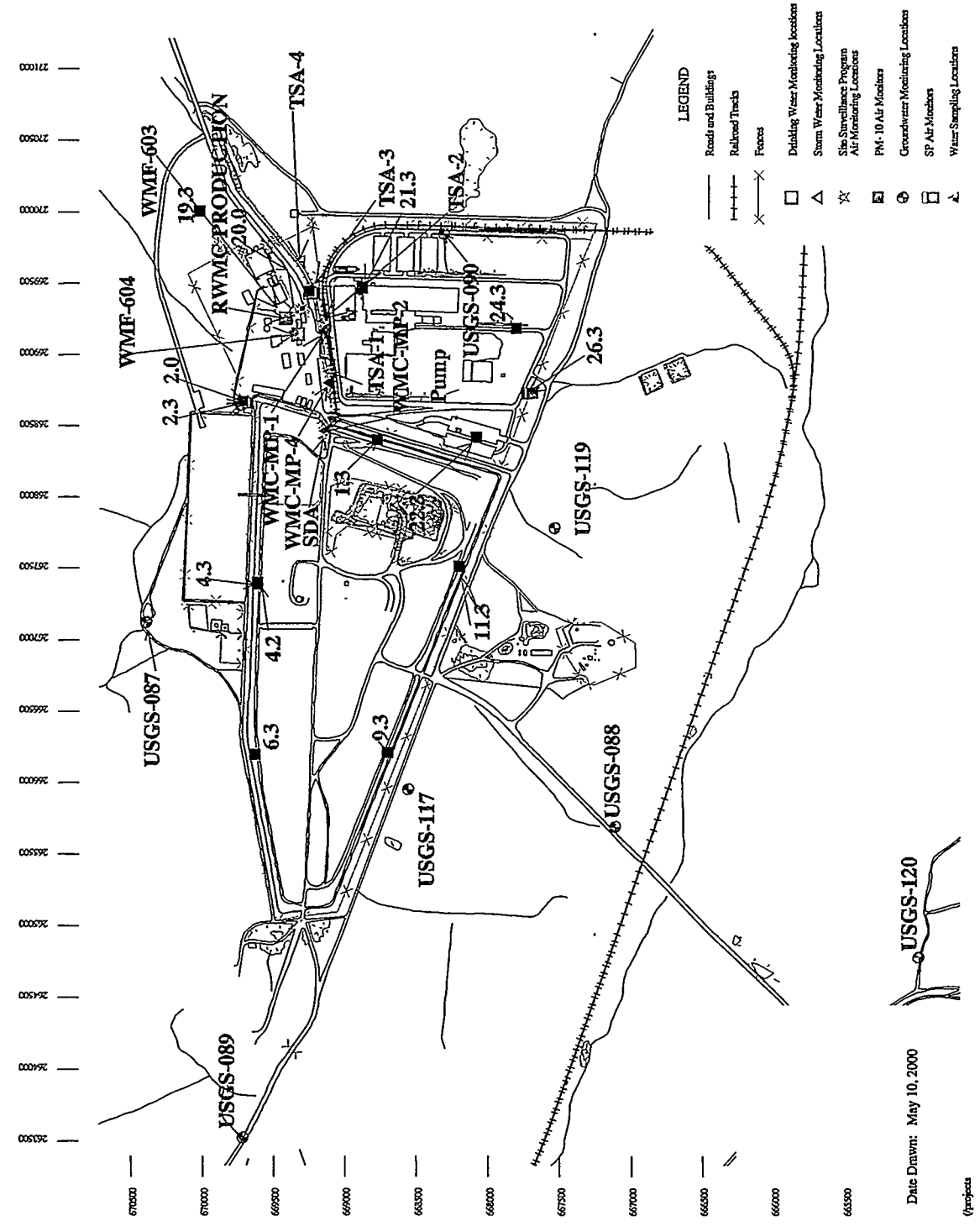

Figure A-12. Radioactive Waste Management Complex monitoring locations.

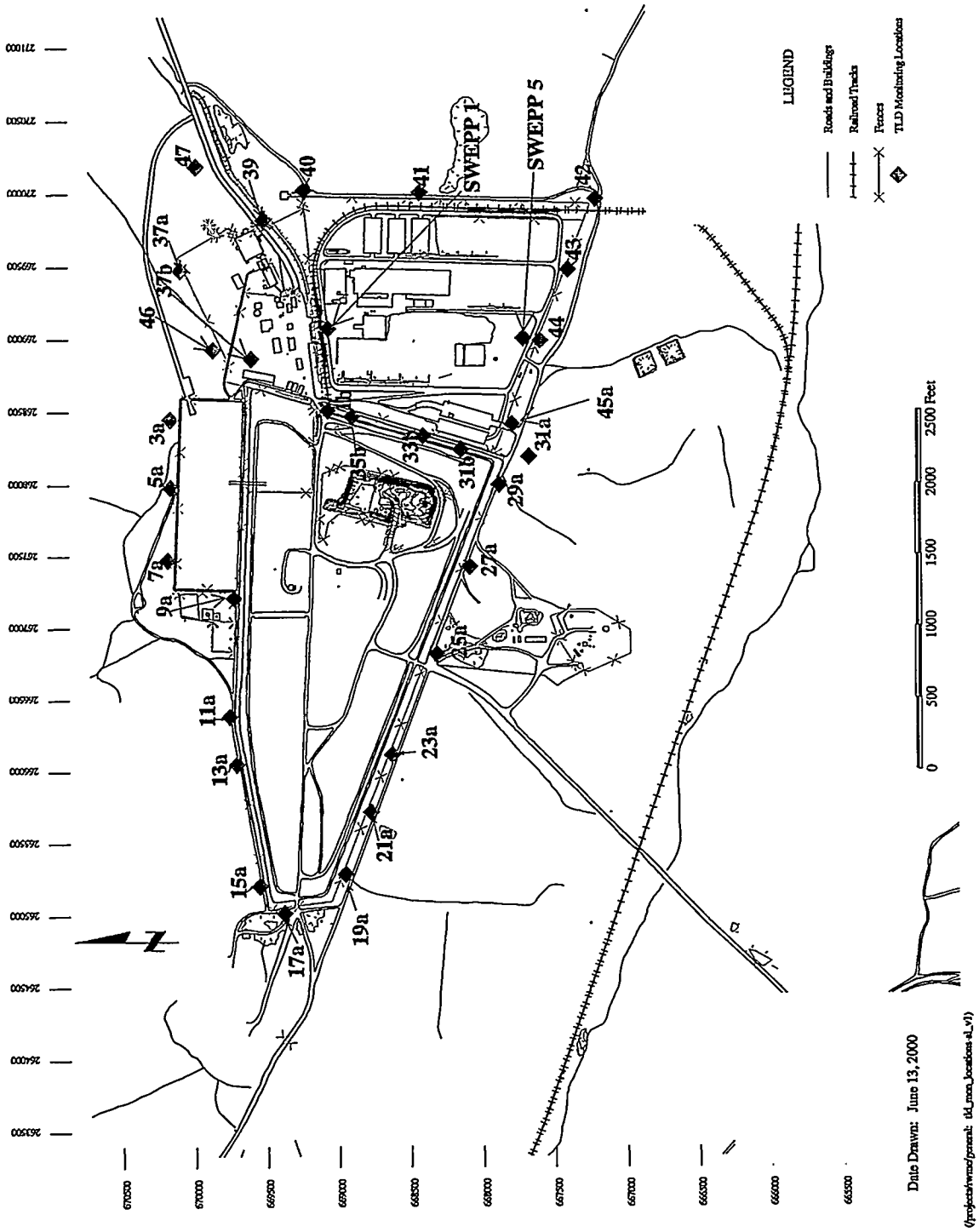

Figure A-13. Radioactive Waste Management Complex thermoluminescent dosimeter monitoring locations.

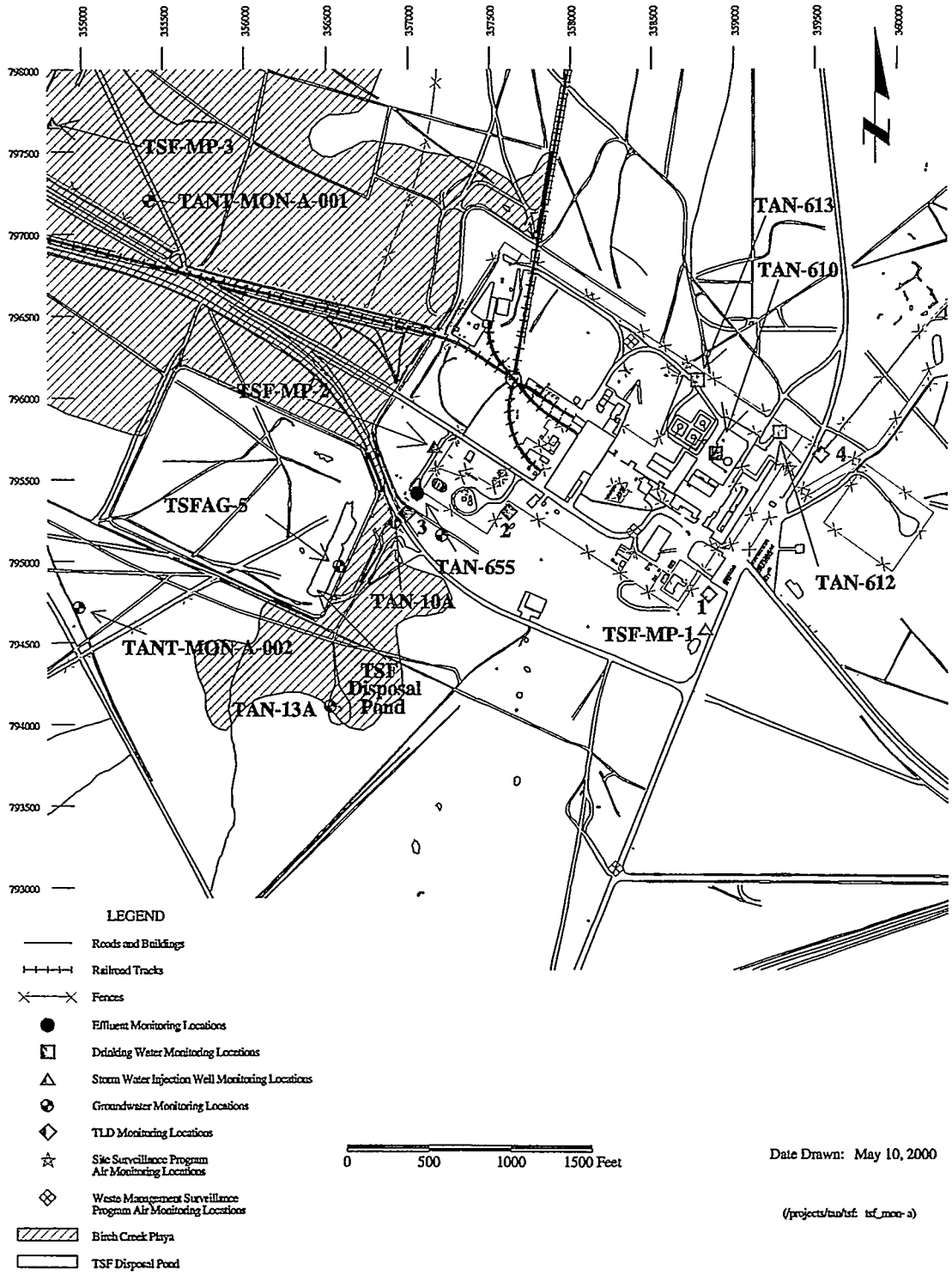

Figure A-14. Test Area North/Technical Support Facility monitoring locations.

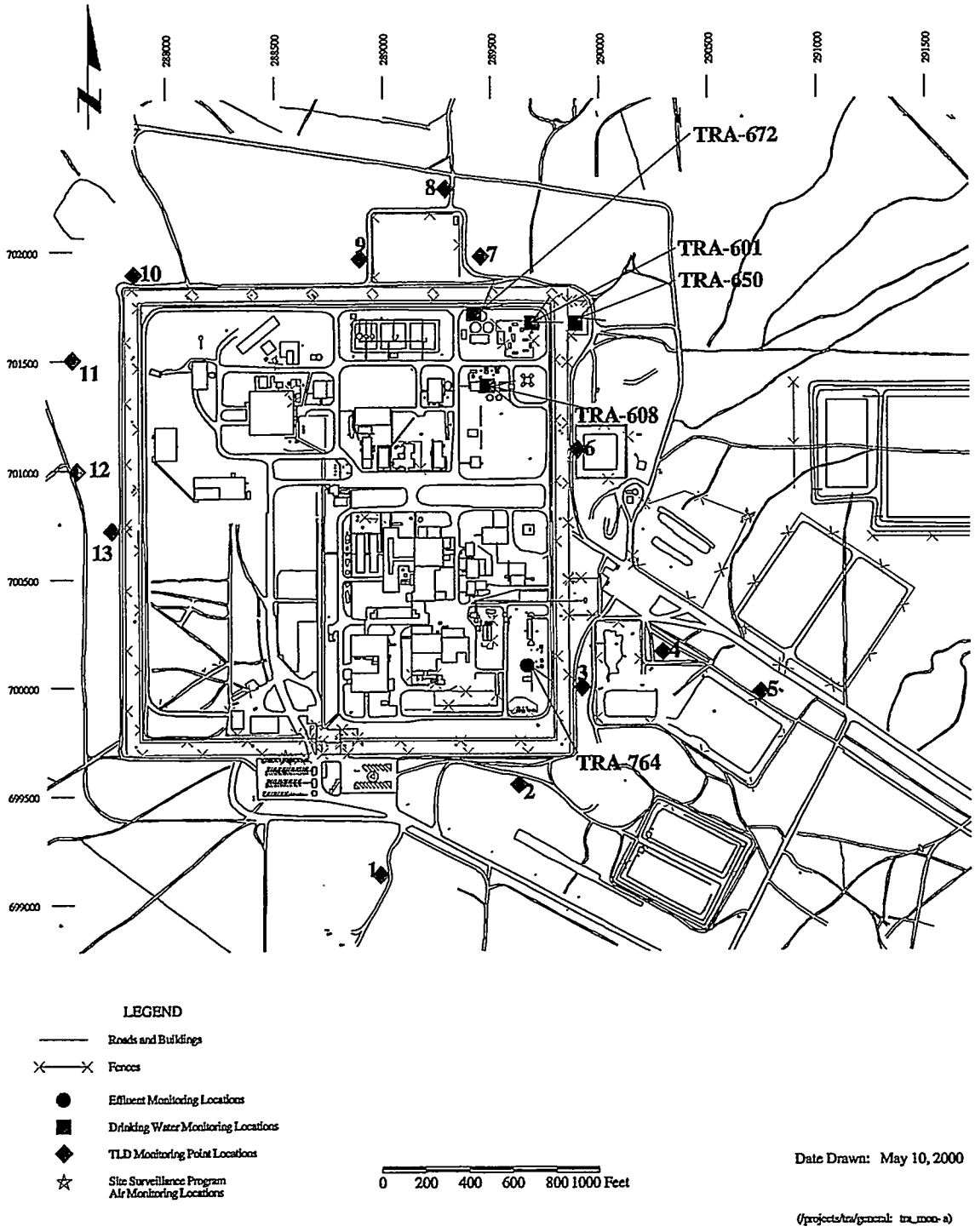

Figure A-15. Test Reactor Area monitoring locations.

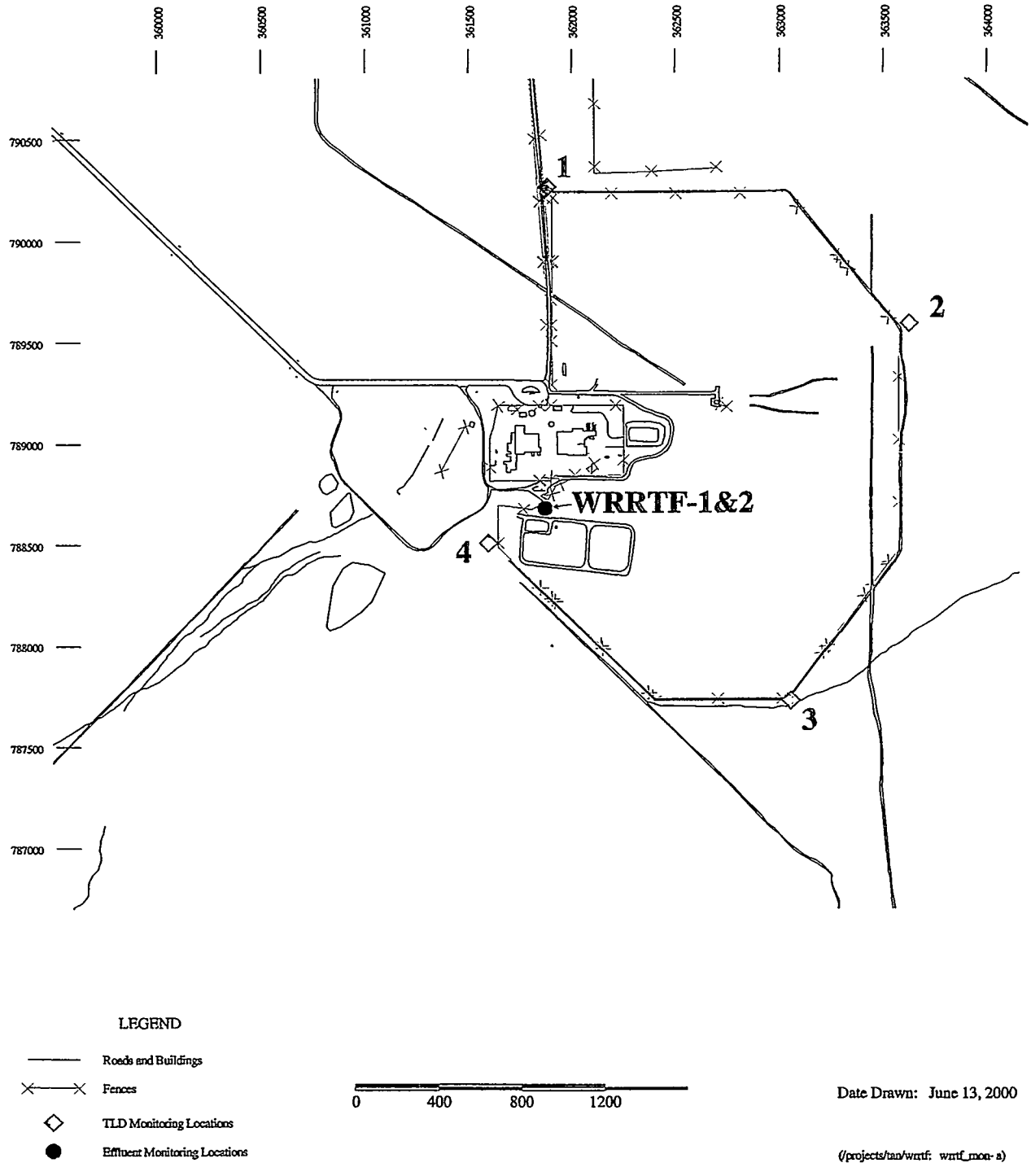

Figure A-16. Water Reactor Research Test Facility monitoring locations.

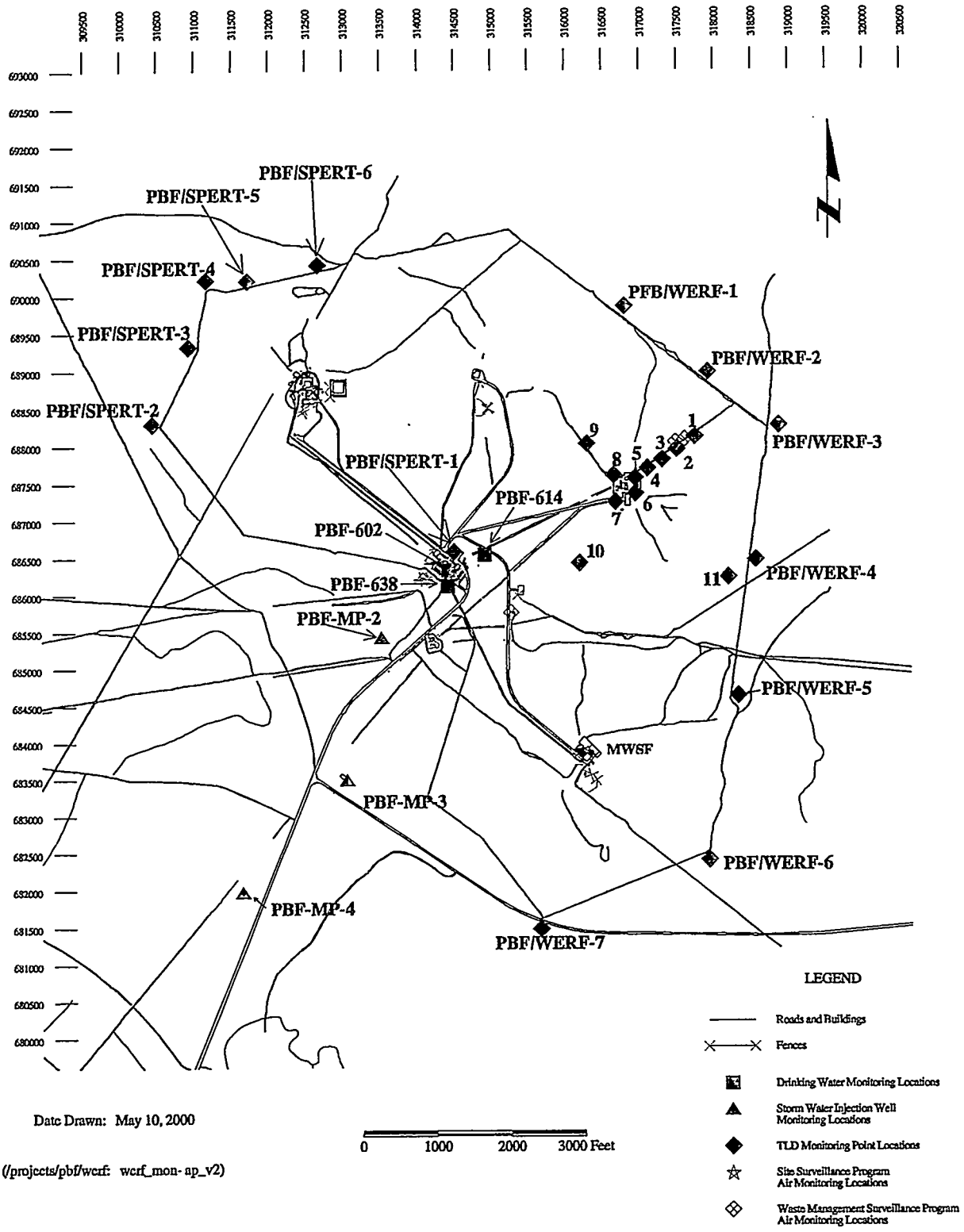

Figure A-17. Waste Experimental Reduction Facility monitoring locations.

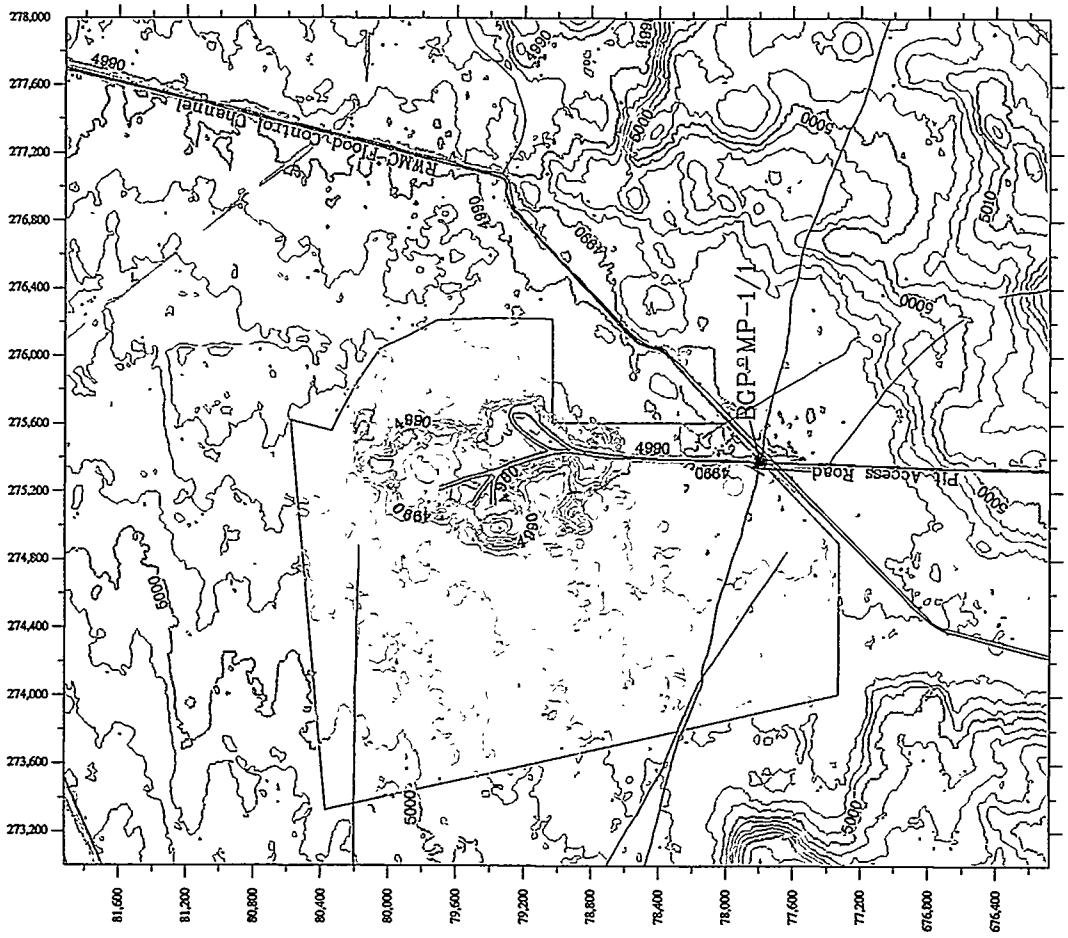

Figure A-18. Adams Boulevard storm water monitoring locations.

Figure A-19. Lincoln Boulevard Gravel Pit storm water monitoring locations.

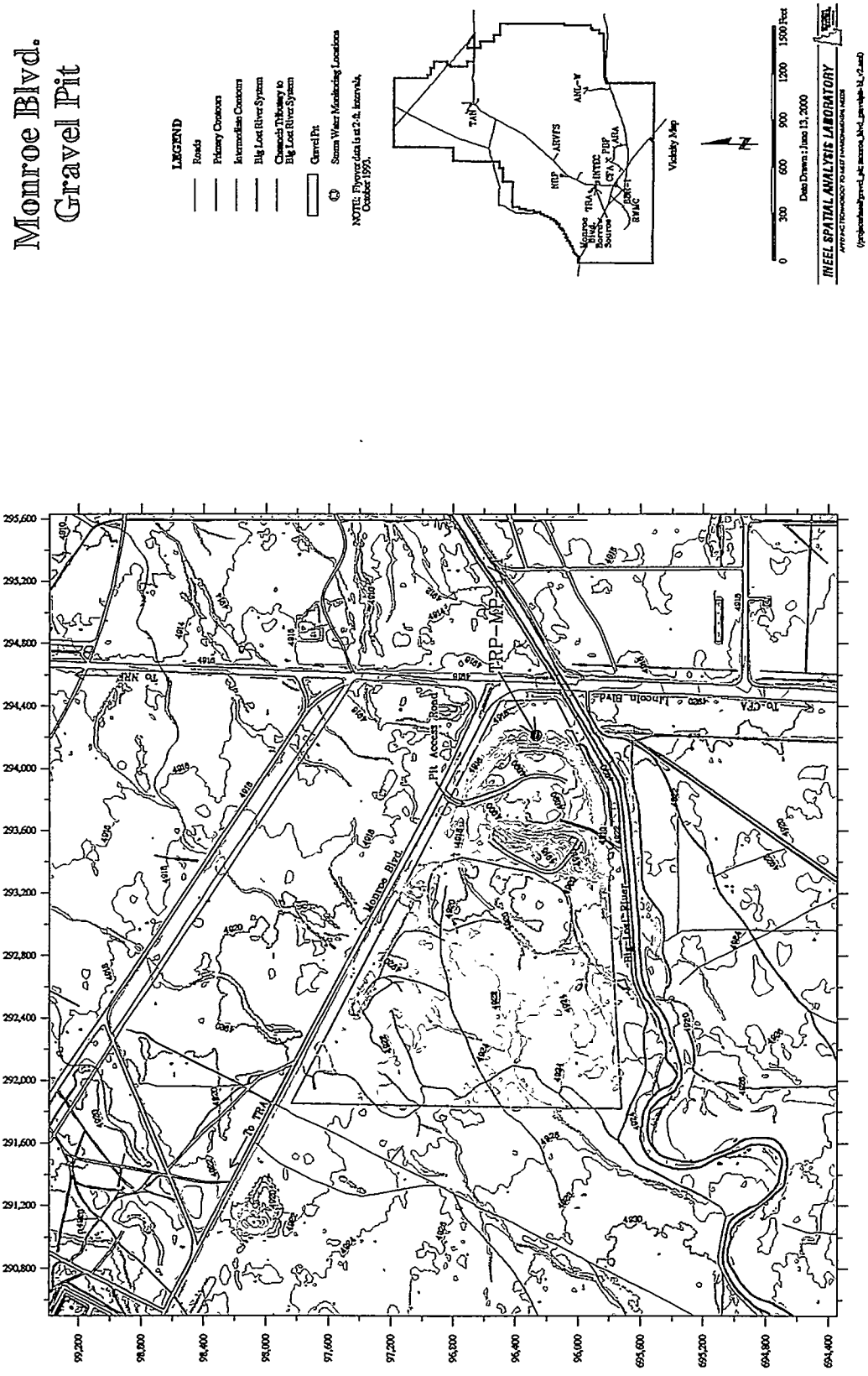

Figure A-20. Monroe Boulevard storm water monitoring locations.

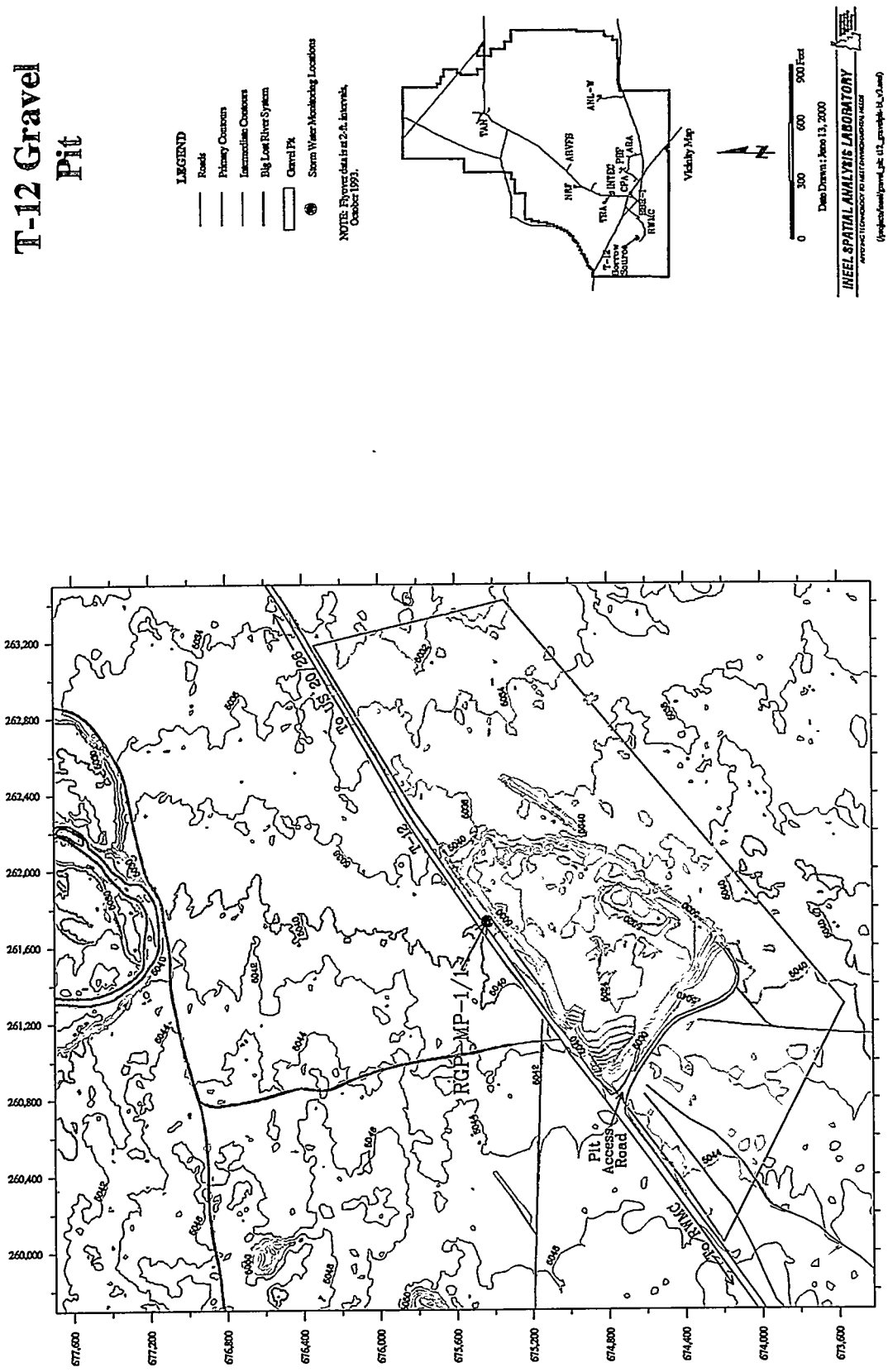

Figure A-21. T-12 Gravel Pit storm water monitoring locations.

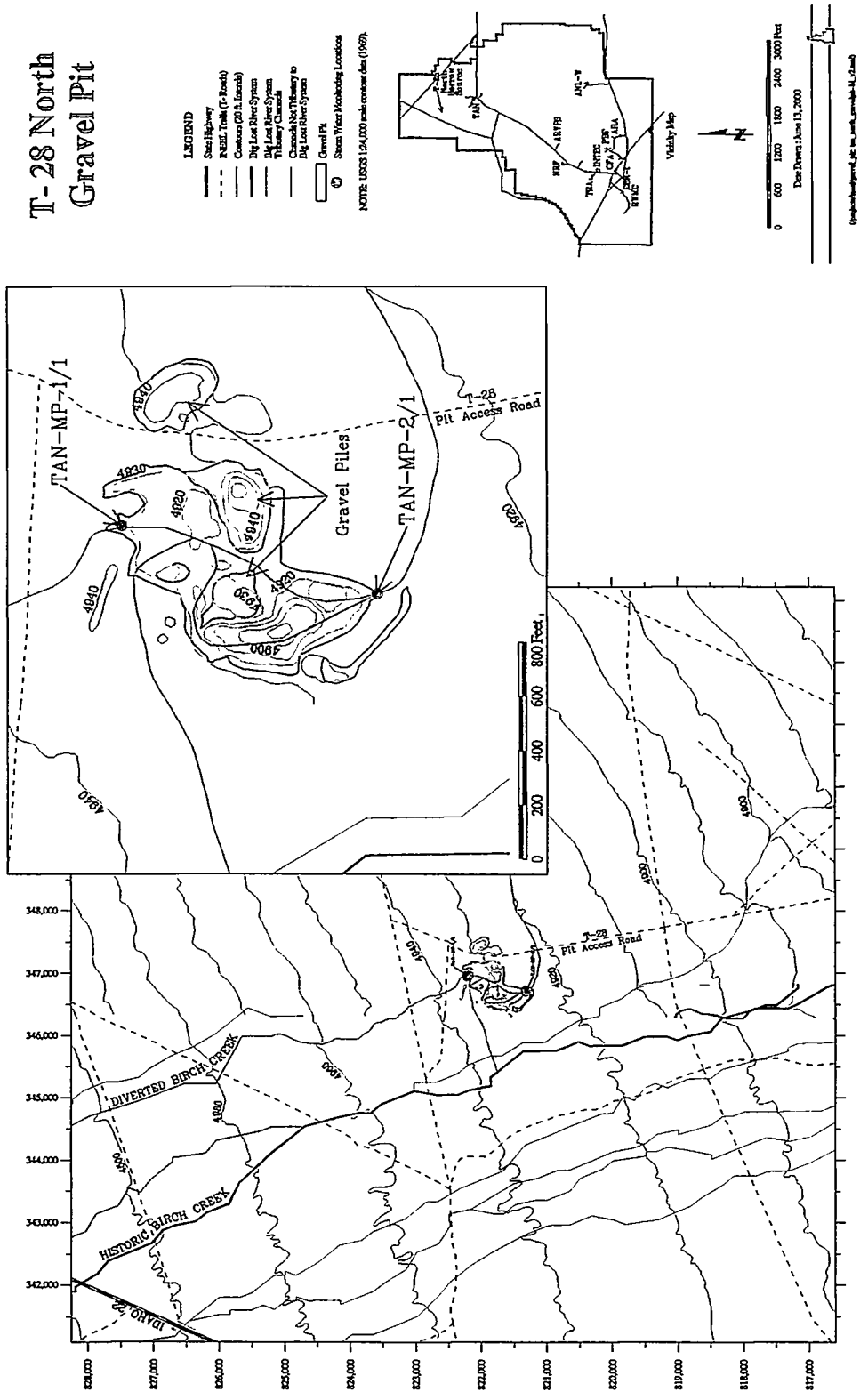

Figure A-22. T-28 North Gravel Pit storm water monitoring locations.

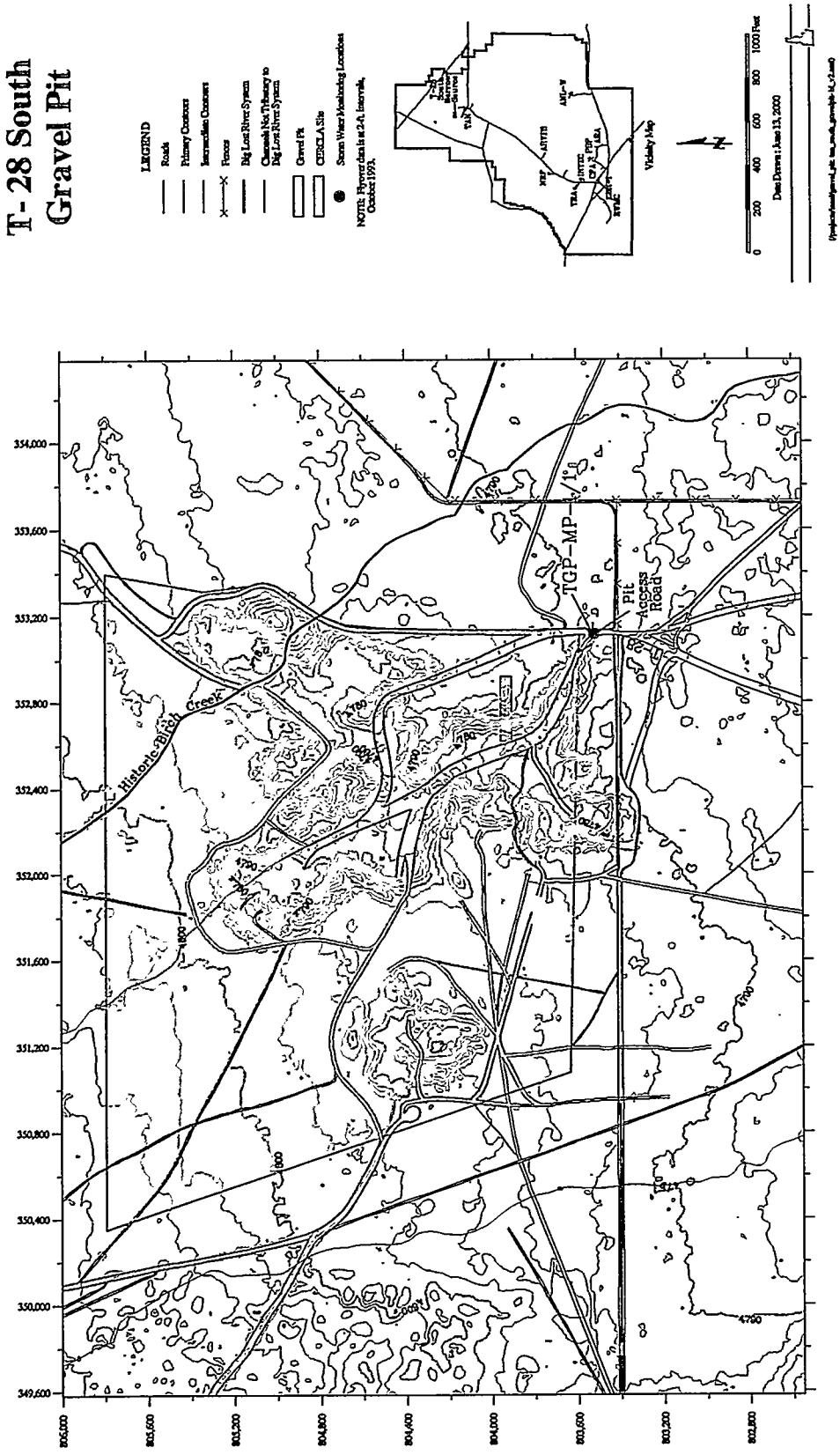

Figure A-23. T-28 South Gravel Pit storm water monitoring locations.

Appendix B

Statistical Analysis Methods

Appendix B

Statistical Analysis Methods

B-1. INTRODUCTION

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

B-2. LIQUID EFFLUENT MONITORING PROGRAM

B-2.1 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.

B-2.2 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.

B-3. ENVIRONMENTAL SURVEILLANCES

B-3.1 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.

B-3.2 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.

B-3.3 Comparisons Between Groupings

B-3.3.1 Penetrating Radiation Data from Thermoluminescent Dosimeters

Differences in yearly TLD data, 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 exposure values from the previous year to the current year is determined by facility. Facility groupings consist of background (or distant community) data, 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 values (either spring or fall) is also of interest.

Box and whisker plots graphically display the differences in median values between groups (either by facility or season). For each grouping, the median value 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 values 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 median values. Even though the outliers are not shown on the box and whisker plots, they are included in the calculation of the median values.

B-3.3.2 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 SPECTROMETRIC 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 (μCi) 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/μCi.

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.

	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

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 Guides 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 guides. 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 16.01.08000-.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 1999 concentration limits for discharges to the City of Idaho Falls sewer.

Table D-7 lists the Environmental Protection Agency benchmarks 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.

Radionuclide	DCGs for the Public[a,b] DCG for Air (μCi/mL)	DCG for Water (μCi/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 ($\mu g/m^3$)[c]
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 Guides for Soil[a] (μCi/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 μm)
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
Nickel	0.1 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

Table D-5. (continued).

Parameter	Maximum Contaminant Level
Endothall	0.1 mg/L
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

Table D-5. (continued).

Parameter	Maximum Contaminant Level
Foaming agents	0.5 mg/L
Iron	0.3 mg/L
Manganese	0.05 mg/L
Odor	3 threshold odor number
pH	6.5–8.5 mg/L
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 1999.

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 Amendments of 1986*, June 19, 1986.

4. 40 CFR 141, "National Primary Drinking Water Standards," *Code of Federal Regulations*, Office of the Federal Register, June 18, 1996.

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, June 18, 1996.

7. IDAPA 16.01.08000-.08999, Idaho Regulations for Public Drinking Water Systems, December 5, 1992.

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.