Idaho National Engineering and Environmental Laboratory

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1997 LMITCO Environmental Monitoring Program Report for the Idaho National Engineering and Environmental Laboratory

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ABSTRACT

This report describes the calendar year 1997 environmental surveillance and compliance monitoring activities of the Lockheed Martin Idaho Technologies Company Environmental Monitoring Program performed at the Idaho National Engineering and Environmental Laboratory. This report includes results of sampling performed by the Radiological Environmental Surveillance, Site Environmental Surveillance, Drinking Water, Effluent Monitoring, Storm Water Monitoring, Groundwater Monitoring, and Special Request Monitoring Programs and compares 1997 data with program-specific regulatory guidelines and past data to evaluate trends. The primary purposes of the surveillance and monitoring activities are to evaluate environmental conditions, to provide and interpret data, to verify compliance with applicable regulations or standards, and to ensure protection of human health and the environment.

Surveillance of environmental media did not identify any previously unknown environmental problems or trends indicating a loss of control or unplanned releases from facility operations. With the exception of one nitrogen sample in a disposal pond effluent stream and iron and total coliform bacteria in groundwater downgradient from one disposal pond, compliance with permits and applicable regulations was achieved. Data collected by the Environmental Monitoring Program demonstrate that public health and the environment were protected.

SUMMARY

The Environmental Monitoring Program monitors environmental media and facility effluents to assess the effects of Idaho National Engineering and Environmental Laboratory 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 to voluntary protection criteria to assess potential environmental impacts and to ensure protection of public health. Monitoring results from the current year are compared to past monitoring results to identify trends or changes that may indicate loss of control, unplanned releases, or ineffectiveness of pollution prevention programs.

Environmental surveillance programs monitor ambient air, direct radiation, soils, biota, and surface water. Surveillance of environmental media during 1997 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. Man-made, gamma-emitting radionuclides that could be attributed to facility operations were not detected in air samples at any facility. Gross alpha and gross beta radiation are routinely detected by air monitors from natural background radionuclides. Results for 1997 were consistent with historical data. The only indication of contamination by specific alpha-emitting radionuclides was one detection of americium-241 at the Radioactive Waste Management Complex where surface soil contamination from the 1960s can be suspended in air. Strontium-90 was detected in air samples at extremely low levels in all four quarters at the Radioactive Waste Management Complex. Concentrations in 1997 were consistent with previous years, indicating no change in conditions.

The New Waste Calcining Facility at the Idaho Chemical Processing Plant was operational for three quarters during 1997. Atmospheric levels of nitrogen oxides were consistent with those in previous years when the calciner was operating. Nitrogen oxides and sulfur dioxide levels were well below EPA-established ambient air quality standards throughout the year.

Surface water samples collected at the Waste Experimental Reduction Facility showed occasional levels of the gamma-emitting radionuclide cesium-137 at concentrations that are comparable to background levels. Also, one detection of cobalt-60 was noted and originated from an area of known, low-level soil contamination. Levels and frequency of detection were consistent with data from previous years, and no evidence of change or trend was detected.

Surface water runoff samples collected at the Radioactive Waste Management Complex showed occasional low levels of the gamma-emitting radionuclide cesium-137. Concentrations were consistent with data from previous years, indicating no changes or trends. No alpha- or beta-emitting radionuclides were detected in runoff in 1997.

Direct radiation exposure was generally consistent with historical data. A number of changes in direct radiation measurements at facilities were noted, but those could be related to changes in facility operations. Radioactive waste stored at the Transuranic Storage Area was moved to new storage buildings, and increases in direct radiation were consistent with the increased level of activity and new storage location. Changes in direct radiation levels at the Waste Experiment Reduction Facility were related to waste storage locations. No new areas of surface soil contamination were identified during direct radiation surveys, and soil activities were lower than historical values at the same locations.

Environmental compliance programs monitored 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, discussed below, where permit criteria were exceeded. Corrective action has been taken or is planned to address those situations.

In the past, coliform bacteria have been detected in drinking water systems at INEEL facilities as a result of old, deteriorating pipes, stagnant water from buildings and storage tanks where water is seldom used, and biofilm. Water treatment systems for bacteria have been installed at all affected INEEL facilities, and there were no detections of coliform bacteria in INEEL drinking water systems during 1997. There are three locations at the INEEL where ground water contains contaminants at or near the drinking water standards. Treatment systems have been installed where necessary and water supplied through drinking water distribution systems meets the drinking water standards.

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

Liquid effluent for four INEEL Site facilities and groundwater at two facilities were monitored for compliance with State of Idaho Wastewater Land Application Permits. Liquid effluents at six additional facilities were monitored for characterization and surveillance purposes. All effluent samples at the Central Facilities Area Sewage Treatment Plant were in compliance with permit requirements.

Two facilities at the Idaho Chemical Processing Plant are monitored under Wastewater Land Application Permits: the Sewage Treatment Facility and the Percolation Ponds. Concentrations of total suspended solids at the sewage treatment plant were in compliance with the permit. Total nitrogen concentrations exceeded the limit of 20 mg/L in one monthly sample. Cold temperatures reduce the effectiveness of the sewage lagoons to remove nitrogen; therefore, alternative operational procedures and treatment methods are being investigated. Concentrations of total nitrogen in perched water approximated effluent levels indicating little treatment in the unsaturated zone. Groundwater at the compliance well met the permit criteria. Groundwater sampling downgradient from the Percolation Ponds indicated high levels of sodium, chloride, and total dissolved solids. These levels are consistent with elevated levels of water treatment

chemicals being discharged to the Percolation Ponds. Permit limits were not exceeded in the groundwater.

Effluent to the Test Area North Disposal Pond was monitored in compliance with the Wastewater Land Application Permit. All effluent data were within the limits of the permit. A few parameters exceeded the permit limits in groundwater at the compliance well. These included iron and total coliform bacteria. Elevated levels of chloride and zinc that approached secondary drinking water standards were detected in one down-gradient well. Groundwater near the Disposal Pond was contaminated by previous waste management practices. Prior to 1972, process and sewage wastes were injected into the aquifer. Therefore, it is difficult to identify the pond as the source of groundwater contamination. Groundwater investigations being conducted at Test Area North will better define the sources of contamination in this area.

There was one instance of discharge of storm water runoff from a permit-required monitoirng location to the Big Lost River System during 1997. A sample was collected in compliance with the General Permit for Storm Water Discharge Associated with Industrial Activities. Additional storm water monitoring data were collected for surveillance purposes, and were compared to DOE Order derived concentration guides and EPA Benchmark concentrations as voluntary protection criteria. A number of samples contained zinc and total suspended solids above the voluntary standards. Zinc may be contributed by galvanized metals in drainage culverts and building materials. Elevated levels of suspended solids at ICPP and RWMC may indicate additional erosion control is necessary. Maintenance of the storm water drainage system is scheduled at ICPP and revegetation and soil stabilization efforts are ongoing at RWMC. These efforts will continue to be monitored and assessed for improvement.

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ACRONYMS

ANL–W	Argonne National Laboratory–West
ARA	Auxiliary Reactor Area
ASAP	Abbreviated Sampling and Analysis Plan
ATR	Advanced Test Reactor
BLRS	Big Lost River System
BOD	biological oxygen demand
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFA	Central Facilities Area
CFR	Code of Federal Regulation
COD	chemical oxygen demand
CTF	Contained Test Facility
DCG	derived concentration guide
DQO	data quality objective
DOE	U.S. Department of Energy
DOE–ID	U.S. Department of Energy Idaho Operations Office
DWP	Drinking Water Program
EBR–I	Experimental Breeder Reactor No. I
ECG	environmental concentration guide
EFS	Experimental Field Station
EPA	U.S. Environmental Protection Agency
ESP	Environmental Surveillance Program
ESRF	Environmental Science and Research Foundation
ESRP	Eastern Snake River Plain
GPRS	global positioning radiometric scanner
ICPP	Idaho Chemical Processing Plant
IDAPA	Idaho Administrative Procedures Act
IDEQ	Idaho Division of Environmental Quality
IFF	Idaho Falls Facility
INEEL	Idaho National Engineering and Environmental Laboratory
INTEC	Idaho Nuclear Technology and Engineering Center
IRC	INEEL Research Center
IWA	Industrial Wastewater Acceptance
LMITCO	Lockheed Martin Idaho Technologies Company
MAC	maximum allowable concentration
MAR	monitoring activities review
M&O	management and operating
MCL	maximum contaminant level
MWSF	Mixed Waste Storage Facility
NESHAP	National Emission Standards for Hazardous Air Pollutants
NPDES	National Pollutant Discharge Elimination System

NRF	Naval Reactors Facility
NURP	Nationwide Urban Runoff Program
NWCF	New Waste Calcining Facility
OMRE	Organic Moderated Reactor Experiment
PBF	Power Burst Facility
ppm	parts per million
ppmv	parts per million by volume
PM_{10}	particulate matter $\leq 10\,\mu m$
ppb	parts per billion
QA	quality assurance
QC	quality control
RCRA	Resource Conservation and Recovery Act
RESL	Radiological and Environmental Sciences Laboratory
RESP	Radiological Environmental Surveillance Program
RWMC	Radioactive Waste Management Complex
SDA	Subsurface Disposal Area
SDWA	Safe Drinking Water Act
SESP	Site Environmental Surveillance Program
SL-1	Stationary Low-Power Reactor No. 1
SMC	Specific Manufacturing Capability
SMCL	secondary maximum contaminant level
SP	suspended particulate
SRMP	Special Request Monitoring Program
SRPA	Snake River Plain Aquifer
STP	sewage treatment plant
SVR20	Soil Vault Row 20
SWEPP	Stored Waste Experimental Pilot Plant
SWPPP-IA	*INEEL Storm Water Pollution Prevention Plan for Industrial Activities*
TAN	Test Area North
TCE	trichloroethylene
TCLP	toxicity characterization leaching procedure
TDS	total dissolved solids
TKN	Total Kjeldahl Nitrogen
TLD	thermoluminescent dosimeter
TOG	total oil and grease
TRA	Test Reactor Area
TRU	transuranic
TSA	Transuranic Storage Area
TSF	Technical Support Facility
TSS	total suspended solids
USGS	United States Geological Survey
VANB	Van Buren Boulevard

VOC	volatile organic compound
WCB	Willow Creek Building
WERF	Waste Experimental Reduction Facility
WLAP	Wastewater Land Application Permit
WMF	waste management facilities
WRRTF	Water Reactor Research Test Facility

1997 LMITCO Environmental Monitoring Program Report for the Idaho National Engineering and Environmental Laboratory

1. INTRODUCTION

This report summarizes the monitoring results and activities of the Lockheed Martin Idaho Technologies Company (LMITCO) Environmental Monitoring Program at the Idaho National Engineering and Environmental Laboratory (INEEL) for calendar year 1997. The purpose of the Environmental Monitoring Program is to monitor effluents and environmental media to assess the impact of INEEL operations on the environment and to protect public health.

1.1 History of the Monitoring Program

The INEEL is owned by the U.S. Department of Energy (DOE), and various management and operating (M&O) contractors have operated at the Site over the years; LMITCO is the current M&O contractor. The DOE 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 changed in 1974 to the Idaho National Engineering Laboratory to include a broader scope of engineering support activities for DOE. In response to the increased role the laboratory currently plays in the environmental cleanup of the DOE complex and technology development, the name was changed in 1997 to the INEEL.

Early monitoring activities focused on pathways along which radioactive contaminants from Site operations could be released and where exposure to the general public in southeast Idaho could occur.[1] The United States Geological Survey (USGS) has been involved in environmental surveillance at the INEEL from the beginning by monitoring groundwater quality in the Snake River Plain Aquifer (SRPA). Because the INEEL was heavily involved in testing nuclear facilities, radionuclides were the major contaminants of concern. Facility operators conducted limited sampling of liquid effluents to develop waste inventory information. As the INEEL environmental monitoring program developed from 1950 to 1993, the M&O contractors conducted monitoring related to facility operations, and the DOE Radiological and Environmental Sciences Laboratory (RESL), or other government agencies, such as the USGS, conducted on-Site and off-Site environmental surveillance.

Ambient air surveillance at the Radioactive Waste Management Complex (RWMC) began in 1972, and surface water monitoring began in 1973.[1] These early activities were designed primarily to meet operational monitoring objectives (e.g., worker safety and contamination control) rather than environmental surveillance objectives, and monitors were located in predominant release paths from disposal activities.

In 1984, an agreement between DOE and the U.S. Environmental Protection Agency (EPA) mandated the establishment of nonradiological environmental monitoring at DOE facilities to ensure compliance with applicable federal, state, and local regulations and to ensure the protection of human health and the environment. The INEEL M&O contractor instituted monitoring of contaminants in nonradiological liquid effluents in 1986.

In response to a U.S. Department of Energy Idaho Operations Office (DOE-ID) request in 1988, a centralized drinking water program was established. Prior to this, facilities were monitored separately. In September 1992, DOE submitted a Notice of Intent to the EPA to obtain coverage of the INEEL for the

"National Pollutant Discharge Elimination System (NPDES) General Permit for Storm Water Associated with Industrial Activity"[2] for storm water discharges. A storm water monitoring plan was implemented in 1993 in compliance with the conditions of the permit. In three areas of the INEEL, storm water runoff in excess of amounts that can be stored in retention basins is discharged to deep injection wells to prevent flooding. In 1997, monitoring of storm water that enters deep injection wells for compliance with State of Idaho Injection Well Permits was transferred from the USGS to LMITCO. The groundwater has been monitored since 1950, and in 1993, DOE-ID formalized an INEEL Groundwater Monitoring Program.

Radiological monitoring of selected effluent streams was added to the Liquid Effluent Monitoring Program in 1992. In 1994, the INEEL obtained its first Wastewater Land Application Permit (WLAP) from the State of Idaho. Additional permit applications have been submitted to cover liquid waste disposal to infiltration ponds and other surface disposal sites. These permits require liquid effluent and groundwater monitoring at the ponds. Monitoring for compliance with permit conditions has been added to the Liquid Effluent Monitoring Program and the Groundwater Monitoring Program.

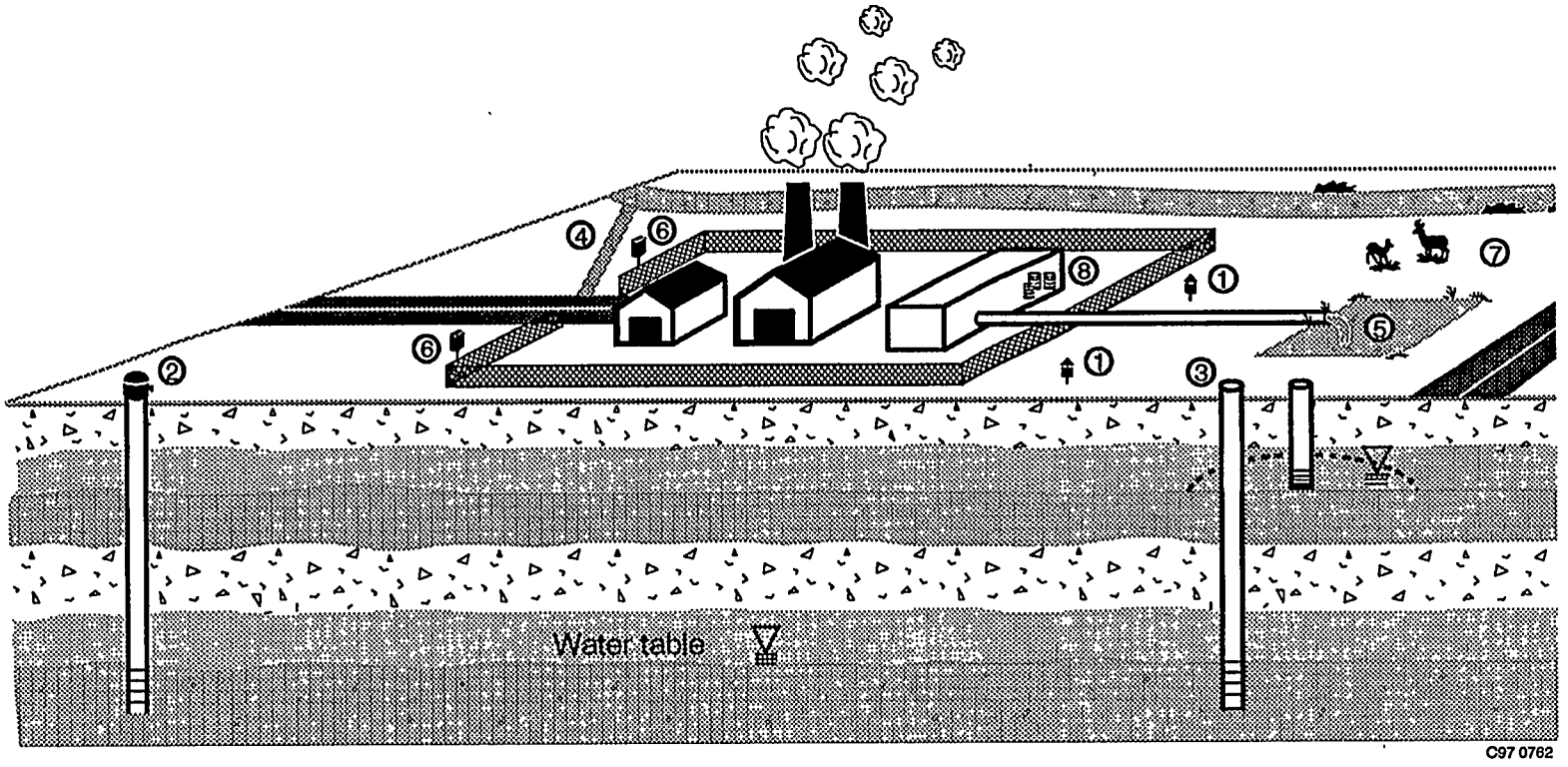
In the fall of 1993, the on-Site portion of the INEEL Environmental Surveillance Program (ESP) was transferred from DOE to the INEEL M&O contractor. The off-Site environmental surveillance activities were transferred from DOE-ID to the Environmental Science and Research Foundation (ESRF).

1.2 Scope

The Environmental Monitoring Program is responsible for conducting environmental surveillance, compliance monitoring, and special request sampling at the INEEL to comply with DOE orders and federal and state regulations and permits. Figure 1-1 illustrates the scope of the media sampled by the LMITCO Environmental Monitoring Program. Program responsibilities include programmatically supported environmental surveillance of ambient air, direct radiation, surface water, and biota at waste management facilities (WMF) and outside of facility fences. Compliance monitoring is conducted for drinking water, storm water, groundwater, and liquid effluents at LMITCO facilities. Special request sampling in support of waste stream characterization is performed to ensure proper disposal of wastes and to support other programs, as necessary.

Two facilities report to organizations outside the DOE-ID project office and have separate environmental monitoring programs. These facilities are Argonne National Laboratory-West (ANL-W), which reports to the DOE Chicago Operations Office, and the Naval Reactors Facility (NRF), which reports to the DOE Pittsburgh Naval Reactors Office. The LMITCO Environmental Monitoring Program conducts Site-wide environmental surveillance activities at ANL-W and NRF, but does not conduct any facility or compliance monitoring at these locations. Off-Site environmental surveillance activities are conducted by the ESRF.

DOE Order 5400.1 requires that each DOE facility prepare an annual site environmental report to communicate environmental monitoring results to the public. Preparation and publication of this report for the INEEL is accomplished by the ESRF. Data from the RESP, SESP, DWP, Liquid Effluent Monitoring Program, and the Storm Water Monitoring Program are provided to the ESRF for inclusion in the *Idaho National Engineering and Environmental Laboratory Site Environmental Report*[3] for the current year. The ESRF combined on-Site monitoring and surveillance data with off-Site surveillance data to determine to total cumulative impact of INEEL activities on the public and local environment.



Key			
1. Ambient air 2. Drinking water	3. Ground water 4. Storm water runoff	5. Liquid effluents 6. Direct radiation	7. Soil and biota 8. Solid waste

Figure 1-1. Environmental Monitoring media sampled (C970762).

1.3 Program Organization

DOE Order 5400.1, "General Environmental Protection Program,"[4] divides environmental monitoring into two activities: environmental surveillance and effluent monitoring. Environmental surveillance provides monitoring of pathways in the environment along which contaminants could move or accumulate. Effluent monitoring provides monitoring of release points at facilities and the wastes that facilities generate. DOE further defines these two activities as the following:

> *Environmental surveillance* involves the collection and analysis of samples or direct measurements of air, water, soil, foodstuff, biota, and other media from DOE sites and their environments for the purpose of determining compliance with applicable standards and permit requirements, assessing radiation exposures of members of the public and assessing the affects, if any, on the local environment.
>
> *Effluent monitoring* involves the collection and analysis of samples or measurements of liquid and gaseous effluents for the purpose of characterizing and quantifying contaminants, assessing radiation exposures to members of the public, providing a means to control effluent at or near the point of discharge, and demonstrating compliance with applicable standards and permit requirements.

1.3.1 Environmental Surveillance

The ESP consists of the Radiological Environmental Surveillance Program (RESP) and the Site Environmental Surveillance Program (SESP). The RESP monitors soils, ambient air, direct radiation, biota, and surface water for impacts from waste management facility operations. The SESP monitors ambient air, soils, and direct radiation outside facility boundaries, but within the borders of the INEEL.

1.3.2 Compliance Monitoring

Compliance monitoring activities include effluent monitoring and other environmental programs: Drinking Water, Liquid Effluent Monitoring, Storm Water Monitoring, and Groundwater Monitoring Programs.

The definition of a public water system is a system that provides piped water for human consumption, if such system has at least 15 service connections or regularly serves an average of at least 25 individuals daily for at least 60 days out of the year. Since the water systems at the INEEL are classified as public water systems, the Drinking Water Program (DWP) monitors potable water supplied to INEEL facilities to ensure compliance with the Safe Drinking Water Act (SDWA).[5]

The Liquid Effluent Monitoring Program monitors process wastewaters and sanitary sewage discharged from INEEL facilities. At the INEEL, most of these liquid effluents are discharged to infiltration ponds that have been or will be permitted by the State of Idaho under the wastewater land application permitting process. LMITCO has also obtained permits from the City of Idaho Falls to discharge from INEEL Idaho Falls facilities to the City sewer system. Monitoring requirements are specified in the permits. The Liquid Effluent Monitoring Program also monitors for other parameters to ensure that discharges to infiltration ponds do not exceed hazardous waste limits or adversely impact the environment.

The Storm Water Monitoring Program monitors runoff from industrial facilities at the INEEL. The program operates in compliance with the NPDES General Permit for Industrial Activities.[2] For compliance with State of Idaho Injection Well Permits, the Storm Water Monitoring Program also monitors storm water that enters deep injection wells when retention basins fill up.

The Groundwater Monitoring Program monitors groundwater in perched water zones and in the Snake River Plain Aquifer. Some monitoring is required by WLAPs to demonstrate that wastewater disposal does not degrade groundwater quality. The USGS conducts monitoring as a surveillance activity to look for trends in groundwater quality that could indicate releases to the groundwater from facilities.

Individual facilities are responsible for monitoring stacks and other emissions to the atmosphere. This information can be found in the INEEL National Emissions Standard for Hazardous Air Pollutants (NESHAP) Annual Report[6] and the Air Emissions Inventory Report.[7]

1.3.3 Special Request Monitoring Program

The Special Request Monitoring Program (SRMP) provides on-call support to facilities and programs, including characterizing unknown materials and supporting waste disposal decisions.

1.4 Program Objectives

DOE Order 5400.1 is the primary DOE order governing environmental monitoring activities. Two other DOE orders are directly applicable to the program. DOE Order 5400.5, "Radiation Protection of the Public and the Environment,"[8] specifically addresses monitoring for radionuclides, and DOE Order 5820.2A, "Radioactive Waste Management,"[9] describes monitoring activities to be conducted at waste management facilities. The objectives in DOE Orders 5400.5 and 5820.2A are subsets of the overall objectives in DOE Order 5400.1. DOE orders provide the objectives of environmental monitoring, but do not provide the details on how objectives are to be met. Additional guidance is provided in the *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance.*[10] This section presents and describes how the Environmental Monitoring Program meets the DOE order objectives.

1.4.1 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, orders, and permits
- 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.

1.4.2 Approach to Meeting Objectives

DOE orders provide objectives for environmental monitoring programs and some guidance on implementation. The general approaches to meeting the DOE order objectives are as follows:

- Review proposed and implemented rules and regulations to determine requirements
- Develop a baseline for effluents and environmental media from historical monitoring data
- Compare 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
- Obtain required permits for effluents
- Monitor according to effluent permit requirements in terms of parameters, frequency, and methods
- Develop 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
- Compare current monitoring data to release criteria in permits and to other criteria that have been adopted by the program
- Identify concerns to facility operations and support operations managers to resolve issues.

2. QUALITY ASSURANCE/QUALITY CONTROL

The Quality Assurance (QA) Program ensures that the sampling methods produce representative samples of the media being monitored, confirms that laboratory analyses are reliable, and verifies that the quality of reported results is suitable to support decisions based on the environmental monitoring data. Quality control (QC) samples are used to measure and document the uncertainty in analytical data.

2.1 Quality Assurance Program

A written QA Program is prepared for all of the Environmental Monitoring programs. Generating quality data begins with preparing written program plans to document responsibilities and requirements for collecting, analyzing, and processing samples. Program design criteria, decision criteria, and implementing procedures are documented in program plans and procedural manuals.

Qualifications for monitoring personnel are documented in the program plans. Sampling personnel are trained on the plans and in the field to ensure that field team members know and follow standard procedures for data collection. The quality program includes processes by which the data and the program are monitored for performance. When deviations from acceptable performance are noted, corrective action is taken; appropriate corrective actions are included in the written program plans. Corrective actions include identifying the cause of the problem and the steps needed to prevent recurrence. Careful documentation is prepared for all samples collected by the program. Bound field log books are used to record activities during sample collection. Chain of custody forms are used to document the control of the samples from the time of collection until the laboratory has completed the analyses. Laboratory analytical results are reviewed and marked with flags to indicate the quality of data. Data qualifier flags indicate the usability of the analytical data. The historical record of documentation for monitoring samples is maintained in Environmental Monitoring Program files as records.

Written procedures are prepared, reviewed, and used to collect and analyze data. Sampling procedures are prepared following accepted methods published by EPA and DOE. For radionuclides, guidance presented in the *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance*[10] has been implemented, when applicable. Procedures are reviewed, and once approved, are controlled to ensure that any revisions go through the same review and approval process as the original. During the laboratory procurement process, laboratory analytical procedures are reviewed and compared with the requirements of the EPA, State of Idaho, or DOE to ensure that analytical results will conform to regulatory requirements and standards of good practice.

To meet the objectives discussed in Section 1.4, monitoring programs are developed to collect data from effluents and environmental media that support decisions. Monitoring program design starts with the decisions to be made with the data, and then determines the location and frequency of sampling to obtain the data to support decisions. Monitoring program designs are also documented in internal written program plans and procedures.

Sampling supplies and laboratory services for analyses obtained from suppliers are procured only after vendor requirements have been carefully developed, and vendors are screened to ensure that supplied materials and services meet program requirements. Laboratories are audited by a team of experienced professionals and quality engineers to ensure that the laboratory has a QA program sufficient to provide analytical data suitable to support the program. Materials purchased by the program are inspected on receipt to ensure that procurement requirements have been met.

Analytical data obtained by the monitoring programs are validated upon receipt from the laboratory. Data validation ensures that method-specified QA steps were followed and that QA criteria were met.

Data are marked with qualifier flags based on this validation, and users can readily determine the usability of the data from the qualifier flags. Auditable records of analyses results or reports are maintained in accordance with the requirements of DOE 5700.6C, "Quality Assurance."[11]

The monitoring programs are periodically assessed for performance by LMITCO management and by external organizations. Environmental Monitoring staff perform management self-assessments to evaluate the programs for conformance to requirements. A self-assessment generally consists of an internal review of the sampling, shipping, and decontaminating procedures used. An assessor accompanies the sampling team to the field and observes collecting, preserving, and shipping samples, and decontaminating equipment. Any deviation from the technical procedure requirements is noted and corrected, and suggestions for process improvements are made and implemented.

Periodic external reviews are performed to determine if the program is acquiring data of suitable quality. QA audits are performed occasionally to determine if the program is following the documented program. There are also periodic technical reviews to assess the technical basis of the program. These reviews are much more intensive and review the design basis of the program, the adequacy of procedures, and other technical elements.

2.2 Quality Control Program

The QC Program consists of submitting samples to the laboratory to measure the amount of uncertainty in analytical data. Results of QC samples are reviewed as part of the program self-assessment to determine if the monitoring data are meeting program goals for uncertainty. The appropriateness of different types of QC samples to different media and the acceptable tolerance levels varies depending on the media and program. Specific QC samples, frequency, and tolerance levels are documented in program-specific plans.

Blank samples of the media to be analyzed are submitted to the laboratory to determine the potential for bias in analytical results. Examples of this are deionized water submitted for water samples, unexposed dosimeters submitted for direct radiation, and unused filters submitted for air samples. The blanks are used to determine if any sample contamination is introduced during field handling, shipping, and preparing samples or another sample handling process. Contamination can give a positive bias to the sample results.

Field duplicate or replicate samples are collected to determine accuracy of monitoring data. Duplicate samples are collected by collocating samplers or splitting sample media into two containers. Replicate samples are analyzed for the same set of elements or compounds. The relative percent difference is calculated for each element or compound and compared to tolerance criteria established in each program plan. Exceeding tolerance criteria can indicate that an unacceptable level of uncertainty is introduced by sample collection, processing, or analysis.

Known standards are submitted blind to the laboratory to measure bias and accuracy of laboratory analysis. Standards are purchased from commercial suppliers, prepared in INEEL laboratories, or obtained from national laboratory comparison programs. LMITCO laboratories participate in the DOE Environmental Measurements Laboratory QA Program, the EPA Environmental Measurements Systems Laboratory QA Program, and several INEEL customer QA programs. Routine sample numbers, labels, and containers are used for the known standards; so, there is no indication to the laboratory that the sample is a QC sample. The percent recovery is calculated for each parameter and compared to media-specific tolerance criteria given in program plans.

Samples for analysis of volatile organic compounds (VOCs) can become cross-contaminated during shipping and handling. Trip blanks are included with shipments of samples for volatile organic analysis to provide an indication of cross-contamination. The trip blank consists of a sample of deionized water that is shipped, processed, and analyzed with the monitoring samples. The frequency of use of trip blanks is documented in individual program plans and sampling 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).

3.1 Demographics

The largest population centers near the INEEL are to the southeast and east along the Snake River and Interstate 15. The largest communities in closest proximity to the INEEL boundaries include Idaho Falls (43,929), which is about 35 km (22 mi) east of the nearest Site boundary; Blackfoot (9,646), about 37 km (23 mi) southeast of the nearest Site boundary; Pocatello (46,080), about 60 km (37 mi) south-southeast of the nearest Site boundary; and Arco (1,016), about 11 km (7 mi) west of the nearest Site boundary. Atomic City (25), which is within about 0.8 km (0.5 mi) of the southern boundary of the INEEL, is the closest town.[12]

3.2 Regional Physical Setting

3.2.1 Physiography

The INEEL is located in the north-central part of the Eastern Snake River Plain (ESRP). The ESRP is the eastern segment of the Snake River Plain and extends from the Hagerman-Twin Falls area northeast toward the Yellowstone Plateau. The ESRP 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 Bitterroot 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 ESRP 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 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 closed topographic basin.

The INEEL measures approximately 63 km (39 mi) long in a north-south direction and 58 km (36 mi) wide at its widest point. The INEEL is 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.

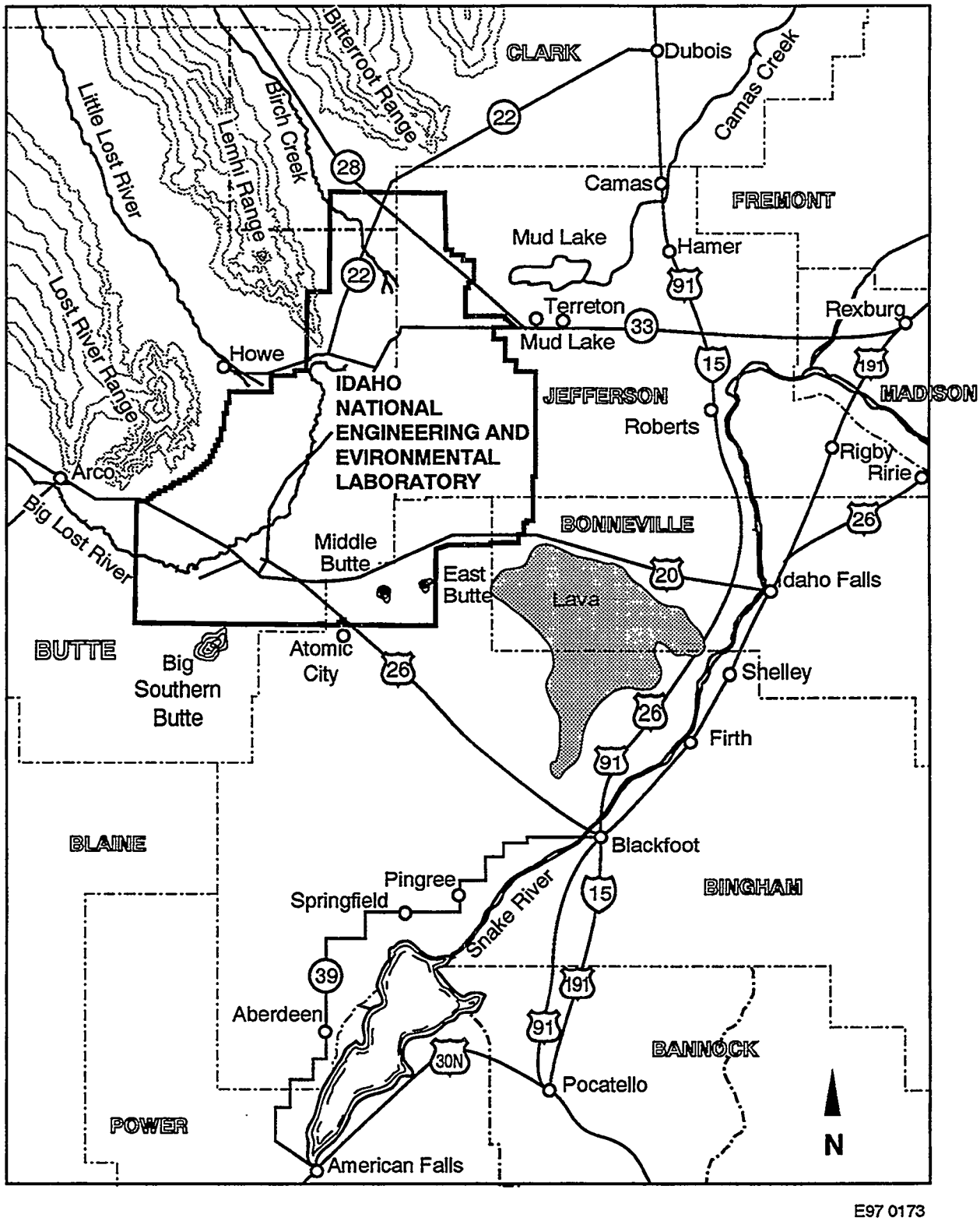


Figure 3-1. Map of INEEL vicinity showing counties and cities (E970173).

3.2.2 Climatology

Physiography is important to the climatology of the INEEL. The mountains lying west and north of the INEEL deflect moisture-laden air masses upward creating an arid to semi-arid climate on the downwind side of the mountains. The 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 stations are currently operating. The following climatological data came from a National Oceanic and Atmospheric Administration report.[13]

The average annual precipitation at the Central Facilities Area (CFA) and Test Area North (TAN) is 22.12 cm (8.71 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 70.1 cm (27.6 in.), and the water content of melted snow contributes between one-quarter and one-third of the annual precipitation. In 1997, precipitation at CFA was 21.7 cm (8.53 in.) with 43 cm (17 in.) of snowfall; 5 cm (2 in.) of the precipitation was from snowfall.

Average daily air temperatures during 1997 at the INEEL (CFA) ranged from a low of –17°C (1.5°F) on December 12 to a high of 23°C (73°F) on July 15. The long-term (1950–1988) average daily air temperature at CFA ranges from –12°C (10°F) during early-January to 21°C (70°F) during the latter half of July. The average annual temperature at the Site exhibits a gradual seven-month increase beginning with the first week in January and continuing through the third week in July. The temperature then decreases over the course of five 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 (always recorded as the direction from which the wind is blowing) have been continuously monitored at many stations on and surrounding the INEEL since 1950. The orientation of the bordering mountain ranges and the general northeast trend of the ESRP exert a strong influence on wind direction. Eastern Idaho lies in a region of prevailing westerly winds. Channeling of these winds within the ESRP 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)]. Several wind directions are associated with the highest hourly wind speeds. Like the rest of the INEEL, TAN usually experiences the highest hourly wind speeds in association with 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 ESRP, a broad northeast trending structural depression that has been filled with silicic and basaltic volcanic rocks and interlayered sedimentary materials. Basalt vents of the ESRP 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 basalt lava flows and interflow sediments beneath the INEEL may vary from as little as 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 Site (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 Site, 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 that includes 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 1997 water year (October 1996 through September 1997), flow was recorded in the Big Lost River at the diversion dam near the RWMC in all months except November and December. A total of 11,560 ha-m (93,707 acre-ft) of water reached the diversion dam in the river. During peak river flows in May and June, 3,470 ha-m (28,133 acre-ft) of water were diverted to the INEEL spreading areas. A total of 8,090 ha-m (65,574 acre-ft) of water flowed past the diversion dam in the Big Lost River channel. Because of infiltration losses in the channel, flow decreased downstream with 6,550 ha-m (53,707 acre-ft) reaching the Lincoln Boulevard bridge and 5,690 ha-m (46,143 acre-ft) reaching the Big Lost River sinks. This was the largest volume of annual discharge in the river since 1986.

Local precipitation and surface runoff occasionally affect the INEEL. INEEL facilities, such as the RWMC, 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 SRPA, a vast groundwater reservoir that may contain more than 1,200 km^3 (1 billion acre-ft) of water, lies under the ESRP.[19] The flow of groundwater in the aquifer is chiefly to the south-southwest at velocities that range from 1.5 to 6 m/day (5 to 20 ft/day).[20] Basaltic lava flows and interbedded sedimentary deposits are the main rock units that make up the aquifer. Water is contained in and moves through intercrystalline and intergranualar 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.

Groundwater inflow to the aquifer at the INEEL consists mainly of underflow from the northeastern part of the plain and from drainages on the west and north.[20] Most of the groundwater is recharged in the uplands to the northeast, moves southwestward through the aquifer, and is discharged to springs along the Snake River near Hagerman. Lesser amounts of water are derived from local precipitation on the plain.[18] Part of the precipitation evaporates, but part infiltrates into the ground surface and percolates downward to the aquifer. At the INEEL, significant recharge is derived from the intermittent flows of the Big Lost River.

3.5 Facility Descriptions

There are nine primary facility areas at the INEEL (Figure 3-2) and a number of smaller facilities around the Site. There are also administrative, scientific support, and non-nuclear research laboratories in Idaho Falls, Idaho. The LMITCO Environmental Monitoring Program conducts surveillance at all of the nine Site facilities, at on-Site INEEL areas outside facility boundaries, and at Idaho Falls facilities. See Appendix A for specific facility maps and monitoring locations.

3.5.1 Argonne National Laboratory-West

The ANL-W is operated by the University of Chicago and reports to the DOE Chicago Field Office. ANL–W administratively controls an area of approximately 360 ha (890 acres) in the southeastern corner of the INEEL, while the facilities themselves cover less than 24 ha (60 acres). The facility conducts research and development for liquid metal fast breeder reactor technology, spent nuclear fuel, and waste treatment technologies.

Radioactive liquid wastes are evaporated and solidified in the Radioactive Liquid Waste Treatment Facility. Process wastewater, which mainly consists of secondary loop reactor cooling water, is discharged to an infiltration pond. Sanitary sewage is discharged to a lined evaporation pond. The Fuel Conditioning Facility and the Hot Fuel Examination Facility are the two primary air emissions sources at ANL-W.

3.5.2 Auxiliary Reactor Area

The Auxiliary Reactor Area (ARA), formerly referred to as the Army Reactor Area, is located in the south-central portion of the INEEL. The ARA was built to develop a compact power reactor for use as a power source at remote military bases. The ARA is made up of four facility areas: ARA-I, -II, -III, and -IV. In addition, the Stationary Low-Power Reactor No. 1 (SL-1) burial ground is located at ARA. The burial ground contains debris produced by a nuclear excursion and steam explosion, at the SL-1 reactor during maintenance operations on January 3, 1961. The ARA facilities occupy less than 16 ha (40 acres).

Activities associated with the ARA program occurred from 1957 through 1965. Use of the ARA facilities has been minimal since the Army Reactor Program was phased out in 1965, and essentially no activities have been undertaken there since 1988. The ARA facilities are currently being decontaminated and dismantled. The SL-1 burial ground was capped and fenced in 1996.

3.5.3 Central Facilities Area

The CFA is located in the south-central part of the INEEL. The facilities provide four major types of functional space: craft, office, services, and laboratory. Many Site-wide services are located at CFA including environmental monitoring, instrument calibration, security, fire protection, medical, communication systems, warehouses, cafeteria, vehicle and equipment pools, and the bus system. Other services include providing clearance badges and visitor passes at the Main Gate and providing training for security and law enforcement agencies at the Gun Range. The Van Buren Boulevard Monitoring Station (VANB) is located 3.5 km (2.2 mi) west of CFA at the junction of Van Buren Boulevard and Highway 20/26.

The principal sources at CFA consist of solid waste landfills, fleet maintenance, and sanitary sewage. Process wastewaters from laboratories, medical facilities, and equipment repair shops are all routed to the sanitary sewage system. There are three inactive solid waste landfills north of CFA that were closed and capped in 1996 under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). There is also an active solid waste landfill north of CFA that receives office and cafeteria

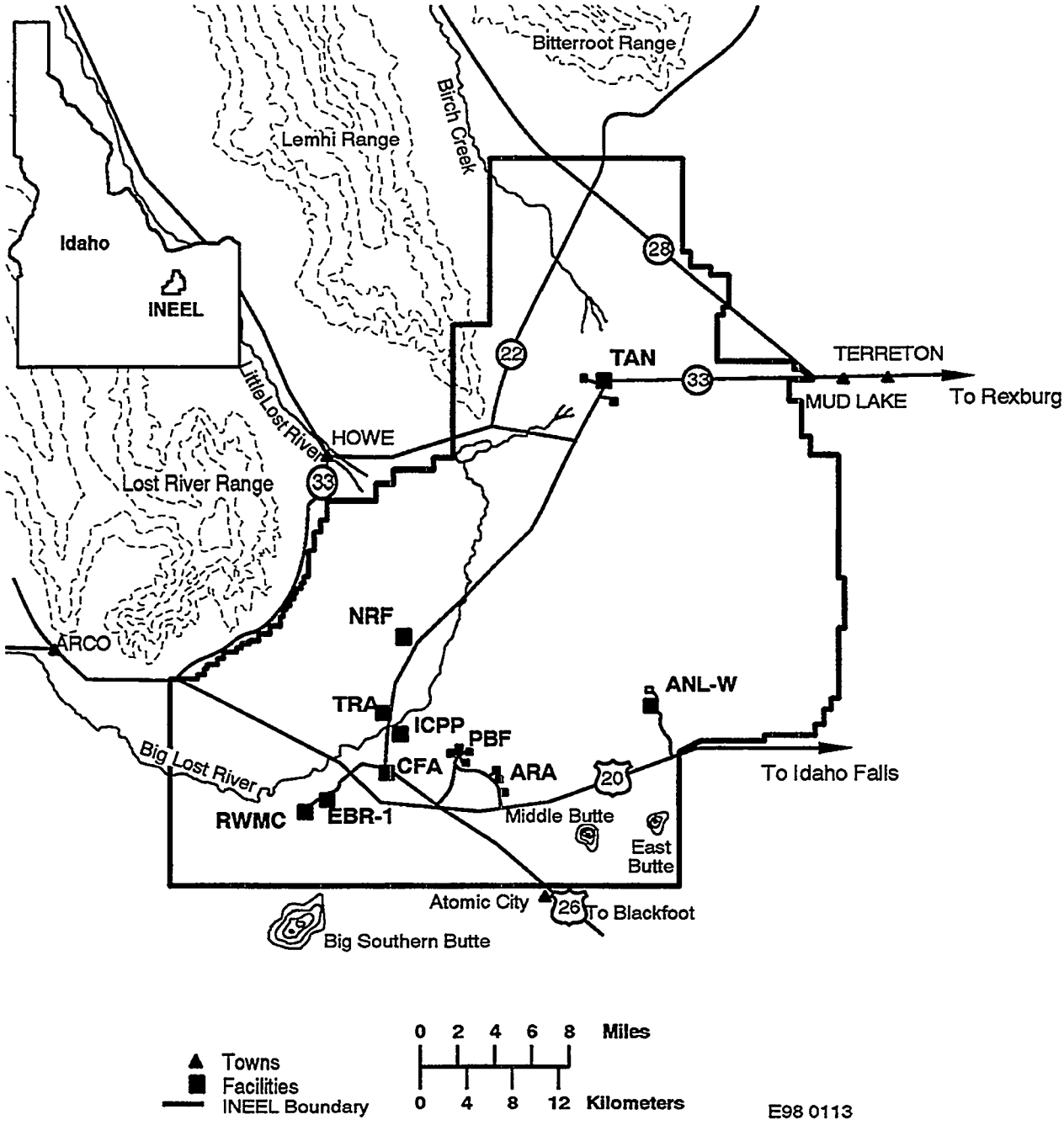


Figure 3-2. Map of the INEEL showing primary and secondary facilities (E980113).

waste. The CFA sewage treatment plant (STP) consists of three lined ponds where biological treatment of the wastewater takes place. The effluent is then sprinkler irrigated on the land surface.

3.5.4 Idaho Chemical Processing Plant

The Idaho Chemical Processing Plant (ICPP) is located on approximately 81 ha (200 acres) in the south-central part of the INEEL. ICPP houses reprocessing facilities for government-owned defense and research of spent nuclear fuels. Since beginning operation in 1953, the facility has recovered more than $1 billion worth of uranium-235. The reprocessing mission was discontinued in 1992. Facilities at ICPP include spent fuel storage and reprocessing areas, high-level liquid waste storage tanks, a waste solidification facility and related waste storage bins, remote analytical laboratories, and a coal-fired steam generating plant.

Facility operations involve storing and handling radioactive and hazardous materials including acids, bases, and petroleum products. Gaseous radionuclides generated from waste calcining and radioactive liquid waste evaporation are released to the atmosphere through the main stack. The main stack also releases oxides of nitrogen from the waste calcining process. A second stack at ICPP is fed by the Coal Fired Steam Generation Facility. Process wastewaters and sanitary sewage wastes are discharged to percolation ponds.

In May 1998, ICPP was renamed the Idaho Nuclear Technology and Engineering Center (INTEC) to reflect the change in the mission from reprocessing spent nuclear fuel to fuel storage and waste treatment. Because the name change occurred after the 1997 calendar year and for consistency with previous monitoring reports, the facility will be referred to as ICPP throughout this report.

3.5.5 Naval Reactors Facility

The NRF is located in the central part of the INEEL and is operated by Westinghouse Electric Company through the DOE Naval Reactors, Idaho Branch Office. The primary function is examination of spent reactor fuel from Navy reactors at the Expended Core Facility. There are also a number of prototype reactors at the facility that were used as training platforms for U.S. Navy personnel. The prototypes have been permanently shutdown.

3.5.6 Power Burst Facility

The Power Burst Facility (PBF) is located in the south-central portion of the INEEL. The area was initially used for testing reactor transient behavior and for safety studies on light-water moderated enriched fuel systems. Five reactors were installed in four facilities at PBF. Four of the five reactors have been removed and the fifth, the PBF reactor, has been in standby mode since 1975. In 1984 and 1985, three of the facilities were radiologically decommissioned and decontaminated and modified for new missions. The facilities are now used by Waste Management Operations for waste treatment and storage.

The Waste Experimental Reduction Facility (WERF) is used to incinerate low-level and mixed radioactive waste, and the Waste Reduction Operation Complex is used for storage and recovery of low-level and mixed radioactive waste. The Mixed Waste Storage Facility (MWSF) is used to store mixed radioactive and hazardous waste for which treatment technologies do not yet exist. There are no liquid process wastes generated by the facility. Sanitary waste are discharged to drain fields. Gaseous effluents from the incineration of low-level radioactive waste are discharged through the WERF stacks.

3.5.7 Radioactive Waste Management Complex

The RWMC is situated on 76 ha (187 acres) located 11 km (7 mi) southwest of CFA. The RWMC was established in 1952 as a controlled area for disposal of solid radioactive wastes. Since 1954, the facility has also received defense wastes for storage. A number of research and development projects dedicated to shallow land burial technology and alternate ways of removing, reprocessing, and repackaging transuranic (TRU) wastes are also conducted at the facility. The RWMC is subdivided into three primary zones;

- Administrative Area
- Subsurface Disposal Area (SDA)
- Transuranic Storage Area (TSA).

Office buildings and equipment maintenance facilities are located in the Administrative and Operations Area, which covers approximately 13 ha (33 acres).

The SDA is a fenced 39-ha (97-acre) facility dedicated to the permanent disposal of low-level beta, gamma, and nonretrievable TRU waste (buried prior to 1970) that is contaminated with mixed fission products and hazardous constituents. Major features at the SDA include the pits, trenches, and soil vaults in which waste was buried, and Pad A, which received low-level waste, primarily nitrate salts, from off-Site generators. An area in the northeast corner of the SDA, Pit 9, is to be remediated under CERCLA.

The TSA is a 23-ha (57-acre) fenced facility dedicated to storing contact- and remote-handled solid TRU wastes. The wastes stored at TSA include TRU (e.g., plutonium) and intermediate-level waste. Major facilities at the TSA include the Type I and Type II storage buildings, TSA-1/TSA-Retrieval, TSA-2, and TSA-3. Within the TSA-2 and TSA-3 are the air-support structures and the Stored Waste Examination Pilot Plant (SWEPP).

There are no process liquid wastes generated at the RWMC. Sanitary sewage is discharged to a lined evaporation pond. Operations of the facility include transportation and burial of radioactively contaminated material which could result in nonpoint source releases to the atmosphere and direct exposure to ionizing radiation.

3.5.8 Test Area North

The TAN is located approximately 43 km (27 mi) northeast of CFA. The TAN complex consists of several facilities for handling, storing, examining, and conducting research and development on spent nuclear fuel. The facilities include one of the world's largest hot shops, storage pools, and examination operations supporting research of the 1979 Three-Mile Island accident.

The major facilities at TAN include the following:

- Contained Test Facility (CTF)
- Technical Support Facility (TSF)
- Water Reactor Research Test Facility (WRRTF).

The CTF is located on the west end of TAN. The mission of CTF was to perform reactor loss-of-coolant studies. After these studies were completed, the facility was decontaminated and used for decontamination and decommissioning of reactors used in the Aircraft Nuclear Propulsion Program.

Currently, part of the CTF and TSF area serves as an operational facility for the Specific Manufacturing Capability (SMC) project. The SMC manufactures armor assemblies for the Army's Tank Unit. The TSF is located in the central part of TAN and serves as the main administration, assembly, and maintenance section for TAN. The Fire Department is also located there. Major programs at TSF include the Three-Mile Island Unit 2 Core Off-Site Examination, Spent Fuel Program, and the SMC.

The WRRTF is located 2.6 km (1.6 mi) southeast of TSF and was originally constructed to conduct pool and table reactor experiments. Various reactor programs were conducted at WRRTF, including the Semiscale (TAN-646), Thermal Hydraulic Loss-of-Coolant Project (TAN-646), the Blowdown Facility (TAN-640), and Two-Phase Flow Loop (TAN-640) loss-of-coolant projects. The facility is currently used by the Applied Engineering and Development Laboratory to work on experimental projects.

Sewage and process wastewater from CTF is discharged to a lined evaporation pond. Process and sanitary sewage waste from TSF and WRRTF are discharged to percolation ponds.

3.5.9 Test Reactor Area

The Test Reactor Area (TRA) is located in the southwestern area of the INEEL, approximately 8 km (5 mi) northwest of CFA. The area was originally established in the early 1950s to conduct experiments associated with developing, testing, and analyzing materials used in nuclear and reactor applications. The Advanced Test Reactor (ATR), located at TRA, produces a neutron flux that simulates long-duration radiation effects on materials and fuels.

Highly radioactive liquid wastes are containerized and shipped to ICPP for evaporation and solidification. Low-level radioactive liquid are discharged to a lined evaporation pond. Process wastewaters from ion exchange demineralizers are discharged to a Chemical Waste Pond. Other process wastewaters and secondary reactor cooling waters are discharged to the Cold Waste Pond. Sanitary sewage is discharged to a lined evaporation pond. Radioactive air emissions are primarily associated with operation of ATR. Other significant air emissions are from diesel-powered generators and particulates from the ATR cooling tower.

3.5.10 Idaho Falls Facilities

Of the buildings operated by LMITCO in the City of Idaho Falls, 16 have Waste Acceptance Form Permits with the City. Only two of the permits require monitoring of liquid effluents: the permit for the Willow Creek Building (WCB) and the permit for the INEEL Research Center (IRC). The WCB houses mainly administrative functions, but also contains a print shop, a photography laboratory, and a medical facility. The IRC contains laboratories for research programs, including materials testing, fossil energy research, biotechnology, environmental monitoring, engineering research, advanced process research, and industrial research.

3.5.11 Secondary Facilities

A number of secondary facilities are located within the INEEL boundaries where the Environmental Monitoring Program conducts monitoring or maintains monitoring stations.

3.5.11.1 Experimental Breeder Reactor-I. Experimental Breeder Reactor No. I (EBR-I) consists of the reactor building and annex (EBR-601), situated on approximately 4 ha (10 acres) of land located approximately 10 km (6 mi) southwest of CFA. EBR-I was constructed in 1949 and the early 1950s. EBR-I was the first reactor in the world to generate usable amounts of electricity. This historic accomplishment took place on December 20, 1951. Today, EBR-I is a Registered National Historical

Landmark where several reactor cores were tested. Two prototype nuclear aircraft engines that were built at the INEEL in the 1950s are also displayed at EBR-I. EBR-I is open to the public from Memorial Day until Labor Day and for special tours after that. The EBR-I water system serves approximately 12,000 visitors per year.

3.5.11.2 Experimental Field Station. The Experimental Field Station (EFS) was previously known as the Experimental Dairy Farm. It was a small-scale dairy farm used to study the movement of radionuclides through the entire air-vegetation-cow-milk sequence of the human food chain. The Site is approximately 10 km (6 mi) north of CFA along the channel of the Big Lost River. Research on methods to effectively provide barriers to water, small mammal, ant, and vegetation root intrusion through protective caps at waste disposal areas is currently conducted there.

3.5.11.3 Security Training Facility. The Security Training Facility consists of two adjacent areas located approximately 4 km (2.5 mi) east of CFA. This facility was formerly known as the Experimental Organic Cooled Reactor and Organic Moderated Reactor Experiment (OMRE) areas. The Experimental Organic Cooled Reactor was constructed directly northwest of the OMRE in 1962. The project was canceled prior to completion, and the area has since been used for materials storage, security force practice, and explosives testing. The facility was decontaminated and dismantled in 1979. The OMRE was designed to develop power from an organic coolant reactor. It consisted of a reactor control building, reactor, heat exchangers, septic system, leach pond, and water tank. The building and underground reactor were disassembled; the radiologically contaminated material was disposed at the RWMC, and the uncontaminated parts were sold as scrap. The leach pond was backfilled with soil, and the entire area was revegetated with a mixture of native grasses in 1981.

4. ENVIRONMENTAL SURVEILLANCE PROGRAMS

The Environmental Surveillance Program (ESP) conducts mostly radiological sampling of air, water, soil, biota, and direct radiation. The ESP consists of the Radiological Environmental Surveillance Program (RESP) and the Site Environmental Surveillance Program (SESP).

The RESP began in 1976 and is conducted in order to meet DOE Order 5820.2A, "Radioactive Waste Management."[9] The RESP provides routine surveillance data for selected LMITCO waste management facilities.

During the fall of 1993, the Radiological and Environmental Sciences Laboratory (RESL) was defederalized and divided into on-Site and off-Site surveillance. The on-Site monitoring of air, soils, and direct radiation is currently conducted by the SESP. The off-Site monitoring is conducted by the ESRF. The SESP, along with the off-Site surveillance, makes up the overall INEEL environmental surveillance program that is required by DOE Orders 5400.1 and 5400.5. The SESP data are provided to the ESRF for incorporation into the Annual Site Environmental Report.[3]

The *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance*[10] lists the criteria for establishing environmental surveillance programs. Both the RESP and SESP activities are structured in accordance with the regulatory guide to support the DOE-ID in maintaining an integrated INEEL environmental surveillance program.

4.1 Radiological Environmental Surveillance Program

The RESP activities are designed to maintain an integrated INEEL environmental monitoring program for DOE-ID. The particular requirements for radiological environmental surveillance at DOE waste management facilities are contained in DOE Orders 5400.1 and 5820.2A. As specified in DOE Order 5400.1, Chapter IV, Section 5, environmental surveillance programs and their components are "determined on a site-specific basis by the field organization." Consequently, the LMITCO Environmental Monitoring Program mission does not include all aspects of environmental surveillance, but only those components that have been assigned to LMITCO by DOE-ID. Responsibilities for each component of environmental monitoring are included in the *Idaho National Engineering Laboratory Environmental Monitoring Plan.*[21] In addition, the RESP complies with the recommendations in the *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance,*[10] when applicable.

4.1.1 Program Design Basis

The general basis for the current program design includes regulatory requirements and guidance for radiological environmental surveillance, historical commitments, and special requests from DOE-ID or LMITCO organizations.

The RESP provides surveillance data for selected INEEL waste management facilities: MWSF, OMRE area, RWMC (SDA and SWEPP), SL-1 surplus area, TAN, and WERF. The RESP activities include ambient air monitoring, biotic surveillance, direct radiation monitoring, surface radiation monitoring, surface water runoff sampling, and surface soil sampling. These programs are summarized in Table 4-1.

Table 4-1. Radiological Environmental Surveillance Program activities performed at waste management facilities.

Facility	Media	Description	Frequency of Analyses	Type of Analyses
RWMC				
SDA	Air			
	• PM_{10}	8 air monitor operated at 0.11 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 0.14 m^3/min	Semimonthly Semimonthly Monthly Quarterly	Gross alpha Gross beta Gamma spectrometry Radiochemistry[a]
	Surface Water	One 4-L sample from SDA 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 packets and 7 background communities (SESP/ESRF)	Semiannually	External radiation levels
	Soil	5 surface locations in each of 5 major areas (plus 1 control area)	Triennially	Gamma spectrometry Radiochemistry[a]
	Vegetation	3 composites in each of 5 major areas (plus 1 control area)[c]	Annually, species sampled varies each year as determined by availability	Gamma spectrometry Radiochemistry[a]
	Visual Inspection	Tour SDA and TSA	Monthly	Results reported for any required corrective action

Table 4-1. (continued).

Facility	Media	Description	Frequency of Analyses	Type of Analyses
SWEPP	Air			
	• PM_{10}	7 air monitors operated at 0.11 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 0.14 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 2 control areas)	Triennially	Gamma spectrometry Radiochemistry[a]
WERF	Air			
	• PM_{10}	4 air monitors operated at 0.11 m^3/min (includes 1 control)	Semimonthly Semimonthly Monthly	Gross alpha Gross beta Gamma spectrometry
	• Suspended Particulate	1 air monitor operated at 0.14 m^3/min	Semimonthly Semimonthly Monthly	Gross alpha Gross beta Gamma spectrometry
	• Ionizing radiation	11 TLD packets and 7 background communities (SESP/ESRF)	Semiannually	External radiation levels
	Soil			
	• Surface Soils	15 surface locations	Triennially[e]	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	15 locations (includes 3 controls)	Triennially	Gamma spectrometry

Table 4-1. (continued).

Facility	Media	Description	Frequency of Analyses	Type of Analyses
MWSF	Air			
	• PM_{10}	1 air monitor operated at 0.11 m^3/min	Semimonthly Semimonthly Monthly	Gross alpha Gross beta Gamma spectrometry
TAN	Air			
	• Suspended Particulate	5 air monitors operated at 0.14 m^3/min	Semimonthly Semimonthly Monthly Quarterly	Gross alpha Gross beta Gamma spectrometry Radiochemistry
SL-1	No monitoring during 1997			
OMRE	Direct Radiation			
	• Surface gamma activity	GPRS detector system	Annually	External radiation levels

a. Analysis for Am-241, Pu-238, Pu-239/240, U-234, U-235, U-238, and Sr-90.

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

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

d. Global positioning radiometric scanner.

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

The results reported by the surveillance activities of the program are primarily estimates of radioactivity concentrations in environmental media. These are typically based on two types of measurements: (a) laboratory analyses of the amount of radioactivity in a sample and (b) the volume or mass of environmental medium represented by the sample. Estimates of radioactivity concentrations are used by this program for two general purposes: (a) analysis of trends compared to past conditions and background levels and (b) comparison to appropriate alert levels.

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

4.1.2 Ambient Air

Air is a critical pathway of contaminant migration through the environment at the INEEL. Fugitive dusts may contain small amounts of sorbed, man-made radionuclides in addition to naturally occurring radionuclides. The general approach to monitoring an area source is to monitor the facility perimeter.

Ambient air was sampled for radioactive particulates during 1997 at the TAN (Figures A-5 and A-13), RWMC (SDA and SWEPP) (Figure A-12), WERF (Figure A-16), and MWSF (Figure A-5). In addition to general RESP objectives, the specific objectives of the ambient air sampling were as follows: (a) determine concentrations of airborne radionuclides in the vicinity of the waste management facilities, (b) report comparisons of measured concentrations to reference levels based on derived concentration guides (DCGs) for the public given in DOE Order 5400.5, (c) detect and report significant trends in measured concentrations of airborne radionuclides, (d) provide an indication of waste confinement integrity, and (e) provide data for pathways analyses on concentrations of airborne radionuclides.

Particulate material is collected on a membrane filter using two types of air monitors: PM_{10} air monitors and suspended particulate (SP) air monitors. While the RESP PM_{10} monitors are designed to only admit particles less than 10 microns in diameter; the SP air monitors admit larger particles. The PM_{10} monitors sample particulates considered to be the respirable fraction, which is also the range of particle sizes that can be transported to the off-Site locations by wind. Measuring the respirable fraction provides data that meet the general RESP objective to provide data that may be used for dose calculations. SP monitors are strategically located with PM_{10} monitors where additional coverage can help characterize conditions at these locations.

Air 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 radionuclides. Filters from the RWMC are also composited quarterly by location and are analyzed for specific alpha- and beta-emitting radionuclides. The approach used for data analysis is presented in Appendix B.

Results of gross-beta analysis of the air filters are evaluated to determine if there are any significant increases in the sample radioactivity that may require more immediate or more in-depth analysis by gamma spectrometry or radiochemistry. Gross-beta analysis is thus used as a quick screening tool. Gross-beta results are evaluated semimonthly by comparing these results with historical and background data to identify trends using a log concentration-versus-time plot. RESP compares each plot against control concentrations, detection limits (Appendix C), and alert levels. Alert levels are 25% of the most restrictive DCGs for the public. Comparisons are made between stations and control monitors using statistical analysis methods (Appendix B). The RESP also compares gross-beta activity to the DCG for Sr-90, which is the most restrictive DCG for waste-related, beta-emitting radionuclides detected at the RWMC (Appendix D).

Replicate PM_{10} samples are collected at the RWMC (locations 4.2 and 4.3, Figure A-12) as part of the RESP QA/QC Program. Control sample locations 15 (SP) and 15.3 (PM_{10}) for the RWMC are at the EBR-I area, approximately 3 km (1.9 mi) east-northeast of the RWMC (Figure A-6). The WERF control sample, location 603.3, serves both MWSF and WERF, and is located next to the INEEL Main Gate Building 603 (Figure A-10).

4.1.2.1 Data Summary and Assessment. Ambient air results are evaluated to determine if radionuclide concentrations exceed alert levels and to detect significant increases that might indicate confinement failure. Summarized 1996 and 1997 gross-alpha and gross-beta data are presented by facility and monitor type in Figures 4-1 and 4-2 to provide an indication of short-term changes in levels. Corresponding summary statistics (e.g., means, medians, maximum, and minimum values) for all 1996 and 1997 data are given in Tables 4-2 and 4-3.

As with the 1996 analysis of gross-alpha values, very little variability was seen among facilities during 1997 (Figure 4-1). Slight decreases in median values from 1996 to 1997 were seen among facilities for both PM_{10} and SP monitors, except for SWEPP and TAN/SMC, where no changes in median values were measured.

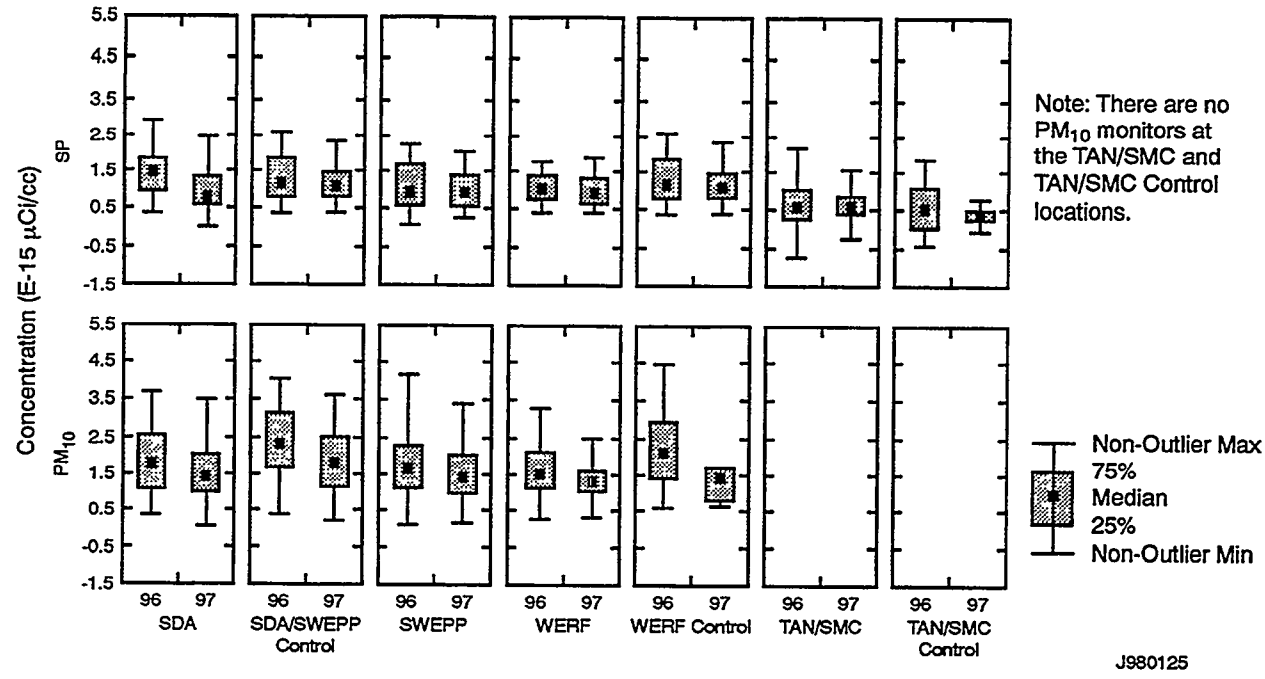


Figure 4-1. 1996 and 1997 box and whisker plots of the gross-alpha concentrations by facility (J980125).

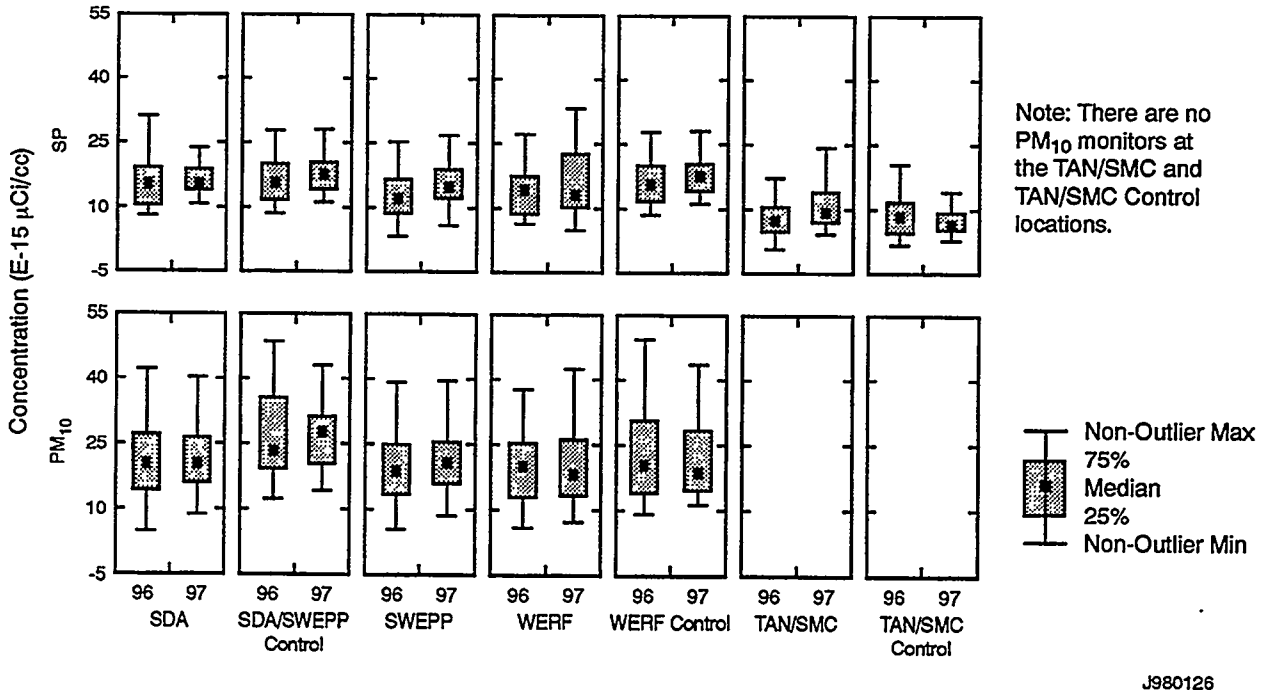


Figure 4-2. 1996 and 1997 box and whisker plots of the gross-beta concentrations by facility (J980126).

Table 4-2. Summary statistics for gross-alpha concentrations.

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	96	24	1.5	1.5	0.4	3.0
		97	21	1.0	0.8	1.0	2.5
	SWEPP	96	46	1.2	1.0	0.1	3.4
		97	48	1.1	1.0	0.3	2.8
	SDA/SWEPP/ WERF Control	96	23	1.3	1.2	0.4	2.6
		97	23	1.3	1.1	0.4	3.3
	WERF	96	24	1.2	1.1	0.4	4.0
		97	24	1.1	1.0	0.4	3.0
	TAN/SMC	96	93	0.7	0.6	-0.7	3.9
		97	93	0.8	0.7	-0.2	2.6
	TAN/SMC Control	96	22	0.7	0.6	-0.4	1.9
		97	24	0.4	0.4	0.0	1.4
PM_{10}	SDA	96	132	2.0	1.8	0.4	10.0
		97	137	1.7	1.4	0.1	5.1
	SWEPP	96	77	1.7	1.6	0.1	4.1
		97	134	1.6	1.4	0.1	5.5
	SDA/SWEPP Control	96	24	2.6	2.3	0.4	7.3
		97	23	1.8	1.8	0.2	3.6
	WERF	96	69	1.7	1.5	0.3	3.3
		97	69	1.4	1.3	-0.1	3.3
	WERF Control	96	23	2.2	2.1	0.6	4.4
		97	20	1.4	1.4	0.6	3.4

Table 4-3. Summary statistics for gross-beta concentrations.

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	96	24	16.1	15.3	7.9	30.8
		97	21	16.5	14.8	10.4	27.1
	SWEPP	96	46	12.9	11.6	3.2	28.1
		97	48	15.9	14.3	5.5	32.4
	SDA/SWEPP/ WERF Control	96	23	16.8	15.3	8.4	34.9
		97	23	18.2	17.3	11.1	32.4
	WERF	96	24	14.5	13.9	6.1	30.0
		97	24	15.6	13.0	4.5	33.0
	TAN/SMC	96	93	7.9	6.7	-0.2	35.0
		97	93	10.4	8.9	3.7	27.9
	TAN/SMC Control	96	22	8.3	8.0	1.2	20.0
		97	24	7.0	1.2	2.3	14.0
PM_{10}	SDA	96	132	22.1	20.5	4.9	69.0
		97	137	22.1	20.3	9.0	48.9
	SWEPP	96	77	20.5	19.8	5.6	47.1
		97	134	22.2	20.8	8.8	51.7
	SDA/SWEPP Control	96	24	27.5	24.1	12.4	73.0
		97	23	27.2	26.0	14.0	49.0
	WERF	96	69	20.3	19.4	6.2	45.0
		97	69	20.8	18.9	7.9	48.7
	WERF Control	96	23	25.1	20.0	9.4	74.0
		97	20	22.1	18.9	11.2	44.7

The median gross-beta values increased for both PM_{10} and SP monitors between 1996 to 1997 at the SWEPP and the SWEPP control location. An increase was also seen at the TAN/SMC. Decreases were seen at all other locations for both monitor types (Figure 4-2). Quarterly averages of RWMC and WERF gross-beta activity (Cs-137 equivalent) since 1987 are shown in Figures 4-3 and 4-4, respectively.

No man-made, gamma-emitting radionuclides attributable to waste management facility operations were detected at any of the monitoring locations during 1997. Table 4-4 lists the specific alpha-emitting radionuclides detected at the RWMC and SMC during 1997. Am-241 and Sr-90 were the only two alpha- and beta-emitting radionuclides detected during 1997. Sr-90 was detected at the RWMC in all four quarters of 1997. The maximum concentration of Sr-90 was detected in composite air samples from RWMC location 19.3 (Figure A-12) during the first quarter. This concentration was 2.51 ± 1.67 E-16 μCi/cc and represents 0.003% of the DCG for airborne releases of Sr-90 to the public. The only Am-241 detection was in a second quarter composite air sample collected from RWMC location 24.3. This concentration was 1.04 ± 0.62 E-17 μCi/cc and is 0.05% of the DCG. These concentrations are comparable to historical concentrations detected previously at the INEEL.

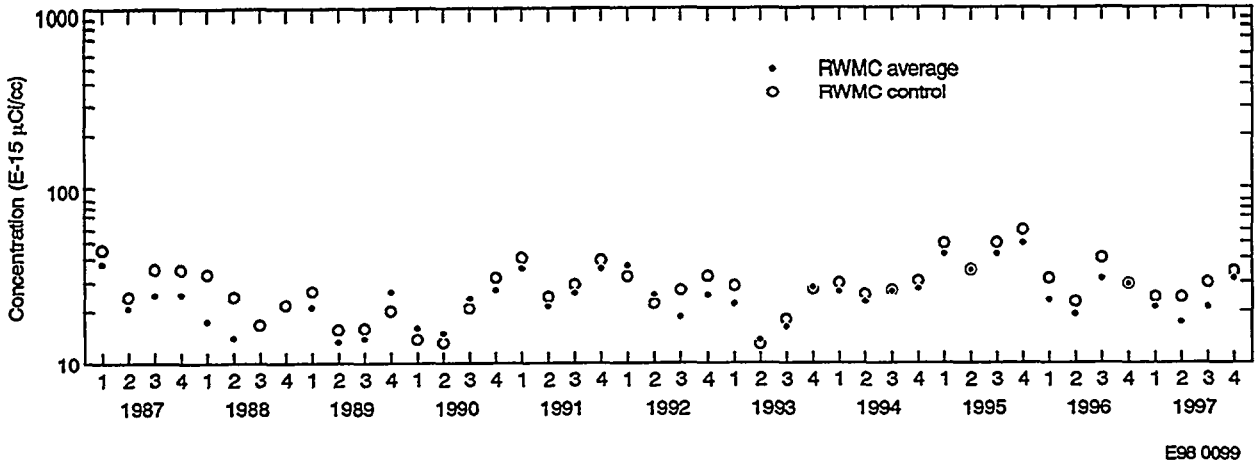


Figure 4-3. Quarterly average of gross-beta air concentrations (Cs-137 equivalent) measured at RWMC for the past 10 years (E980099).

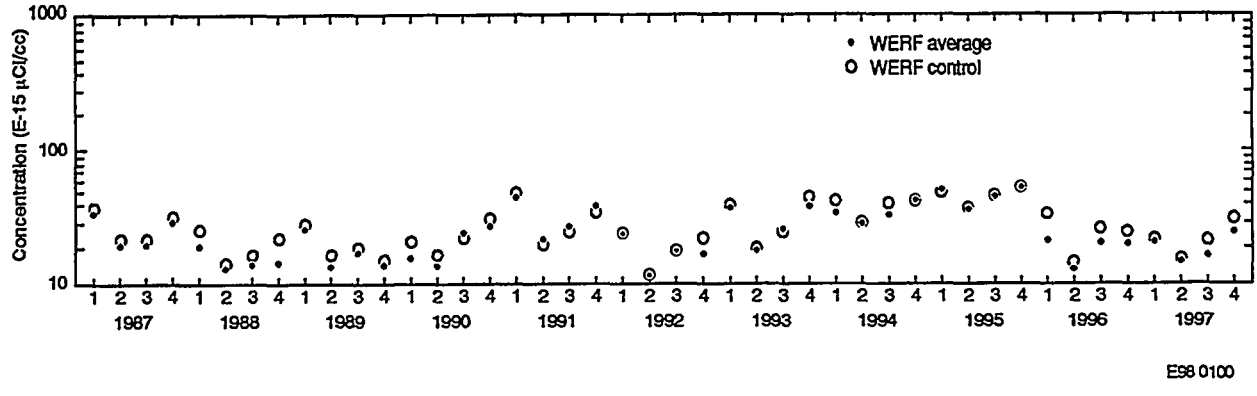


Figure 4-4. Quarterly average of gross-beta air concentrations (Cs-137 equivalent) measured at WERF for the past 10 years (E980100).

Table 4-4. Summary of radionuclides detected by radiochemistry during 1997.

Facility	Location	Radionuclide	Quarter	Concentration[a] (E-15 μCi/cc)	% of DCG[b]
RWMC	20.0	Sr-90	First	0.229 ± 0.197	0.003
RWMC	19.3	Sr-90	First	0.251 ± 0.167	0.003
RWMC	6.3	Sr-90	Second	0.027 ± 0.026	0.0003
RWMC	22.3	Sr-90	Second	0.044 ± 0.036	0.0005
SMC	104.0	Sr-90	Second	0.023 ± 0.022	0.0003
RWMC	24.3	Am-241	Second	0.0104 ± 0.006	0.05
RWMC	20.0	Sr-90	Third	0.0181 ± 0.018	0.0002
RWMC	4.3	Sr-90	Fourth	0.109 ± 0.056	0.001
RWMC	15.3	Sr-90	Fourth	0.106 ± 0.048	0.001

a. Uncertainties shown are the associated 2 sigma.

b. In accordance with DOE Order 5400.5, the DCGs for Am-241 and Sr-90 are 20 E-15 μCi/cc and 9,000 E-15 μCi/cc, respectively.

Yields for actinide radiochemical analyses of second quarter RESP air filters were very low for plutonium isotopes (generally much less than 5%) and uranium isotopes (generally less than 20%). The data for plutonium and uranium isotopes are considered to be biased low. Although there were no 2 sigma positive detections in this quarter, the low bias may have impaired the ability to detect these radionuclides at or near background concentrations. The Am-241 and Sr-90 yields were acceptable.

4.1.3 Biotic Surveillance

Biotic surveillance is conducted at the RWMC and WERF. Plant uptake of radionuclides at the RWMC has been documented by RESL.[22]

In addition to the general RESP objectives, the specific objectives of the routine biotic surveillance are to (a) determine if biota are transporting radionuclides from buried waste or contaminated soil, (b) identify biotic conditions that may compromise waste confinement at waste storage and disposal facilities, and (c) detect and report significant trends in the radionuclide concentrations in biotic samples.

Crested wheatgrass is collected in odd-numbered years and is clipped at ground level within a 0.9 × 0.9-m (3 × 3-ft) frame. Russian thistle is collected in even-numbered years, and the entire plant is pulled up within a 0.9 × 0.9-m (3 × 3-ft) frame. Either rabbitbrush or sagebrush is collected in odd-numbered years by clipping 20% of the branches from the designated plants. Thus, the same plant can be sampled biennially.

Crested wheatgrass and rabbitbrush samples were collected in 1997 from the RWMC (Figures 4-5 and 4-6, respectively). Vegetation sample collection from WERF began in 1984 and is normally performed every three years; therefore, no samples were scheduled for collection from WERF during 1997.

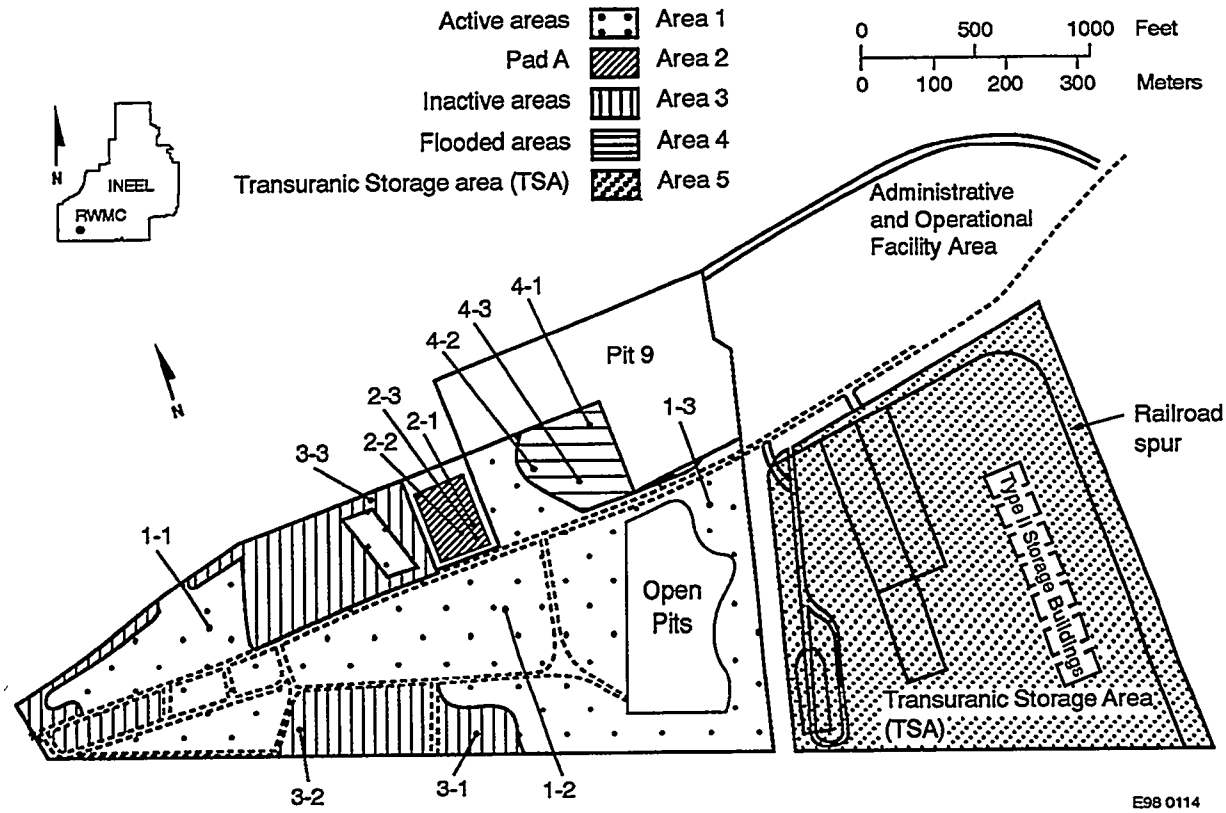


Figure 4-5. 1997 crested wheatgrass sampling locations (E980114).

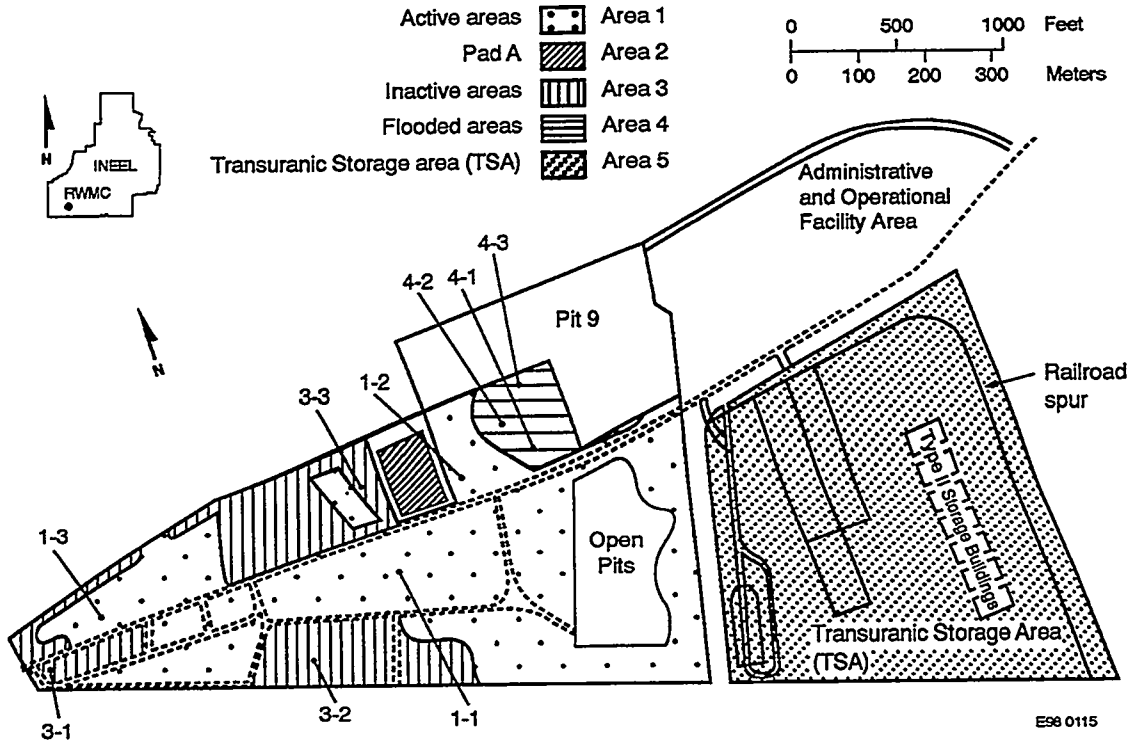


Figure 4-6. 1997 rabbitbrush sampling locations (E980115).

Control samples are collected from the Tractor Flats area and the East Butte, located adjacent to U.S. Highway 20, which is approximately 8 km (5 mi) east of the ANL-W entrance. The samples are dried, milled, and weighed before they are submitted to the Radiation Measurements Laboratory for gamma spectrometry analyses. Based on gamma analyses, selected samples are submitted to the Radiological Environmental Measurements System for specific alpha and beta analyses.

4.1.3.1 Data Summary and Assessment. Crested wheatgrass samples were collected from the RWMC, with the exception of the TSA (Area 5 on Figure 4-5), due to the operational activity in this area. No gamma-emitting radionuclides were detected in any of the crested wheatgrass samples.

Six selected crested wheatgrass samples were analyzed for specific alpha- and beta-emitting radionuclides. Am-241 was detected in one sample collected from the Inactive Area (Area 3 on Figure 4-5). This concentration was 1.04 ± 0.66 E-3 pCi/g and was within the range reported in historical concentrations at the RWMC.[22] Sr-90 was detected in two samples, one from previously flooded area (location 4-2) and the other from the inactive area (location 3-3), which had the maximum concentration of 5.39 ± 1.85 E-2 pCi/g. This concentration is also within the range of typical concentrations historically reported at the RWMC.

Rabbitbrush samples were also collected from the RWMC, Areas 1, 3, and 4 (Figure 4-6). Operational activities prevented sample collection in Area 5, and limited growth prevented sampling from Area 2. Cs-137 was detected from two different areas (Area 1 and Area 4) at the RWMC. The maximum was found in Area 1 (active area). This concentration was 2.2 ± 1.2 E–1 pCi/g. This is within the range of concentrations attributable to fallout and are comparable to historical concentrations for these areas.

Four selected rabbitbrush samples were analyzed for specific alpha- and beta-emitting radionuclides. Am-241 was detected in two samples. These samples were from the previously flooded area (location 4-2) and the active area (location 1-1) (Figure 4-6). These concentrations were 1.14 ± 0.20 E-1 pCi/g and 1.47 ± 0.90 E-3 pCi/g, respectively. Pu-239, -240 was only detected in one sample collected from the previously flood area (location 4-2). This concentration was 2.14 ± 1.22 E-3 pCi/g. Am-241 and Pu-239, -240 concentrations detected in vegetation at these levels can be attributed to past flooding conditions at the RWMC. Sr-90 was detected in RWMC samples from the active area (location 1-1), which had the maximum concentration of 2.01 ± 0.12 E-0 pCi/g. This concentration is consistent with historical concentrations in vegetation samples and is likely attributable to fallout.

4.1.4 Direct Radiation

The specific objectives of the direct radiation monitoring activities are to (a) demonstrate compliance with the limit for direct penetrating radiation, (b) characterize direct radiation levels at specific points of interest at INEEL waste management facilities, and (c) detect and report significant trends in measured levels of penetrating radiation.

Thermoluminescent dosimeters (TLDs) are used to measure cumulative exposures to ambient ionizing radiation at the RWMC and WERF. The TLDs are used to detect changes in ambient exposures attributed to handling, processing, or disposing radioactive waste. TLDs are sensitive to beta energies greater than 200 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 1997 were from November 1996 to May 1997 (Spring) and from May to November 1997 (Fall). Figure A-12 shows the 31 TLD sampling locations and identification numbers on and around the RWMC, TSA, SWEPP, and SDA areas. The WERF TLD locations are shown on Figure A-16.

Background exposures result from direct radiation from natural terrestrial sources (rocks and soil), cosmic radiation, fallout from testing nuclear weapons, and local industrial processes. The background exposures used in this report are exposure averages measured by TLDs in distant communities located outside the INEEL boundary.

4.1.4.1 Data Summary and Assessment. A statistical summary of the 1996 and 1997 TLD 6-month exposures can be found in Table 4-5. During 1997, the maximum concentration was measured at the SDA during the fall reporting period.

Cumulative 6-month exposure data for 1987 through 1997 from the SDA, TSA, and WERF are presented in Figure 4-7. (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 polynomial smoothing. The data are plotted on a logarithmic scale to give a clearer picture of the trends. Although some values have cycled, the general trend in the graph indicates a gradual decline in TLD exposures over time.

Long-term decreases can generally be attributed to the following: (a) changes in operational activities, (b) placement of additional soil over pits and trenches, and (c) radioactive decay of the radionuclides in waste already buried. Many exposures have decreased to near background exposures and tend to vary directly with background exposures.

Figures 4-8 through 4-10 show the six-month exposures measured by individual TLDs, which have recorded increased exposures in recent years. Those areas that had low exposure levels or levels that were consistently near the background are not plotted. Average distant community background exposures are shown on each graph for comparison.

Figure 4-8 shows the exposure levels for stations 23A and 25A on the south border of the SDA. The maximum exposure level measured during 1996 was at Station 23A, and this exposure level returned to historical levels during 1997.

Exposures measured at Stations 40 and 41 (located along the east and northeast borders of the TSA) are shown in Figure 4-9. The maximum exposure level measured during 1997 was at Station 41. These exposures increased significantly due to waste being moved from the TSA-Retrieval Enclosure to the Type II storage buildings. The exposures in this area are likely to continue to increase as the amount of waste in these buildings increases.

The six-month exposures for the TLD station (located along the northwest of the 50-m perimeter of WERF) at WERF that has changed significantly in the past is shown in Figure 4-10. All other areas at WERF were consistently at or near background levels and were not plotted.

Station 8 is located near an area where waste is stored prior to processing. Waste stored adjacent to Station 8 was removed during the second half of 1996, and the exposure levels dropped in 1997, but still remained slightly higher than the others at WERF.

4.1.5 Surface Radiation

The specific objectives of surface radiation monitoring are to (a) identify areas of surface contamination at the INEEL, (b) characterize direct radiation levels at specific points of interest at INEEL waste management facilities, and (c) detect and report significant trends in measured levels of direct radiation.

Table 4-5. Summary statistics for direct radiation measured over 6-month periods in 1996 and 1997.

Facility	Season	Number of Samples	Mean (mR)	Median (mR)	Minimum (mR)	Maximum (mR)
			1996			
SDA	Spring	17	95	78	63	152
	Fall	19	104	89	72	232
TSA	Spring	11	80	78	57	145
	Fall	12	90	81	74	157
WERF	Spring	11	70	65	57	106
	Fall	11	89	83	70	153
Distant Communities	Spring	6	59	57	51	73
	Fall	7	68	68	64	71
			1997			
SDA	Spring	19	78	74	61	106
	Fall	19	81	75	63	147
TSA	Spring	11	75	66	59	135
	Fall	12	75	68	61	140
WERF	Spring	11	75	70	65	110
	Fall	11	73	69	64	103
Distant Communities	Spring	7	63	58	57	75
	Fall	7	60	61	56	65

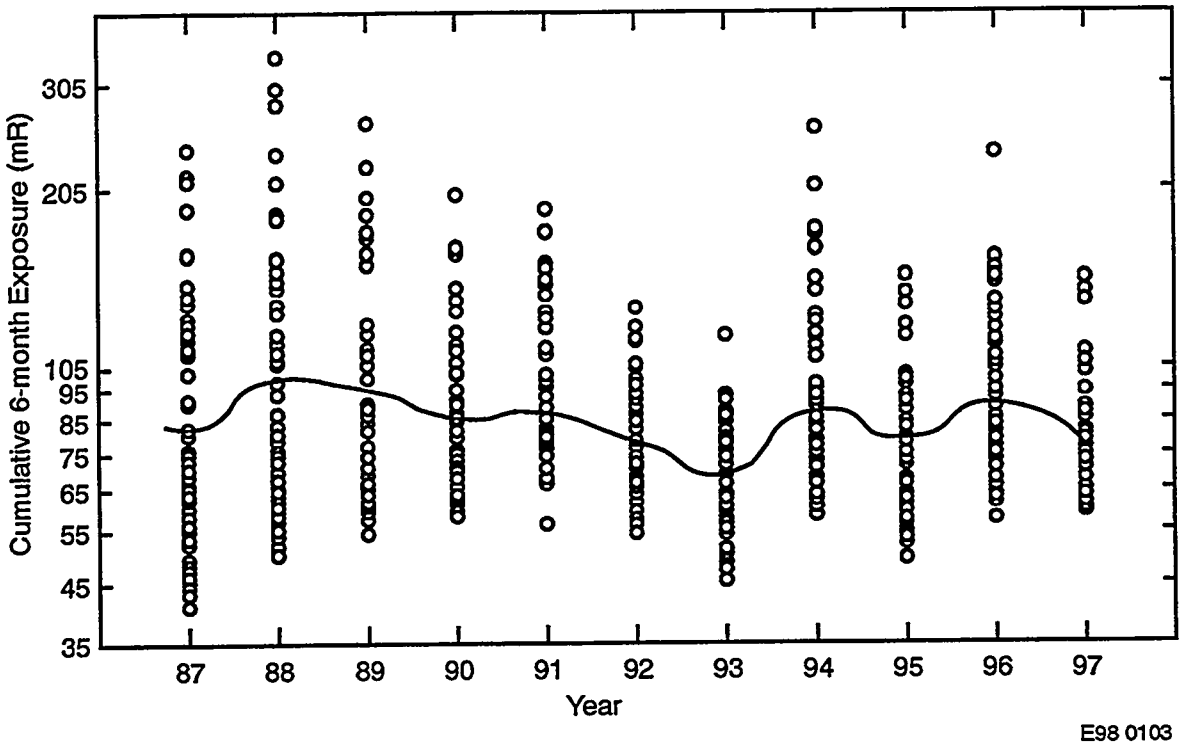


Figure 4-7. 1987–1997 TLD exposures using second order polynomial smoothing (E980103).

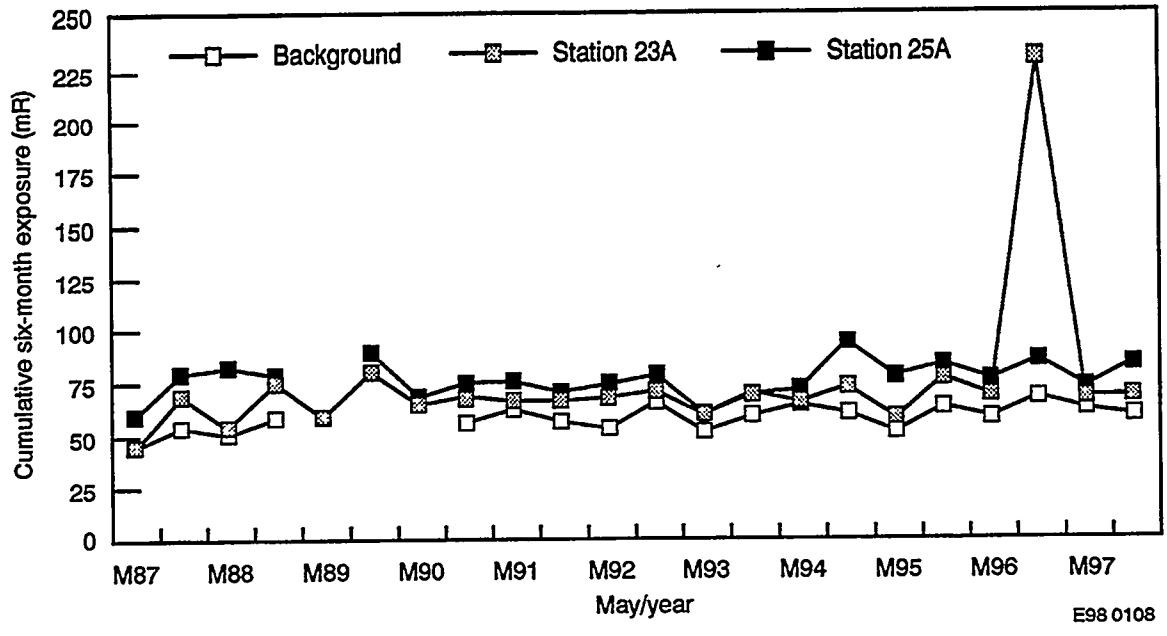


Figure 4-8. Six-month exposures measured by TLDs on the south border of the SDA (E980108).

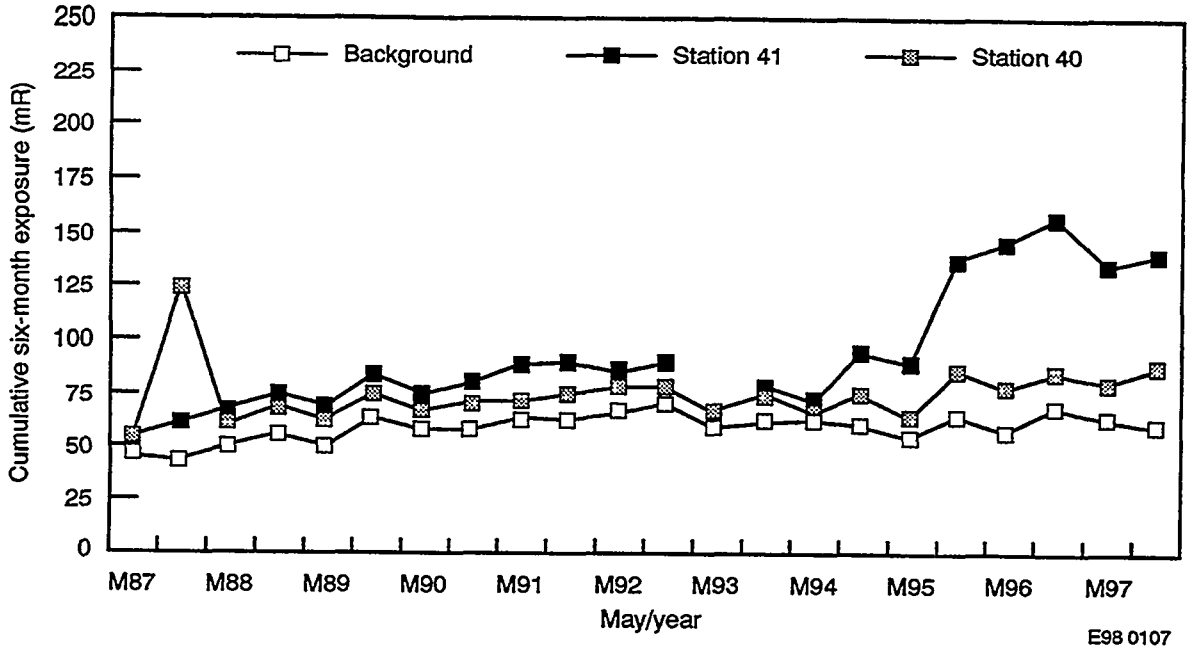


Figure 4-9. Six-month exposures measured by TLDs on the east and northeast borders of TSA (E980107).

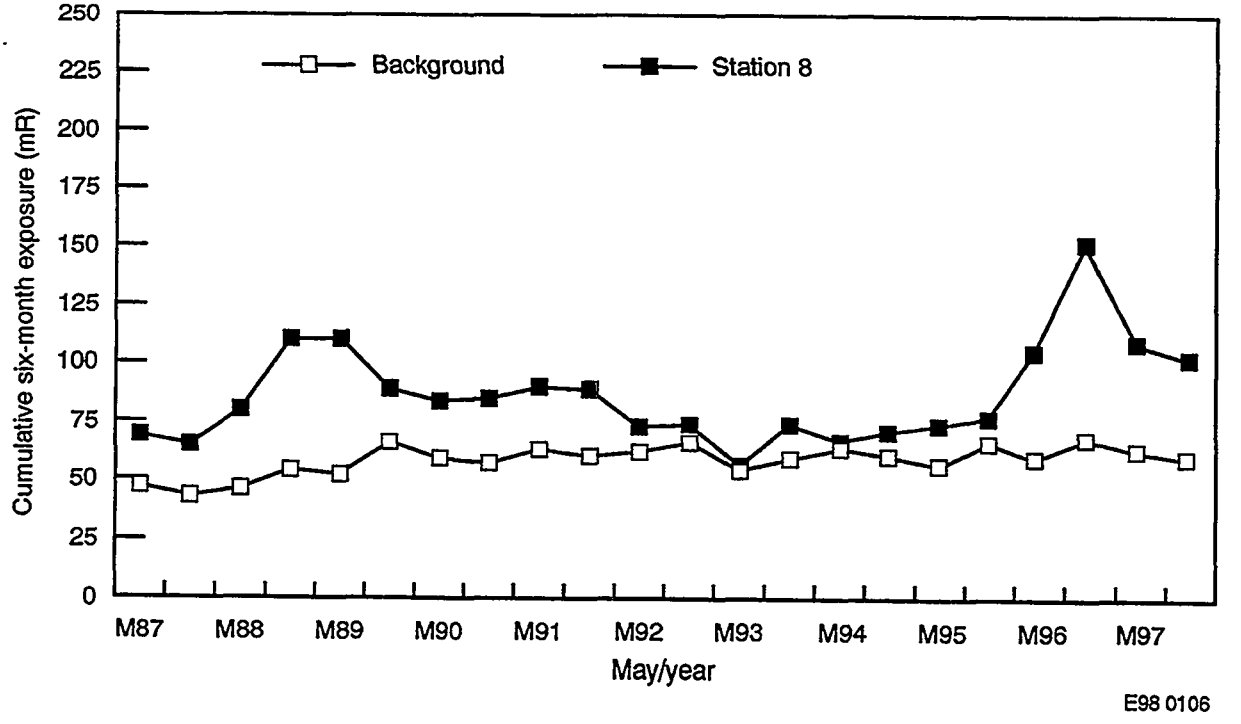


Figure 4-10. Six-month exposures measured by TLDs northwest of the 50-m perimeter around WERF (E980106).

These surveys are useful in detecting soils that have become contaminated with gamma-emitting nuclides. Areas that exceed an internal limit of 1 mR/h at 0.91 m (3 ft) are covered with additional soil by the appropriate facility personnel. This 1 mR/h criteria ensures that personnel are not subjected to significant radiation exposure.

The ESP uses a global positioning radiometric scanner (GPRS) system to collect gamma-radiation surveys. The GPRS is mounted on a four-wheel drive vehicle (Figure 4-11); two plastic scintillation detectors identify contaminated areas, and a computer records the data. The vehicle is driven at a speed of approximately 5 mph to collect the data.

During 1997, surface radiation surveys were conducted at RWMC and OMRE. RWMC is surveyed semiannually usually in the spring and fall, and OMRE is surveyed annually.

4.1.5.1 Data Summary and Assessment. The maximum activity of 0.13 mR/h at 0.9m (3 ft) at OMRE was lower than radiation levels found during previous area surveys, and no new areas were identified with activity above background. These measurements were close to background levels and comparable to historical values.

The radiation readings of the 1997 spring and fall surveys at the RWMC are shown in Figures 4-12 and 4-13, respectively. The maximum activity for the RWMC spring survey was 0.25 mR/h at 0.9 m (3 ft), which was along Soil Vault Row 7. The maximum activity for the fall survey was 0.40 mR/h at 0.9 m (3 ft) and was at the same location as the maximum activity identified in the spring survey along the Soil Vault Row 7. As expected, activity levels increased during the fall survey due to a decrease in shielding from reduced soil moisture.

Figure 4-11. Global positioning radiometric scanner system (CD971365).

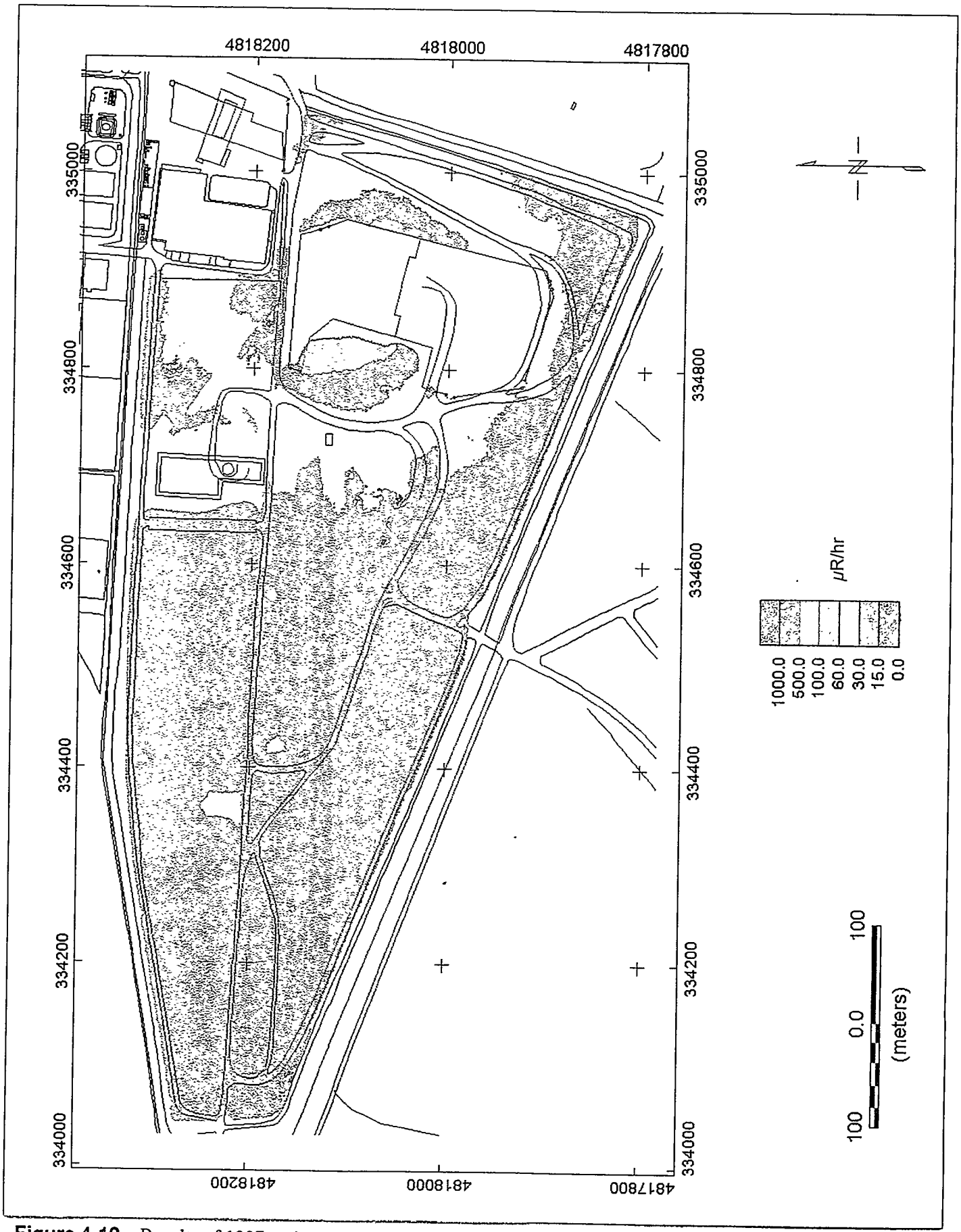


Figure 4-12. Results of 1997 spring RWMC surface radiation surveys.

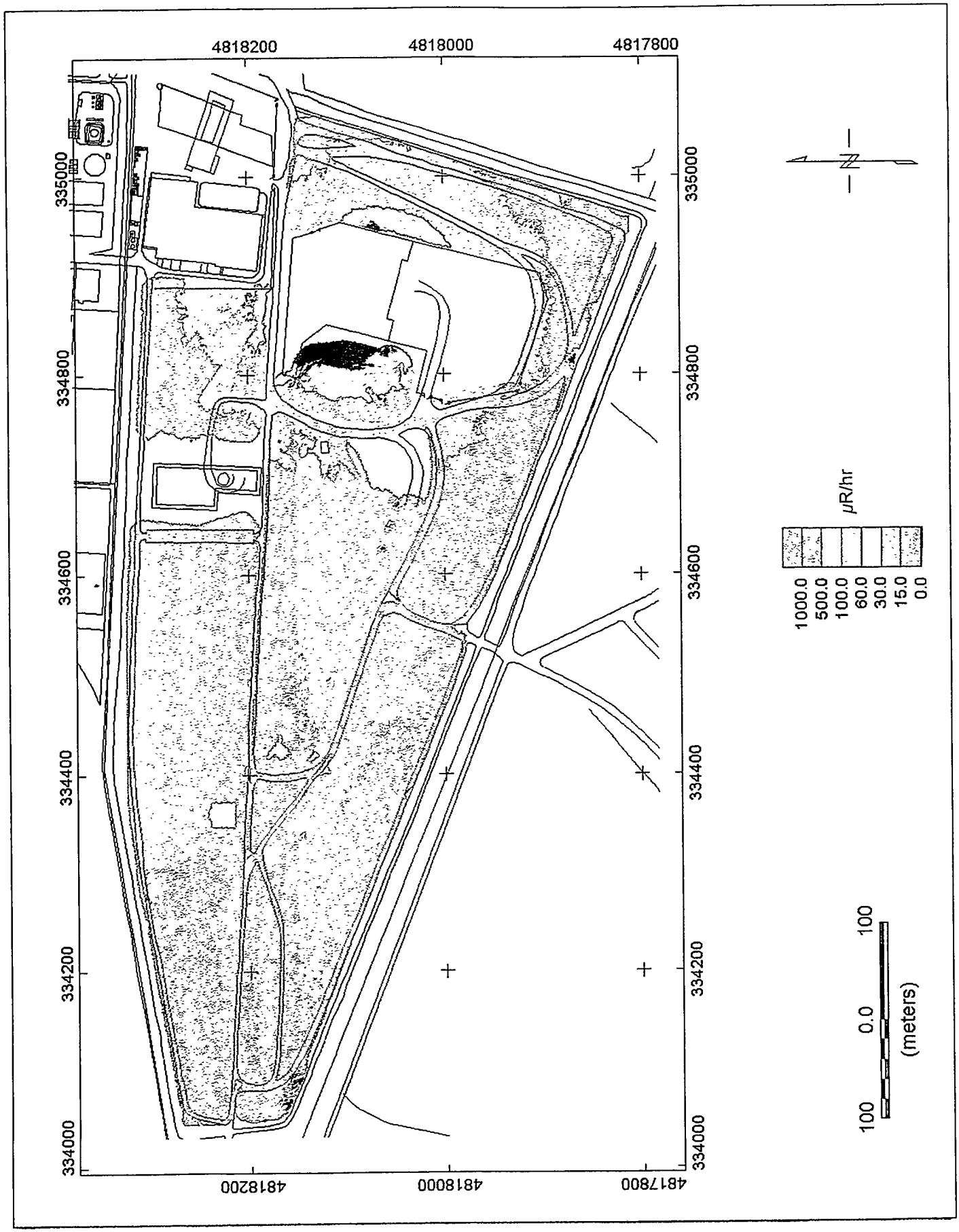


Figure 4-13. Results of 1997 fall RWMC surface radiation surveys.

Pad A cannot be surveyed using the GPRS vehicle due to facility driving restrictions. Therefore, no GPRS data for Pad A are plotted in either figure. Pad A was traversed with a hand-held HHD-440, which does not have global positioning capability. No area was noted above background levels at Pad A during either survey.

No new areas were identified during either the spring or fall survey. Activities detected were lower than historical values for the previously identified locations.

4.1.6 Surface Water Runoff

The specific objectives of the surface water sampling activities are to (a) determine concentrations of radionuclides in any surface water leaving INEEL waste management facilities, (b) report comparisons of measured concentrations against reference levels based on DCGs for the public given in DOE Order 5400.5, and (c) detect and report significant trends in measured concentrations of radionuclides in surface waters leaving INEEL waste management facilities.

Surface water runoff is collected to determine if radionuclide concentrations exceed alert levels or if concentrations have increased significantly at RWMC and WERF.

Radionuclides could be transported outside the boundaries of the RWMC via surface water runoff. Surface water runoff occurs at the SDA only during periods of rapid snow melt or heavy precipitation. At these times, water may be pumped out of the SDA into a drainage canal. Water also runs off the asphalt pads around TSA 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, enhancing subsurface migration.

Beginning in 1994, quarterly surface water runoff samples were collected at the WERF seepage basins (Figure 4-14) 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 TSA and WERF samples is on the west side of the rest rooms at the Lost River Rest Area, and the control location for SDA 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 T-12 access road.

4.1.6.1 Data Summary and Assessment. Surface water runoff samples were collected during the second and third quarters of 1997 at the RWMC. Cs-137 was the only man-made, gamma-emitting radionuclide detected in RWMC samples and was collected from TSA-2 (Figure A-12) in the second quarter. The maximum concentration was 3.1 ± 1.8 E-9 μCi/mL. Cs-137 is commonly detected in environmental samples collected at the RWMC and is usually at or near background levels. This concentration represents 0.10% of the DCG for Cs-137 releases to the public. Third quarter water samples were radiochemically analyzed and no specific alpha and beta radionuclides were detected in any of these samples.

Samples were also collected from the WERF seepage basins during the second and third quarters in 1997. Cs-137 was detected in samples collected from two of three locations at WERF. The maximum concentration was 9.9 ± 2.2 E-9 μCi/mL and was collected at the west basin and represents 0.33% of the DCG. These concentrations are comparable to historical values and other monitoring results from water samples collected at the INEEL.

Co-60 was detected in the particulate fraction from the sample collected from the west seepage basin. This concentration was 3.01 ± 1.52 E-9 μCi/mL and represents 0.06% of the DCG during 1997. Co-60 was detected during the original seepage basin soil characterization. This concentration is consistent with the characterization data.

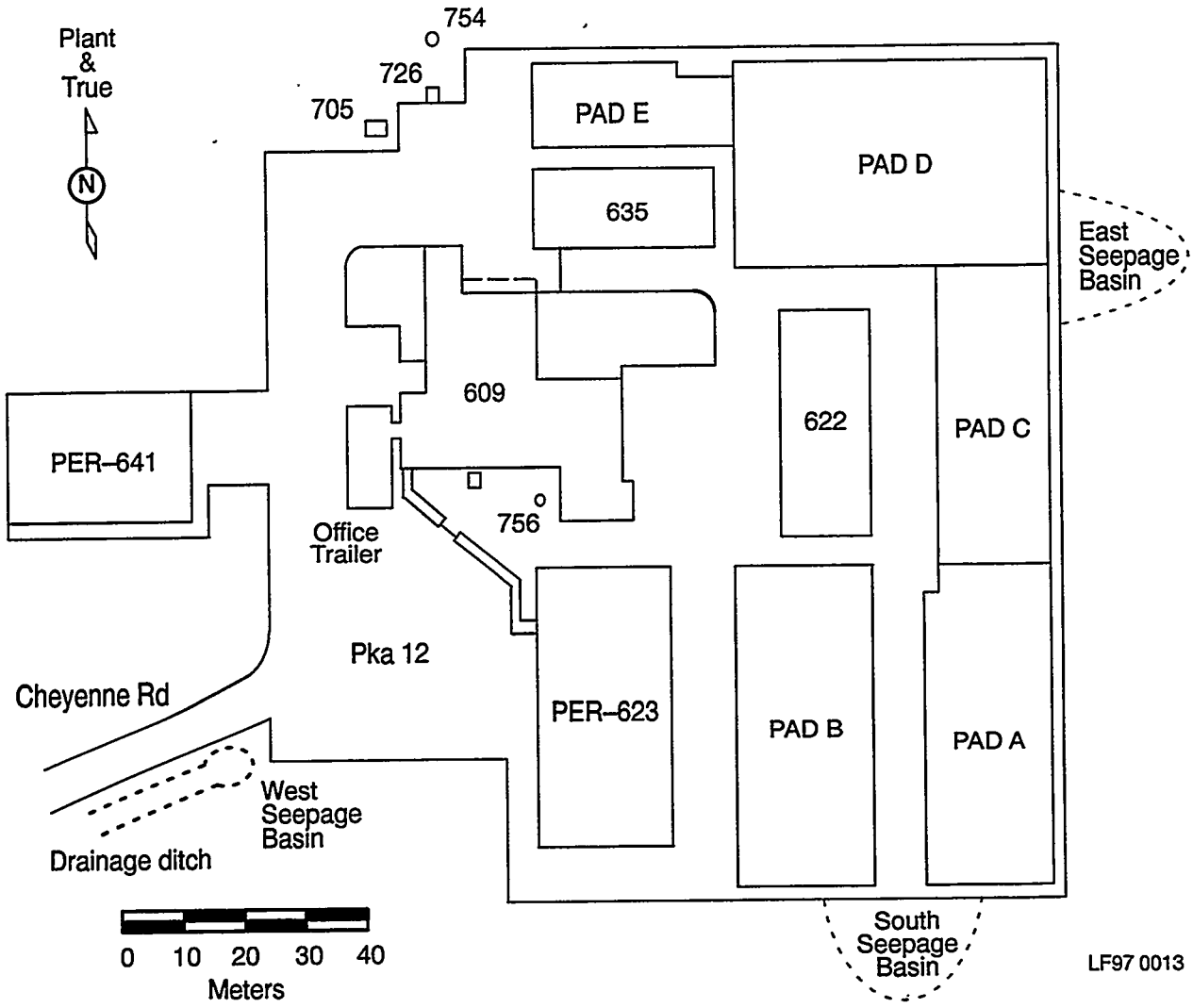


Figure 4-14. WERF surface water runoff and soil sampling locations (LF970013).

4.1.7 Surface Soils

The specific objectives of the surface soil sampling activities are to determine concentrations of radionuclides in soils within the vicinity of INEEL waste management facilities and to detect and report significant trends in measured concentrations of radionuclides in soils. Surface soil sampling activities are conducted at RWMC (SDA), SWEPP, and WERF.

Surface soil samples are collected to determine if radionuclide concentrations exceed alert levels or if an order of magnitude increase in concentrations has occurred, which might indicate confinement failure. These alert levels are not compliance requirements but are used as indicators of potential migration of radionuclides or loss of confinement integrity.

Surface and near-surface soils at the RWMC have become contaminated as a result of the past flooding of open pits, waste handling, and intruding biota. Of particular concern is the presence of Pu-239, -240 and Am-241 deposited in surface soils inside and outside of the northeast corner of the SDA during flooding events.[23]

At each sampling location, a soil sample is collected at each of the four corners of a 10 × 10-m (approximately 11 × 11-yd) square and at the center of the square. A stainless-steel sampling ring and scoop are used to collect a 12-cm (4.7-in.) diameter × 5-cm (2-in.) deep sample from these soils. The samples are combined to form a single composite sample. The composite samples are then dried, weighed, homogenized (ball-milled), screened through a number 35 sieve, and then analyzed by gamma spectrometry, and selected samples are submitted for radiochemistry.

4.1.7.1 Data Summary and Assessment. During 1997, RESP collected 37 soil samples from RWMC. Only one gamma-emitting radionuclide, Cs-137, was detected in RWMC soil samples. The maximum concentration collected from the control locations was 8.2 ± 0.8 E-01 pCi/g [representing 14% of the environmental concentration guide (ECG), Table C-2], while the maximum concentration collected from within the RWMC was 6.0 ± 0.6 E-01 pCi/g (representing 10% of the ECG). These concentrations are comparable to historical concentrations and are within the range of concentrations attributable to fallout.

During 1997, WERF seepage basin soil samples were collected. Only one gamma-emitting radionuclide, Cs-137, was detected. The maximum concentration was 3.7 ± 0.6 E–01 pCi/g and represents 6.2% of the ECG. This concentration is comparable to previous samples collected at WERF. It is also within the range of concentration that is attributable to fallout.

4.1.8 Special Studies

The 1994 Monitoring Activities Review[24] (MAR) recommended that improved airborne tritium sampling methods be developed. At about the same time, the State of Idaho INEEL Oversight Program developing a tritium sampling procedure. A cooperative study was initiated with the State Oversight Program to develop methods for measuring airborne tritium. The objective was to ensure the accuracy and comparability of INEEL and Oversight data, and to establish common sampling and analysis procedures.

Each organization developed prototype equipment and procedures for sampling and collocated the equipment at SDA Soil Vault Row 20 (SVR20), where neutron-activated beryllium was buried in 1993. The beryllium contains about 300 kCi of tritium, which is slowly released by corrosion. Some of the released tritium migrates to the surface soil, where it is emitted to the atmosphere from a small area [about 4 m^2 (4.78 yd^2)] directly above the beryllium. This causes elevated concentrations of airborne tritium, providing a suitable situation for testing tritium sampling equipment under field conditions.

Samples were collected at SVR20 beginning in 1995, and results for sampling through 1997 are presented in Figure 4-15. The data show pronounced seasonal variations in the airborne concentration of tritium. The maximum concentration measured during 1997 was 8.6 ± 0.1 E-08 μCi/cc. The results were used to develop release and off-site dose estimates for INEEL NESHAP compliance, as reported in the NESHAP annual report.[6] Sampling for the special study will be continued as a regular part of the monitoring at SDA.

4.1.9 Quality Assurance/Quality Control

The LMITCO Analytical Laboratories analyze all of ESP samples as specified in the statements of work. These laboratories participate in several QA programs, which verify all the methods used to analyze environmental samples. These programs include the DOE Environmental Measurements Laboratory QA Program and the EPA Environmental Measurements Systems Laboratory QA Program. The results of QC sample analyses and laboratory performance in these programs during calendar year 1997 are available in the *INEEL Site Environmental Report for Calendar Year 1997*. With few exceptions, the laboratories met the performance objectives specified by the Environmental Measurements Laboratory and Environmental Measurements Systems Laboratory.

QA/QC samples were also submitted on a routine basis with program samples and demonstrated acceptable agreement ratio with spiked values for all radionuclides. As a result of the low yields in the RESP second quarter air filters and other previous laboratory performance concerns, ESP personnel worked with the laboratories to implement corrective actions. Laboratory performance continues to improve.

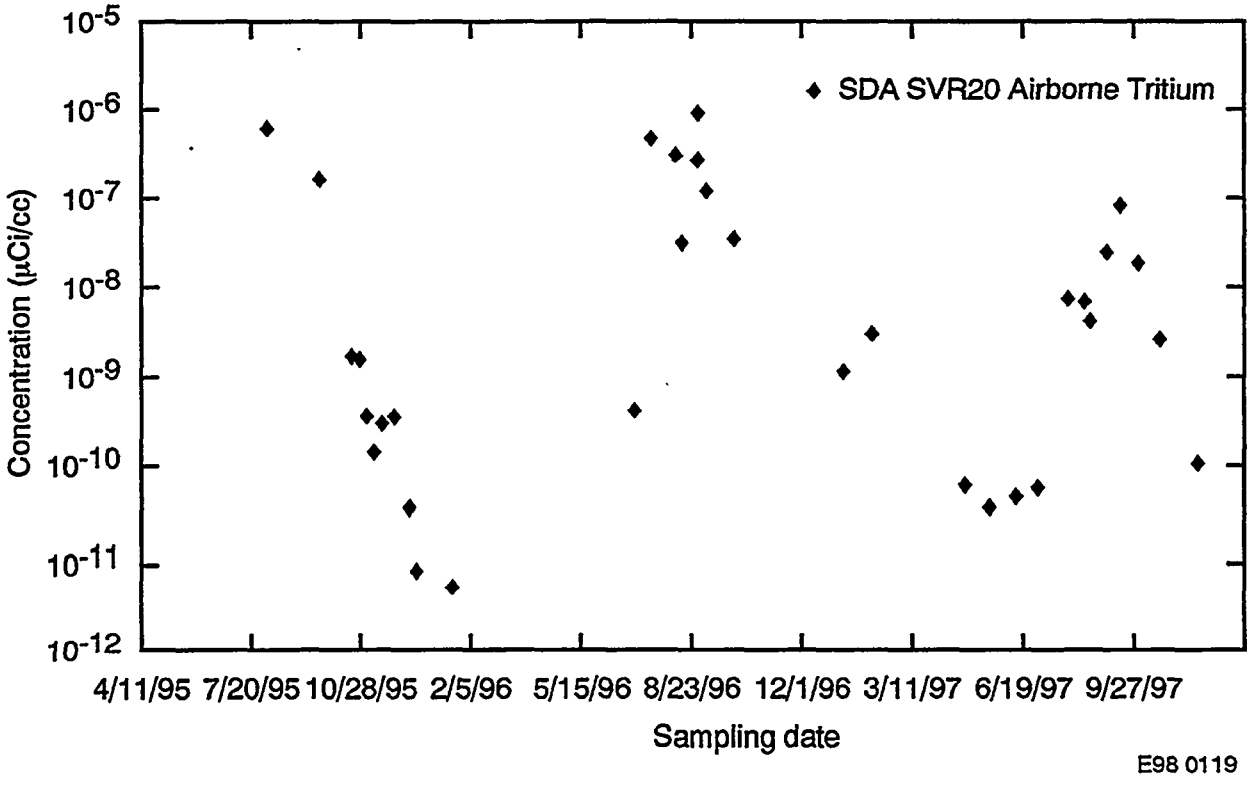


Figure 4-15. Airborne tritium concentrations measured above the beryllium blocks at the SDA Soil Vault Row 20 (E980119).

4.2 Site Environmental Surveillance Program

The SESP complies with requirements for environmental surveillance contained in DOE Order 5400.1, Chapters II and IV,[4] and DOE 5400.5, Chapters II and III.[8] As specified in Section 5, Chapter IV, environmental surveillance programs and their components are "determined on a site-specific basis by the field organizations." Consequently, the SESP mission does not include all aspects of environmental surveillance, but only those components that have been identified by the DOE-ID Environmental Programs as appropriate to the operations at the INEEL.

4.2.1 Program Design Basis

During normal operations at INEEL facilities, some radioactive and nonradioactive materials are released to the environment. These materials may be transported by various environmental processes from the Site to nearby populations. Environmental transport through the atmosphere directly results in exposure of people off-Site. Exposure may also occur indirectly from radionuclides deposited in soil or taken up by plants or animals. The SESP is responsible for conducting environmental surveillance on-Site, and Table 4-6 summarizes these activities.

The transport pathways are ranked in terms of relative importance according to four criteria: (a) mechanism of transport, which is considered to be either direct or indirect in terms of transporting contaminants to a human receptor, (b) amount of contaminant that could potentially be transported, (c) the rate at which the contaminant could be transported to the receptor point, and (d) the duration of the exposure to the contaminant by each transport pathway.[25]

The results of the ranking analysis indicate that air is the most important transport pathway. It is considered more important than the groundwater pathway because air has the potential to transport a large amount of activity to the receptor in a relatively short period. The biota pathway is ranked higher than the surface water pathway because there is seldom any surface water on the INEEL that could transport contaminants to off-Site receptors. The biota and surface water pathways are both seasonal and intermittent, and neither are considered to be significant transport pathways to on-Site or off-Site receptors.

4.2.2 Ambient Air

The specific objectives of the ambient air monitoring activities are to (a) determine the concentration of airborne radionuclides in ambient air at the INEEL; (b) compare measured concentrations of radionuclides to reference levels based on DCGs; (c) compare measured concentrations of nonradiological parameters to appropriate standards or regulatory limits; (d) determine concentrations of selected criteria pollutants as required by INEEL air permits; (e) detect and report significant trends in measured concentrations of airborne radionuclides; and (f) measure the ambient air concentrations of radionuclides in the event of a nonroutine or diffuse source release.

Ambient air results are evaluated to determine if radionuclide concentrations exceed alert levels and to detect significant increases that might indicate confinement failure. SESP air monitoring involves the weekly collection of filters from a network of low-volume air monitors. Each low-volume air monitor maintains an average air flow of about 57 L/min (2 ft^3/min) through a set of filters consisting of a 1.2 μm pore membrane filter followed by a charcoal cartridge. The filters are 99% efficient for airborne

Table 4-6. Summary of the Site Environmental Surveillance Program 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, ICPP, 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, ICPP, 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, ICPP, 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, ICPP, EFS, Van Buren, PBF, NRF
	Particulate	Quarterly	Blackfoot, Craters of the Moon, Idaho Falls, Rexburg	ANL-W, ARA, CFA, EBR-I, TAN, TRA, RWMC, ICPP, 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, ICPP, EFS, Van Buren, PBF, NRF
Air-NO_x	NO_x	Continuously	NA[b]	EFS, Van Buren
Air-SO_2	SO_2	Continuously	NA	Van Buren
Air-Moisture	Tritium	4 to 13 weeks	NA	EFS, Van Buren
Soil	Gamma Spectrometry	Annually	NA	Each major facility[c] once every seven years.
	Radiochemistry	Annually	NA	Each major facility once every seven 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, ICPP, EFS, Van Buren, PBF, NRF
	Surface Surveys	Annual	NA	Each perimeter of the major facilities every three years

a. Radiochemistry—Am-241, Pu-238, Pu-239, -240; and Sr-90 is also included.

b. NA—not applicable.

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

d. TLDs—thermoluminescent dosimetry.

particulate radioactivity and airborne iodides. These filters are analyzed weekly for gross-alpha and gross-beta screening then composited quarterly by location. They are then analyzed using gamma spectrometry and specific alpha- and beta-emitting radionuclide analyses. In addition to the particulate filter, charcoal cartridges are collected and analyzed weekly by gamma spectrometry.

Results of the gross-beta analysis of the air filters are evaluated to determine if there are any significant increases in the filter radioactivity that may require more immediate, in-depth analyses by gamma spectrometry or radiochemistry. Therefore, gross-beta analysis is used as a screening tool. The results are also used to indicate any trends in environmental radioactivity.

The SP dust burden is monitored with the same low-volume filters used to collect the radioactive particulate samples. There is no requirement to monitor the dust burden at the INEEL, but it is included in the program to provide comparison information to other monitoring programs and DOE-ID.

Nitrogen oxides are monitored at VANB and EFS using an EPA-equivalent method to implement the *Ambient Nitrogen Dioxide Monitoring Plan for the INEL*,[26] fulfilling one of the conditions specified in the "Permit to Construct, Idaho Chemical Processing Plant Nitrogen Oxide Sources."[27]

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

4.2.2.1 Data Summary and Assessment. The maximum gross-alpha concentration for each location is shown in Table 4-7. Gross-alpha concentrations for 1997 were, in general, typical of those measured previously. The mean gross-alpha concentrations are shown in Table 4-8.

Due to the meteorological conditions, the highest concentrations of gross-beta occurred historically during winter months. Consistent with this historical trend, the January 3, 1997, concentrations were the highest. The maximum concentration represented 0.57% of the DCG. The highest mean concentrations during 1997 were detected in the fourth quarter (Table 4-9).

No gamma-emitting radionuclides were detected in the quarterly composite 2-in. low-volume filter samples submitted for analyses during 1997. In addition, no positive detections of I-131 were noted on any charcoal cartridge.

Sr-90 was the only radionuclide detected by radiochemistry (Table 4-10). The maximum concentration collected from the ANL-W was 1.8 ± 0.9 E-16 μCi/cc and represents 0.002% of the DCG. All of the concentrations were either at or near background concentrations.

Results for the 1997 annual mean of the quarterly SP concentrations are shown in Table 4-11. Higher particulate concentrations were found at the distant and boundary locations than on the INEEL. The largest source of airborne particulates in the vicinity of the INEEL is considered to be resuspended dust from high winds and the local agricultural operations.

Tritium samples were collected at EFS and VANB. Preliminary laboratory analyses indicated that some samples may have contained detectable concentrations of tritium, but uncertainties in both sampling and laboratory analyses make these results questionable. An investigation of these results is in progress, but no conclusions have been reached at this time. A separate report detailing the conclusions will be issued.

Table 4-7. Maximum gross-alpha concentrations for 1997 per location.

Location	Date	Maximum Concentration[a] (E-15 μCi/cc)
ANL-W	03/12	2.4 ± 1.6
ARA	10/01	2.2 ± 1.0
CFA	10/22	2.7 ± 0.9
EBR-I	09/17	4.1 ± 1.8
EFS	03/26	2.9 ± 1.0
ICPP	07/16	2.3 ± 1.1
NRF	03/26	4.7 ± 1.2
PBF	10/22	2.7 ± 1.2
RWMC	10/01	2.8 ± 0.9
TAN	11/05	2.5 ± 1.0
TRA	10/22	3.7 ± 1.0
VANB	07/02	3.5 ± 1.1
OFF-SITE	01/15	4.4 ± 1.1

a. Uncertainties shown are the associated 2 sigma.

Table 4-8. Mean gross-alpha concentrations for 1997 per location.

Location	1st Quarter Concentration (E-15 μCi/cc)	2nd Quarter Concentration (E-15 μCi/cc)	3rd Quarter Concentration (E-15 μCi/cc)	4th Quarter Concentration (E-15 μCi/cc)	Annual Concentration (E-15 μCi/cc)	Annual % of DCG
ANL-W	0.4	0.3	0.8	0.9	0.6	3.0
ARA	0.7	0.9	0.5	0.8	0.7	3.7
CFA	0.1	0.8	0.7	0.9	0.6	3.2
EBR-I	0.4	0.9	1.6	0.9	1.0	4.8
EFS	0.7	1.1	1.0	0.8	0.9	4.4
ICPP	0.3	0.9	1.2	0.1	0.6	3.1
NRF	1.2	0.9	1.1	0.8	1.0	5.0
PBF	0.8	0.5	0.8	0.8	0.7	3.7
RWMC	0.2	0.7	1.1	0.9	0.7	3.6
TAN	0.7	1.2	1.1	1.0	1.0	4.9
TRA	0.3	0.8	1.1	1.0	0.8	3.9
VANB	0.2	0.8	1.4	0.9	0.8	4.1
OFF-SITE	0.8	1.0	1.2	1.1	1.0	5.2

Table 4-9. Mean gross-beta concentrations for 1997 per location.

Location	1st Quarter Concentration (E-15 μCi/cc)	2nd Quarter Concentration (E-15 μCi/cc)	3rd Quarter Concentration (E-15 μCi/cc)	4th Quarter Concentration (E-15 μCi/cc)	Annual Mean Concentration (E-15 μCi/cc)	Annual % of DCG
ANL-W	16	16	22	25	20	0.2
ARA	17	18	25	27	22	0.2
CFA	15	16	20	25	19	0.2
CPP	20	15	20	26	20	0.2
EBR-I	19	19	25	27	22	0.2
EFS	21	18	21	28	22	0.2
NRF	21	18	25	30	23	0.3
PBF	18	20	25	26	22	0.2
RWMC	16	14	21	22	18	0.2
TAN	20	18	22	24	21	0.2
TRA	20	19	25	28	23	0.3
VANB	18	18	21	24	20	0.2
OFF-SITE	18	16	21	24	20	0.2

Table 4-10. Sr-90 analyses results for 1997.

Location	Quarter	Concentration[a] (E-15 μCi/cc)	% of DCG[b]
ANL-W	First	0.18 ± 0.09	0.002
VANB	First	0.14 ± 0.05	0.002
ARA	Third	0.10 ± 0.04	0.001
PBF	Fourth	0.12 ± 0.05	0.001
ARA	Fourth	0.17 ± 0.06	0.002
Blackfoot	Fourth	0.13 ± 0.06	0.002

a. Uncertainties shown are the associated 2 sigma.

b. The DCG value for Sr-90 (9,000 E-15 μCi/cc) is defined in DOE Order 5400.5.

Table 4-11. 1997 annual mean for suspended particulate concentrations.

Location	Concentration ($\mu g/m^3$)
ANL-W	13
ARA	7
CFA	5
EBR-I	8
EFS	9
ICPP	10
NRF	7
PBF	9
RWMC	10
TAN	8
TRA	9
VANB	9
Blackfoot	12
Craters of the Moon	8
Idaho Falls	18
Rexburg	18

Ambient nitrogen dioxide measurements were obtained on a continuous basis at the stations located at the intersection of Van Buren Boulevard and U.S. Highway 20/26 and the EFS. The New Waste Calcining Facility (NWCF) at ICPP, the largest single source of nitrogen dioxide on the INEEL, operated during three quarters of 1997. The mean nitrogen dioxide concentrations for 1997 at VANB and EFS were 4.4 $\mu g/m^3$ (2.3 ppb) and 8.5 $\mu g/m^3$ (4.5 ppb), respectively. These were significantly lower than the EPA national primary ambient air quality standard of 100 $\mu g/m^3$ (53 ppb). See Figure 4-16 for quarterly mean concentrations of nitrogen oxide in 1997.

Ambient sulfur dioxide was continuously monitored at VANB during 1997. The mean sulfur dioxide concentration was 5.3 $\mu g/m^3$ (2.0 ppb) or 6.7% of the annual primary air quality standard. The maximum daily concentration of 23.2 $\mu g/m^3$ (8.7 ppb) was 6.4% of the primary standard for a 24-hour period. The maximum recorded three-hour average of 24.8 $\mu g/m^3$ (9.3 ppb) was 1.9% of the secondary standard.

4.2.3 Direct Radiation

The specific objectives of direct radiation monitoring are to characterize direct radiation levels at the perimeter of INEEL facilities and to detect and report significant trends in measured levels of penetrating radiation.

The SESP maintains environmental TLD locations on the INEEL along major highways and around the perimeter fences of each major facility (Figure A-1). Results of TLD measurements (beta energies greater than 200 keV and gamma energies greater than 10 keV) are analyzed to detect trends and are directly compared to applicable standards and action levels. At each location, a TLD packet containing

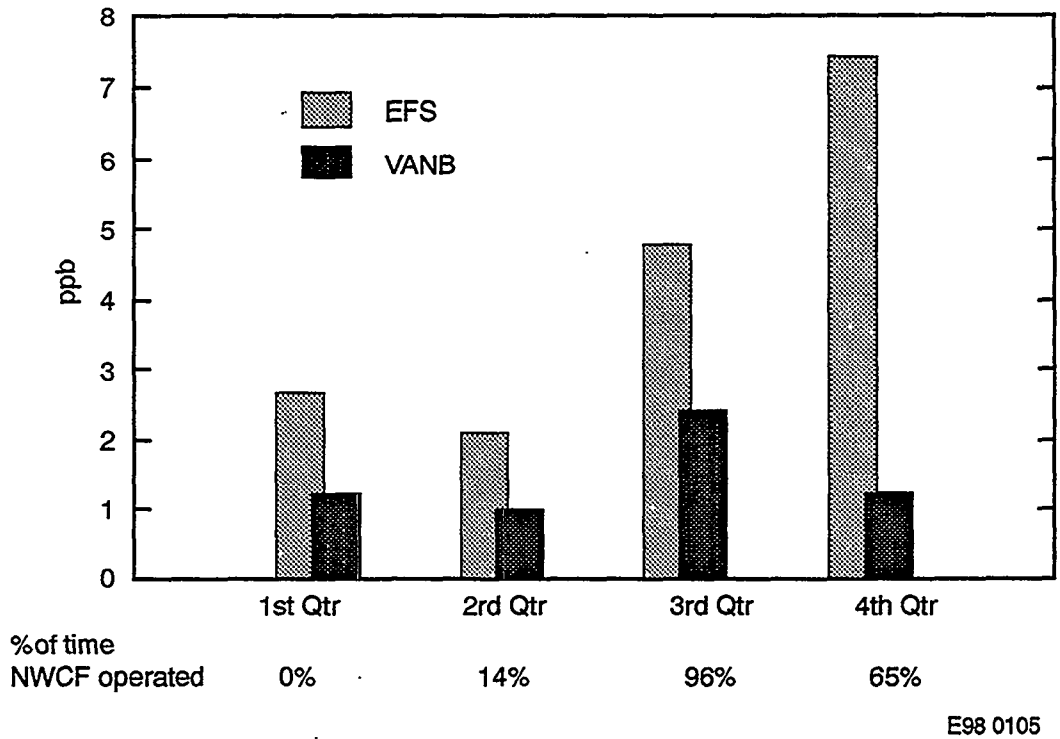


Figure 4-16. Quarterly mean concentration of nitrogen dioxide for 1997 (E980105).

five individual chips is placed 0.9-m (3-ft) aboveground. The TLD packets are replaced in May and November of each year. The sampling periods for 1997 were from November 1996 to May 1997 (Spring) and from May to November 1997 (Fall).

The ESP uses a GPRS system to collect gamma-radiation surveys. The GPRS is mounted on a four-wheel drive vehicle (Figure 4-11); two plastic scintillation detectors identify contaminated areas, and a computer records the data. The vehicle was driven at a speed of approximately 5 mph to collect the data.

4.2.3.1 Data Summary and Assessment. None of the dosimeters were missing during either semiannual changeout. Table 4-12 shows the TLD data from the six locations with the highest measurements for 1997 compared to past data. Most remaining exposures were close to background and are comparable to historical exposures.

During 1997, ARA #4 TLD measurements increased due to decontamination and decomissioning operations at ARA. Primarily, the area adjacent to this TLD has become a temporary storage area for radioactive waste boxes.

ICPP #9 is located in a contaminated soil area and showed an increase during 1996. In 1997, measurements were comparable to past data. ICPP #20 is also located in the vicinity of a radioactive material storage area and remains consistent with historical measurements.

TRA #2 and TRA #3 are adjacent to the former radioactive disposal pond that has been drained and covered with clean soil. These areas are also close to a radioactive material storage area, which is just inside the TRA facility fence line. TRA #3 had the maximum measurement (328 ± 14 mR) for 1997. Both these locations are consistent with historical measurements. TRA #11 has been gradually increasing over the past two years as additional waste has been added to the radioactive material storage area.

Table 4-12. Comparison of the highest 1997 TLD concentrations to past data.

Location	Exposure ± 2 σ (mR)			
	1994	1995	1996	1997
ARA 4	160 ± 7	157 ± 9	167 ± 10	270 ± 11
ICPP 9	202 ± 8	83 ± 4[a]	283 ± 18	196 ± 8
ICPP 20	217 ± 9	236 ± 9	251 ± 13	245 ± 10
TRA 2	242 ± 14	261 ± 13	270 ± 10	257 ± 9
TRA 3	—[a,b]	295 ± 11	345 ± 16	328 ± 14
TRA 11	148 ± 5	151 ± 4	194 ± 6	246 ± 12

a. Missing during Fall change-out.

b. Missing during Spring change-out.

Three high exposures were identified during 1996 for which no known sources were identified. These locations were the RWMC 17A, RWMC 23A, and Highway 20 mile marker 276. During 1997, these measurements returned to levels comparable to past data.

Triennial gamma radiation surveys around the perimeter of INEEL facilities, annual surveys in contaminated soil areas, and annual surveys of major INEEL roadways were conducted in 1997 to document gamma radiation levels using the GPRS system. No abnormalities were noted during any of the surveys, and levels were comparable to historical levels.

4.2.4 Soil Sampling

The specific objectives of the SESP soil sampling activities are to determine present concentrations of radioactivity in soil (natural and fallout), assess any buildup of radioactivity due to INEEL operations, and detect and report significant trends in measured concentrations of radionuclides in soil.

At each sampling location, a soil sample is collected at each of the four corners of a 10 × 10-m (approximately 11 × 11-yd) square and at the center of the square. A stainless-steel sampling ring and scoop are used to collect a 12-cm (4.7-in.) diameter × 5-cm (2-in.) deep sample from these soils. The samples are combined to form a single composite sample. The composite samples are then dried, weighed, homogenized (ball-milled), screened through a number 35 sieve, and then analyzed by gamma spectrometry, and selected samples are submitted for radiochemistry. Soil samples were collected from the TRA locations shown in Figure 4-17. All soil samples are analyzed for gamma-emitting radionuclides. Selected samples are then submitted for specific alpha- and beta-emitting nuclides.

4.2.4.1 Data Summary and Assessment. Six soil samples were collected and analyzed by gamma spectrometry, and 29 in situ gamma spectometry measurements were collected from TRA (Figure 4-17). Samples were not collected in areas that were impacted by the TRA Warm Waste Pond remediation effort (except location 5.2). Twelve of the previously sampled locations were lost due to the installation of the lined ponds. The comparison of the Cs 137 data to the in situ data collected at the same six locations is presented in Table 4-13. Cs 137 was the only man-made radionuclide that was found above detection limits. The maximum sample concentration was 1.39 ± 0.14 pCi/g, and the maximum in situ measured concentration was 1.60 ± 0.04 pCi/g. Both maximum concentrations were found at location 3.3. These

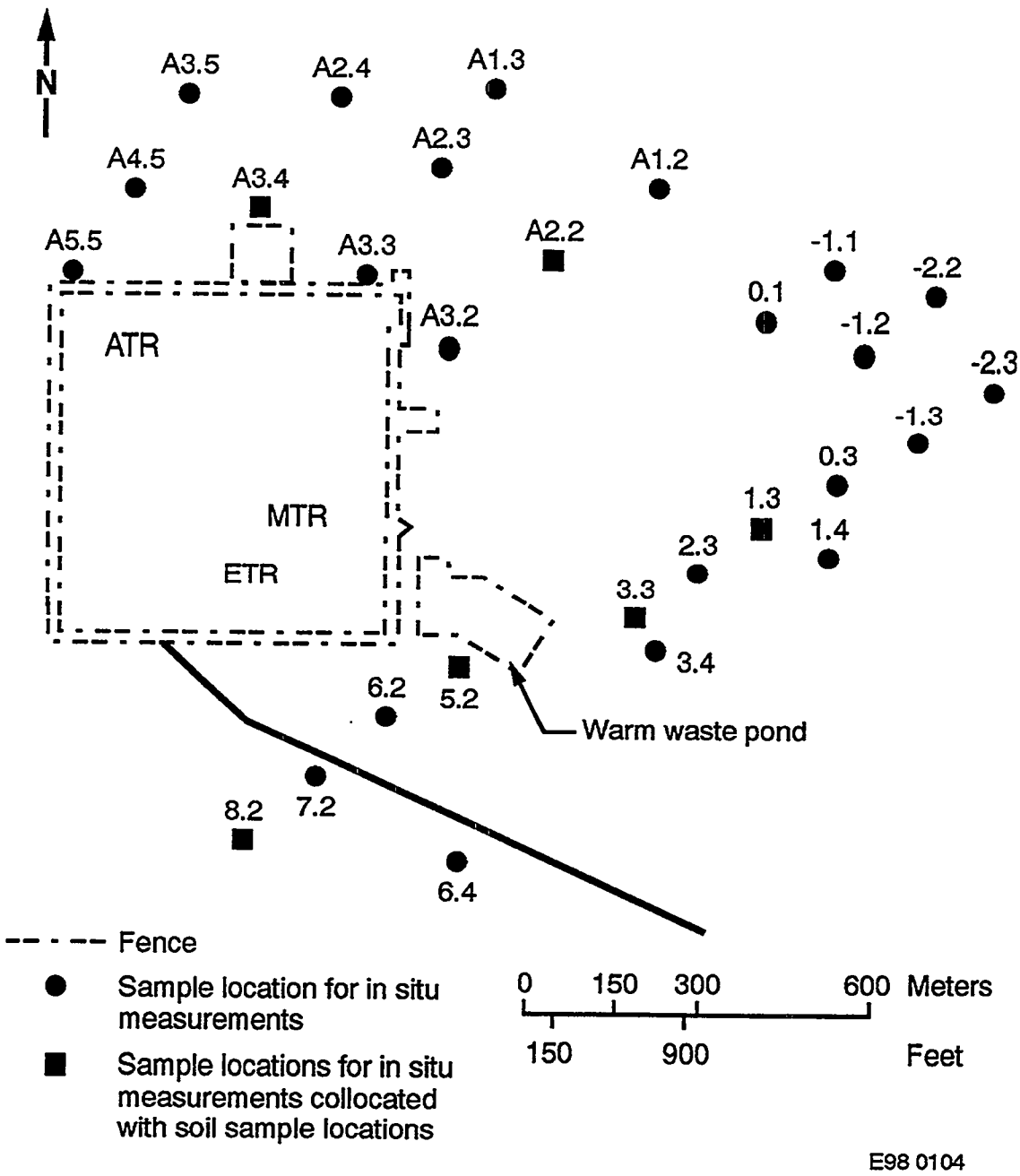


Figure 4-17. TRA soil sampling locations grid map (E980104).

Table 4-13. Comparison of Cs-137 results from in situ measurements and laboratory analyses.

Location	Measurements (pCi/g)	
	In situ	Laboratory Analyses
1.3	1.11 ± 0.04	10.4 ± 0.12
3.3	1.60 ± 0.04	1.39 ± 0.14
A2.2	0.68 ± 0.03	0.61 ± 0.06
A3.4	0.77 ± 0.04	0.72 ± 0.12
5.2	0.17 ± 0.06	0.07 ± 0.06
8.2	1.01 ± 0.04	1.05 ± 0.08

concentrations (both in situ and analytical) show a general decrease of approximately 15% from the 1990 data collected by RESL.[28] With the exception of location 5.2, the results are comparable. The inhomogeneity of the soils and the difference in counting geometry make an exact correlation difficult. As additional data are collected, a correlation factor for the two methods will be evaluated. Location 5.2 is the only location where the soil was disturbed by the remediation and construction activities and is also in close proximity to a radioactive material storage area. The storage area may have affected the in situ data (no collimator was used for this data set). Samples have been submitted for specific-alpha analysis, but the data were not received in time to be included in this report.

4.2.5 Quality Assurance/Quality Control

The QA/QC measures are the same for all of the ESP. See Section 4.1.9 for a discussion of the ESP QA/QC Program

5. COMPLIANCE MONITORING PROGRAMS

The Compliance Monitoring Program consists of the following: Drinking Water, Liquid Effluent Monitoring, Storm Water Monitoring, and Groundwater Monitoring Programs.

In 1988, in response to a DOE-ID request, a centralized drinking water program was established at most INEEL facilities. With the consolidation of contractors, the remaining facilities were incorporated into a Drinking Water Program (DWP), which was implemented in January 1995. In addition to the monitoring, the DWP also coordinates the INEEL Cross-Connection Control Program.

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 has been added as permits are obtained.

In September 1992, DOE submitted a Notice of Intent to EPA to obtain coverage of the INEEL under the NPDES General Permit.[2] A Storm Water Monitoring Program in compliance with permit conditions was implemented in 1993. The program has been modified as data are evaluated and needs are identified.

In 1993, DOE-ID formalized the INEEL Groundwater Monitoring Program. The purpose of this program is to integrate, to the extent possible, all groundwater monitoring programs at the INEEL. The INEEL Groundwater Monitoring Program is documented in the *Idaho National Engineering Laboratory Groundwater Monitoring Plan.*[29] In 1997, monitoring of storm water that enters deep injection wells for compliance with State of Idaho Injection Well Permits was transferred from the USGS to LMITCO.

5.1 Drinking Water Program

The DWP was established for monitoring production and drinking water wells, which are multiple-use wells for industrial use, fire safety, and drinking water. Routine monitoring is conducted at all LMITCO-operated facilities. According to the Idaho Regulations for Public Drinking Water Systems [Idaho Administrative Procedures Act (IDAPA) 16.01.08],[30] LMITCO drinking water systems are classified as "nontransient or transient, noncommunity water systems." The transient, noncommunity water systems are at EBR-I, Gun Range, and Main Gate. The rest of the water systems at the INEEL are classified as nontransient, noncommunity water systems.

Because groundwater supplies the drinking water at the INEEL, information on groundwater quality was used to help develop the DWP. The USGS and LMITCO monitor and characterize groundwater quality at the INEEL. Three areas of groundwater contamination at the INEEL are the TAN area; the CFA, TRA, and ICPP area; and the RWMC area.

5.1.1 Program Design Basis

The DWP conducts monitoring to ensure drinking water is safe for consumption by demonstrating that the drinking water quality meets federal and state regulations [maximum contaminant levels (MCLs) are not exceeded]. The SDWA establishes the overall requirement for the DWP.

The DWP uses only EPA-approved analytical methods for drinking water analyses in compliance with IDAPA 16.01.08[30] and 40 Code of Federal Regulation (CFR) 141.28.[31] These EPA methods have specific practical quantitation levels and holding times, and these are listed in the 40 CFR 141–143.[31]

Laboratories used by the DWP performed analyses according to specified EPA methods, protocols, and procedures as listed in 40 CFR 141–143. In addition, the State of Idaho and EPA require laboratories

to be certified by the State of Idaho or be certified by a state that has reciprocity with the State of Idaho before performing drinking water analyses . All laboratories used by the program were either State of Idaho-certified or were certified by a state having reciprocity.

Currently, 17 wells and 10 distribution systems are monitored by the DWP on a routine basis at the INEEL. Table 5-1 lists the drinking water parameters that were monitored in 1997 along with the frequency of sampling. Parameters are regulated by the State of Idaho under authority of the SDWA.[5] Primary drinking water standards set MCLs for parameters that have been proven to cause cancer or other health problems at high concentrations. Parameters that have not been proven to cause adverse health effects, but can cause aesthetic problems in a water supply, are regulated by secondary maximum contaminant levels (SMCLs).

Parameters with primary MCLs are required to be monitored at least once every compliance period, which is three years. Parameters with SMCLs are monitored every three years based on a recommendation by the EPA. The three-year compliance periods for the DWP are 1993–1995, 1996–1998, and so on. Many parameters require more frequent sampling during an initial time period to establish a baseline, and subsequent monitoring frequency depends on the baseline.

The DWP monitors more frequently than the minimum regulatory requirements at CFA, TSF, and RWMC because of known tritium, trichloroethylene (TCE), and carbon tetrachloride, respectively, in groundwater. Even though regulations only require quarterly monitoring for bacteriological analyses, the DWP collects some samples more frequently because of historical problems with bacteriological contaminants (Table 5-1). These detections were usually caused by deteriorating water lines and stagnant water, and resampling of these areas normally indicated compliance with the MCL.

5.1.2 Data Summary and Assessment by Facility

During 1997, a total of 683 routine samples were collected and analyzed at CFA, EBR-I, Gun Range, ICPP, Main Gate, PBF, RWMC, TAN (CTF and TSF), and TRA. In addition to the routine sampling, the DWP had 21 nonroutine requests for sampling. Based on 1997 sampling results, no MCLs were exceeded at the compliance point for LMITCO-operated water systems at the INEEL. Those analytical results that exceeded or approached an MCL in 1997 are presented in Table 5-2 and are discussed in the subsections below. A discussion of a previously identified bacteria problem at PBF is also included.

5.1.2.1 Central Facilities Area. Routine monitoring for tritium from the SRPA began in 1961. In general, tritium concentrations in groundwater have been decreasing due to changes in disposal rates, disposal techniques, recharge conditions, and radioactive decay. 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. The CFA water system serves over 1,000 people daily.

Since the early 1950s, wastewater containing tritium has been disposed to the SRPA at TRA and ICPP (Figure 3-2) through injection wells and infiltration ponds. These wastewaters migrated south-southwest and are the source of tritium contamination in the CFA water supply wells. In 1993, waste disposal practices were changed, and wastewater containing tritium is now discharged to lined ponds or evaporated.

Table 5-1. 1997 drinking water monitoring locations and schedule.

Facility	Sample Point	Parameters	Samples Frequency
CFA	Selected Buildings	Bacteriological	2 monthly[a] 4 monthly[b]
		Total trihalomethanes	1 quarterly[a]
	1603	Nitrate	1 annually[a]
	1603, point-of-entry to distribution system after treatment and #1 Well	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[b]
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[b]
	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[b]
	601 and Well	Organics (40 CFR 141.12, .24, .40, and .61)[c]	1, as required (quarterly or annually)[a]
	601	Metals, inorganics, and secondary drinking water standards	1, as required every 3 years
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[b]
	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
ICPP	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[b]
	614	Metals, inorganics, and secondary drinking water standards	1, as required every 3 years

Table 5-1. (continued).

Facility	Sample Point	Parameters	Samples Frequency
Main Gate	Selected Buildings	Bacteriological	1 quarterly[a] 1 monthly[b]
	603, point-of-entry to distribution system after treatment	Nitrate	1 annually[a]
		Gross alpha, beta, and tritium	1 quarterly[b]
	603 and Well	Organics (40 CFR 141.12, .24, .40, and .61)[c]	1, as required (quarterly or annually)[a]
	603	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]
		Gross alpha, beta, and tritium	1 quarterly[b]
	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
RWMC	Selected Buildings	Bacteriological	1 quarterly[a] 3 monthly[b]
	604, point-of-entry to distribution system after treatment	Nitrate	1 annually[a]
	604, point-of-entry to distribution system after treatment	Metals, inorganics, and secondary drinking water standards	1, as required every 3 years
	603 well, 604, point-of-entry to distribution system after treatment	Gross alpha, beta, and tritium	1 quarterly[b]
		Organics as listed in Table 5 (40 CFR 141.12, .24, .40, and .61)[c]	1, as required (quarterly or 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[b]
	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	1 quarterly[a] 3 monthly[b]
		Total trihalomethanes	1 quarterly[b]
	610, point-of-entry to distribution system after treatment	Nitrate	1 annually[c]
		Gross alpha, beta, and tritium	1 quarterly[b]

Table 5-1. (continued).

Facility	Sample Point	Parameters	Samples Frequency
TSF (continued)	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.

b. Surveillance samples.

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

Table 5-2. Parameters that exceeded or approached the MCLs for 1997.

Parameter	Location	Average Results	MCL
Trichloroethylene	TSF #1 Well	6.10 μg/L[a]	5 μg/L
Tritium	CFA Dist.	13,418 pCi/L[b]	20,000 pCi/L
	CFA #1 Well	13,400 pCi/L[b]	20,000 pCi/L
	CFA #2 Well	11,900 pCi/L[b,c]	20,000 pCi/L
Carbon Tetrachloride	RWMC Well	4.23 μg/L[b]	5 μg/L
	RWMC Dist.	2.65 μg/L[b]	5 μg/L

a. This is only an average of two quarters at the wellhead. The compliance point is after the sparger system (air stripping process); the compliance result is 0.84 μg/L for the three quarters average. No sampling was conducted during the fourth quarter since the system had been taken out of service to replace piping.

b. These values did not exceed their respective MCLs, but are known contaminants that the DWP is tracking. See specific sections for details.

c. Due to construction activities (replacing the pump), the well was out of service during the fourth quarter; therefore, this is a three quarter average.

At the distribution system (CFA-1603), the mean quarterly concentration of tritium was 13,418 pCi/L, compared to the MCL of 20,000 pCi/L. In 1997, the CFA #1 well mean quarterly tritium concentration was 13,400 pCi/L, and the CFA #2 well mean tritium concentration was 11,900 pCi/L. Since December 1991, the mean tritium concentration has been below the MCL at both wells and the distribution system. Figure 5-1 illustrates the variation of tritium concentrations since 1990 with results from RESL and other analytical laboratories identified separately. In general, mean concentrations in both wells have been decreasing, and should continue to gradually decrease over the years for the following reasons: tritium is not being disposed in the infiltration ponds, and the aquifer level has increased 4 to 5 ft in the last couple of years; so, the tritium is becoming more dispersed and gradually decaying. The higher concentration of tritium in CFA #1 well appears to be related to the wells proximity to the contamination source.

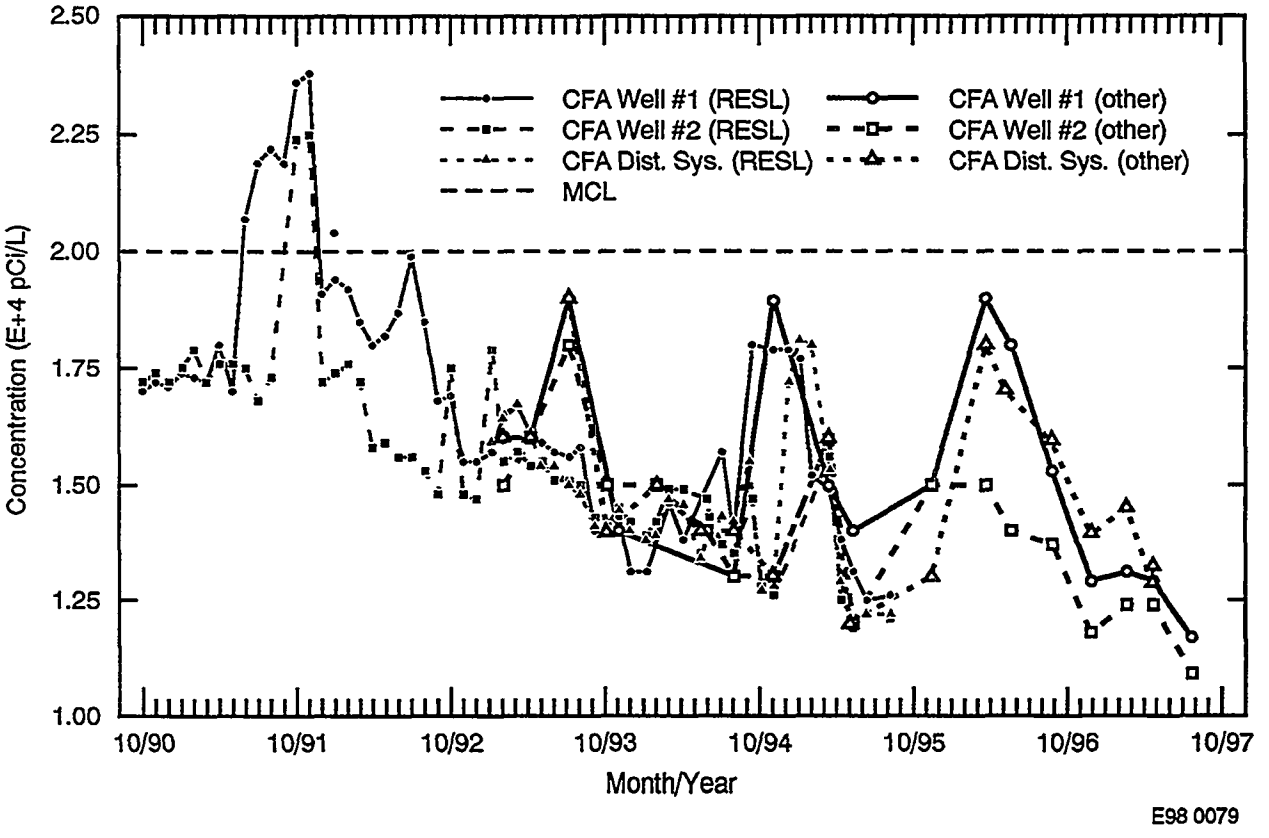


Figure 5-1. Tritium concentrations in CFA drinking water (E980079).

5.1.2.2 Power Burst Facility. Water samples were collected from the PBF #1 well, located at PBF-602; PBF #2 well, located at PBF-614; and PBF distribution system, located at PBF-638, the point of compliance for drinking water sampling. PBF #1 and PBF #2 wells normally supply drinking water to all personnel at the PBF area. The PBF water system serves over 100 people on a daily basis.

Because of the presence of coliform bacteria (absent for *Escherichia Coli*) in the past, PBF personnel have been supplied bottled water to drink from July 1995 until March 1997. The bacteria are believed to be a result from a combination of old, deteriorating pipes, stagnant water from buildings, storage tanks where water usage is limited, and biofilm that can cause positive coliform detections.

Instead of super-chlorinating the system and risking the possible return of coliform bacteria, a continuous, mixed-oxidant disinfection system was installed and began operating in March. There have been no coliform bacteria detections at PBF since.

5.1.2.3 Radioactive Waste Management Complex. Various solid and liquid radioactive and chemical wastes, including TRU wastes, have been disposed at the RWMC. The RWMC contains pits, trenches, and vaults where radioactive and organic wastes were disposed below-grade, as well as placed above-grade and covered on a large pad. During a Site-wide characterization program, carbon tetrachloride and other VOCs were detected in groundwater at the RWMC.[32] 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, TCE, tetrachloroethylene, toluene, benzene, 1,1,1-trichloroethane, and lubricating oil. High vapor-phase concentrations (up to 2,700 ppmv) of VOCs have been measured in the unsaturated zone above the water table. Groundwater models predict that VOC concentrations will continue to increase in the groundwater at the RWMC.

The RWMC 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 from the RWMC well and from the point of entry to the distribution system, which is the point of compliance, located at WMF-604.

Since monitoring began in 1988, there has been an upward trend in levels of carbon tetrachloride (Figure 5-2). In October 1995, the levels of carbon tetrachloride increased to 5.48 μg/L at the well. This was the first time the levels in the well exceeded the MCL of 5.0 μg/L. The MCL for carbon tetrachloride is 5.0 μg/L for a four quarter average. The levels at the well are used for comparison purposes only because no MCL was exceeded at the distribution system (WMF-604), which is the compliance point. This is also the point from which water is first consumed at RWMC. The USGS results are comparable. The mean concentration at the well for 1997 was 4.23 μg/L, with a maximum concentration of 5.10 μg/L. The mean concentration for the distribution system was 2.65 μg/L, with a maximum concentration of 3.10 μg/L. Technologies are being considered for treatment of the carbon tetrachloride to ensure the water is safe for potable usage (e.g., drinking, eye washes, and showers). Co-sampling with USGS and increased DWP monitoring are being implemented to track carbon tetrachloride concentrations. 1997 USGS sampling results are presented in Section 5.4.

5.1.2.4 Test Area North. The TSF injection well (TSF-05) is believed to be the principle source of groundwater contamination at the TAN facilities. VOCs were first detected at TAN in 1987 during routine sampling of the water supply wells. The USGS followed up with a more comprehensive sampling program at TAN and detected high levels (up to 35,000 μg/L) of various VOCs in groundwater monitoring wells.[33] A number of investigations into the extent of groundwater contamination have been conducted under consent orders signed under CERCLA authority among DOE-ID, the State of Idaho, and the EPA Region 10. Groundwater contamination at TAN is currently being investigated under Operable Unit 1-07 of the Federal Facility Agreement and Consent Order for the INEEL.[34] A remedial investigation has been conducted to develop information necessary to assess the risk posed by the groundwater contamination and to select a remedial action, if necessary.[35] During 1997, water samples were collected from four wells and two distribution systems at CTF and TSF. Approximately 300 people are served by the two water systems at TAN.

5.1.2.4.1 TSF Water System—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 a sparger system (air stripping process) was installed in 1988 in the water storage tank to volatilize the TCE below the MCL and provided drinking water safe for consumption. To date, the sparger system has been effective.

Concentrations of TCE averaged 6.1 μg/L for the first two quarters of monitoring in TSF #1 well, which exceeded the MCL of 5 μg/L. Although the MCL was exceeded at the wellhead, the compliance point is the point of entry to the distribution system (TSF-610) after treatment by the sparger system. The MCL was not exceeded at the distribution point. During the third quarter of 1997, TSF #1 was taken off-line because it was determined that the TCE in groundwater at TAN qualified as a Resource Conservation and Recovery Act (RCRA) listed hazardous waste. Third and fourth quarter monitoring samples were not collected because of handling and disposal issues. TCE levels are historically higher at TSF #1 during the third and fourth quarter; therefore, and the missing third and fourth quarter samples likely account for the lower average concentrations for 1997.

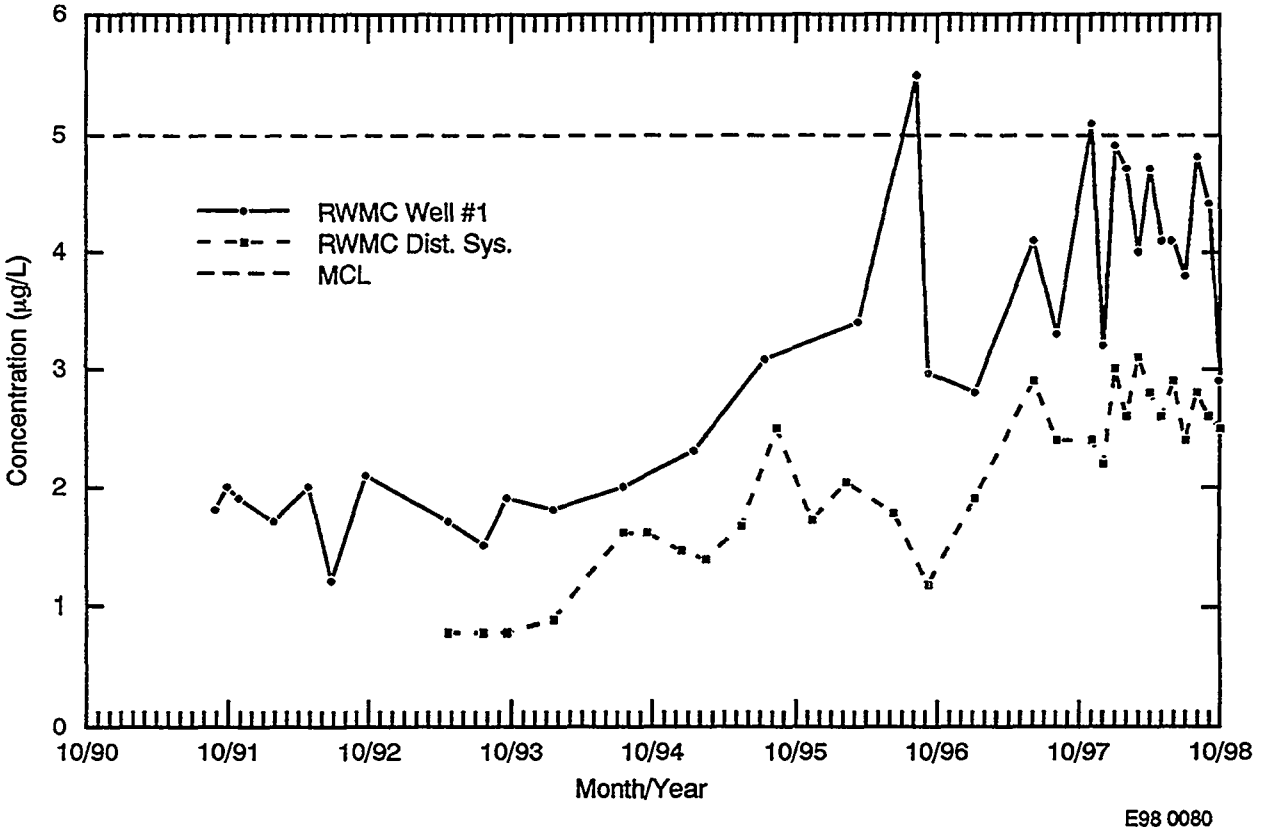


Figure 5-2. Carbon tetrachloride concentrations in the RWMC drinking water systems (E980080).

The sparger was not used after groundwater was determined to contain a RCRA listed waste. Well #2 was put online, which required no treatment (sparger), since the TCE levels were below the MCL. TSF #2 well was the main well used in 1997. The average of TCE at the distribution system decreased from 1.66 μg/L in 1996 to 0.84 μg/L because TSF #2 was the main well used in 1997. Figure 5-3 illustrates the concentrations of TCE in both TSF wells and the distribution system from 1994 through 1997. The exceeded MCL in the August 1994 distribution sample is attributed to preventive maintenance activities interrupting operation of the distribution system. The differences between the two wells are attributed to different usage rates, proximity to the contamination source, seasonal change, and groundwater mobility.

5.1.3 Cross-Connection Control Program

In February 1988, the INEEL Cross-Connection Control Program was initiated to perform inspections of all facilities managed by the M&O contractor to locate cross-connections and identify potential problems. The main objective of the Cross-Connection Control Program is to ensure the work force is supplied safe water by protecting potable water from contamination from a nonpotable source or from a reverse of normal flow in the distribution systems and plumbing within buildings. The Cross-Connection Control Program inspects the potable water plumbing and distribution systems for cross-connections with a nonpotable source.

Water distribution systems at the INEEL consist of two types. Multiple-use water systems (combination fire/industrial and potable water) utilize drinking water from a common water distribution system. These systems have the highest potential for cross-connections and the highest degree of oversight is applied in these areas of cross-connection control. Split systems typically are segregated from one another: fire/industrial water is either fed from a separate source or isolated from a common supply by means of a back-flow prevention device that is commensurate to the degree of hazard.

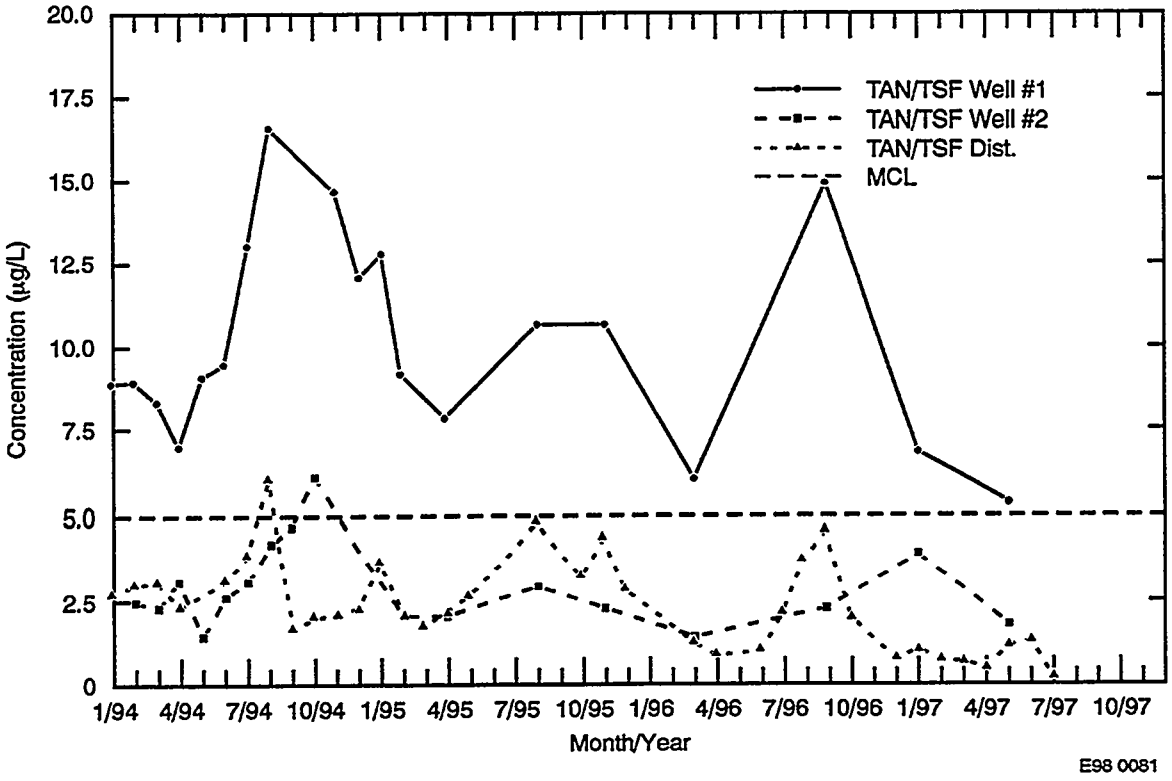


Figure 5-3. Trichloroethylene concentrations in TSF drinking water systems (E980081).

To meet guidelines set forth in OSHA Standard 1910.141 and 1926.51,[36] the INEEL Cross-Connection Control Program performs annual inspections of potable water plumbing and distribution systems, annual certified backflow assembly testing, and maintenance of backflow prevention devices and assemblies for properties owned or operated by the DOE-ID. System inspections, certified backflow device testing, and maintenance are performed in accordance with the *Uniform Plumbing Code*[37] and "Idaho Regulations for Public Drinking Water Systems."[30]

5.1.4 Quality Assurance/Quality Control

The DWP follows established procedures and analytical methodology before samples are collected. The DWP has established data quality objectives (DQOs) that are found in the program plan. The DQOs are qualitative and quantitative statements that specify the study objectives, the study boundaries and limitations, the types and amounts of data to collect, and levels of decision errors that will be acceptable to support decisions.

For the DWP, the decisions to be made, along with the sample design and frequency are defined by state and federal drinking water regulations. All parameters that were monitored in 1997 were below applicable MCLs and monitored within the required time frame, except as stated in Table 5-2.

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

The DWP has a programmatic goal of 100% of all compliance samples being submitted, analyzed, and validated. This goal was met for 1997. Also, 10% of the samples submitted each calendar year will be QA/QC samples (duplicates, field blanks, and blind spikes).

Overall the blind spike recoveries were within the QC standard range. Occasionally, there was a low or a high bias (VOCs only), usually for one parameter. Also, methylene chloride was detected a few times in the trip blanks. Methylene chloride is a common laboratory contaminant and is often present in trip blanks and laboratory method blanks. All QA/QC blind samples were validated and found not to have affected the results.

Overall, the internal QC samples that were submitted for the DWP for 1997 were within the QC standards and the DWP DQOs as stated above.

5.2 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. The program is designed to ensure that liquid effluent samples provide representative data to demonstrate compliance with regulatory requirements.

5.2.1 Program Design Basis

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.[38] 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 (40 CFR 403, "General Pretreatment Regulations for Existing and New sources of Pollution").[39] Industrial Wastewater Acceptance (IWA) Forms are obtained for facilities that dispose process liquid effluent through the City of Idaho Falls sewer system. These requirements apply to all LMITCO and DOE-ID-operated facilities that discharge to the City sewer system. Permits include general requirements applicable to all facilities and specific monitoring requirements for the IRC and the WCB 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."[40] 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"[41] (WLAPs). LMITCO operates seven WLAP facilities at the INEEL. Permit applications have been submitted to the Idaho Division of Environmental Quality (IDEQ) for three facilities: WRRTF process and sewage ponds, TRA Cold Waste Pond, and TRA Chemical Waste Pond. Four facilities have been issued WLAPs: CFA sewage treatment plant (STP), ICPP Percolation Ponds, ICPP STP, and TAN/TSF STP. A temporary permit was issued for the TRA STP in 1997, but the irrigation system was never used, and the permit was closed in November 1997. Each permit lists operational, compliance, and monitoring requirements. The permits generally require compliance with the Idaho groundwater quality standards[40] in specified downgradient groundwater monitoring wells, annual discharge volume and application rates, and effluent quality limits.

The *1997 Annual Wastewater Land Application Site Performance Reports for the Idaho National Engineering Laboratory*[42] for permitted wastewater land application facilities were submitted to the IDEQ on February 26, 1998. The reports describe site conditions for the CFA STP, the ICPP STP, the ICPP Percolation Ponds, and the TAN/TSF STP as required by State of Idaho WLAPs. These reports contain permit-required monitoring data, status of special compliance conditions, and discussions of environmental impacts by the facilities.

Parameters monitored in 1996 were reviewed in 1997 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. Locations are chosen at points where the samples most closely represent the released effluent, when practical. Effluent discharges that fall under a permit are monitored as the permit requires.

During 1995, an approach was developed to evaluate effluent sampling locations, frequencies, and parameters based on risk.[43] Risk is defined as the statistical probability of exceeding a release limit (both regulatory limits and environmental risk-based limits). The program evaluated the historical data for all effluent streams using this approach and modified the sampling design during 1996. The modified design

was implemented in 1997, and resulted in an overall reduction in monitoring locations, frequencies, and parameters.

The design differentiates between streams requiring characterization monitoring and those requiring surveillance monitoring. The objectives of characterization are to provide data from which risk can be quantified and to establish baseline conditions for measuring change. Streams requiring characterization did not have sufficient historical data to quantify risk. Surveillance requirements were determined from historical data and risk.

Effluent streams that were sampled during 1997 and the parameters and frequency of monitoring for each stream are listed in Table 5-3. Each facility area (e.g., CFA, ICPP, Idaho Falls, RWMC, TAN, and TRA) was sampled monthly, quarterly, or semiannually depending on requirements. The specific day during the period was randomly selected, and the specific locations sampled during any given period within each facility area varied. Each location was determined by rotating through the complete list of available locations within one area or as required in applicable permits. 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 possible 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 WLAPs require use of analytical methods for the analysis of pollutants listed in 40 CFR 136, Subchapter N, "Effluent Guidelines and Standards."[44]

5.2.2 Data Summary and Assessment by Facility

During 1997, a total of 15 effluent discharge points were routinely monitored for nonradiological parameters and seven for radiological parameters at six areas: CFA, ICPP, Idaho Falls, RWMC, TAN, and TRA.

INEEL facilities use water in a variety of processes and operations; therefore, the final liquid effluents released to the environment are composed of discharges from a range of sources. In many cases, the impact of water usage by a given facility process on raw water quality is minimal, creating relatively clean wastewater effluents that are roughly comparable in quality to the raw water source. In other cases, however, wastewater effluents contain pollutants characteristic of particular processes.

Two major classes of liquid effluents from LMITCO facilities exist: those generated by numerous contributing sources within a facility, and those generated by a single source (i.e., a unique process or operation). For effluents generated by numerous contributing sources within a facility (i.e., nonspecific sources), annual mean concentrations of individual pollutants usually lie in a relatively narrow range, well below regulated levels. For a single-source effluent, a change associated with its source has a more direct impact on the observed character of the effluent.

To assess the data for trends or changes that might indicate loss of process control or unplanned release, statistical confidence limits are calculated based on past monitoring data. Limits are based on the variance estimate of the analyte concentrations around the mean concentration for the period 1986 through 1996. Because of the many measurements below the detection limit for radionuclides and VOCs, confidence limits are not calculated for those parameters. A Level 2 statistical control limit is set at the upper 99% confidence limit on individual measurements. If a measurement for the current year exceeds the Level 2 control limit, there is a less than 1% chance of this happening because of random fluctuations. Values that exceed the Level 2 control limit fall outside what is expected based on historical stream characteristics, but do not necessarily indicate possible adverse environmental consequences. Instances

Table 5-3. 1997 effluent monitoring locations, parameters, and frequencies.

Location	Discharge Description	Type of Monitoring	Parameters[a]	Frequency
CFA-LS1, STP Lift Station	Untreated wastewater from all sanitary sewer drains throughout CFA	WLAP	WLAP parameters[b]	Monthly
CFA-STF, STP effluent pump pit	Treated wastewater from the CFA STP lagoons prior to land application	WLAP and Characterization	Cl, F, SO_4, TDS, ICP metals[c] + Hg and radiological parameters[d]	Quarterly
			WLAP parameters	Monthly (when pivot operating)
CFA-696,[e] Transportation Complex Oil and Water Separator	Water associated with the floor drains and vehicle maintenance areas in the new transportation complex	Characterization	Total oil and grease and VOCs[f]	Quarterly
CPP-769, influent to STP	Untreated wastewater from sanitary sewer drain throughout CPP	WLAP	WLAP parameters	Monthly
CPP-773, STP effluent to Rapid Infiltration Trenches	Treated wastewater from the CPP lagoons prior to the infiltration trenches	WLAP and Characterization	WLAP parameters	Monthly
			ICP metals + Hg and radiological parameters	Quarterly
TRA-708,[e] Acid Caustic Pumphouse	Water treatment process at the TRA demineralizer facility	Surveillance	ICP metals + Hg, Cl, F, SO_4, TDS, and NNN	Quarterly
			Radiological parameters	Annually
TRA-764, effluent to Cold Waste Pond	Nonradioactive, nonsanitary drains throughout TRA	Surveillance	ICP metals + Hg, Cl, F, SO_4, TDS, and radiological parameters	Quarterly
TRA-LS1,[e] STP Lift Station	Untreated discharges to the sanitary system	WLAP	WLAP parameters	Monthly (through September)
TRA-STF,[e] STP Pond 1	Sewage treated in lagoon No. 1	WLAP	WLAP parameters	Monthly (through September)
TAN-655, effluent to TSF pond	Combination of process water from TAN-607 and treated sewage	WLAP and Surveillance	Radiological parameters	Quarterly
			WLAP parameters	Monthly
WRRTF-1,[e] Sewage Lagoon sump	Treated effluent from the sanitary system at WRRTF	Surveillance	ICP metals + Hg, Cl, F, SO_4, TSS, TDS, BOD, NNN, TKN, and P	Annually
WRRTF-2,[e] process pond sump pit	Nonsanitary, nonradioactive sources at WRRTF	Surveillance	ICP metals + Hg, 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	IWA Form	RCRA metals[g] + Cu, Ni, Zn, CN, and phenol	Semiannually

Table 5-3. (continued).

Location	Discharge Description	Type of Monitoring	Parameters[a]	Frequency
IFF-616, WCB effluent	Sanitary sewage and wastewater from WCB	IWA Form	RCRA metals + Cu, Ni, Zn, CN, and phenol	Semiannually
RWMC, Sewage Lagoon[e]	Sanitary sewage from RWMC	Characterization	ICP metals + Hg, Cl, F, SO_4, TDS, TKN, NNN, P, TSS, BOD, and VOCs	Quarterly

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. ICP metals include antimony, arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, thallium, 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. EPA Method 624 Target List.
g. RCRA metals include arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver.

where monitoring data exceed the Level 2 control limit are reviewed to determine if a significant change has occurred in the effluent stream or to determine if there are possible adverse environmental consequences. In most cases, there is no concern identified. When the change is substantiated and environmental or regulatory issues are identified, appropriate follow-up action is taken. CPP-773 was the only stream for which a parameter repeatedly exceeded a Level 2 control limit (Section 5.2.2.2). All other level two exceeded parameters were one-time 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 RCRA 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 RCRA characteristic hazardous waste limits and City of Idaho Falls limits. With the exception of a single total nitrogen sample at the ICPP STP, which exceeded a WLAP limit, all results were within regulatory limits.

Additionally, concentrations in discharges to land application facilities were compared to calculated risk-based release levels. Release levels were developed for disposal of wastewater to land application facilities (percolation ponds or sprinkler irrigation sites).[45,46] 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 WLAP limits. In some instances, calculated release values that are protective of the environment would be greater than RCRA toxicity characterization leaching procedure (TCLP) hazardous waste or DOE DCGs. In cases where the regulatory criteria are more stringent, those criteria take precedence and are used as the release level. Gross alpha and gross beta concentrations were compared to the DCG for the most restrictive alpha- and beta-emitting radionuclides potentially present (Am-241 and Sr-90).

Minimum, maximum, and mean concentrations for 1997 data were calculated. Historical and 1997 summary statistical data for permitted effluent streams and streams for which permit applications have been submitted are presented in Appendix E. The following sections discuss effluent characteristics and parameters that exceeded the applicable limits in 1997 for selected effluent streams. Concentrations for parameters measured in 1997 were all below corresponding release levels, except where noted in the following sections.

5.2.2.1 Central Facilities Area. The sanitary sewage drains throughout CFA affect the chemical characteristics of the overall CFA effluent. A number of unique discharge sources exist, including chemical laboratories, the craft shops, the cafeteria, print shop, the warehouse, vehicles services, and the dispensary. One location upstream of the STP was monitored totaling three CFA effluent monitoring locations (Table 5-3 and Figure A-4). The transportation complex oil and water separator was monitored to characterize the discharge from the new facility constructed in 1996.

The only effluent discharge to the environment monitored at CFA was from the STP. The CFA STP receives wastewater from sanitary sewage drains throughout CFA. A new STP was put into operation and replaced the old system in February 1995. The STP consists of a 1-acre partial-mix, aerated lagoon, a 3.6 ha (9-acre) facultative lagoon, and a 0.2-ha (0.5-acre) polishing pond, and provides application on up to 30 ha (73.5 acres) of native desert range land through a sprinkler pivot irrigation system.

A State of Idaho WLAP was issued for this system in July 1994. The permit limits wastewater application to 63.5 ha-cm/ha/year (25 acre-in./acre/year) from March 15 through November 15, and limits leaching losses to 7.6 cm/yr (3 in./yr). Irrigation began in June 1997 and continued through September. Application of wastewater to a native range habitat is a unique practice, and this technology is being evaluated to determine the benefits and suitability.

The permit specifies effluent monitoring locations, frequencies, and parameters. No parameter concentration limits are specified in the permit. The two locations monitored for compliance with the permit include the influent to the STP collected monthly at the Lift Station (CFA-LS1) and the final effluent to the pivot monitored at the pump pit (CFA-STF) during months of pivot operation. An unscheduled shutdown in pivot irrigation occurred from July 14 to August 5 that prevented the collection of the July sample.

Yearly average concentrations for parameters measured in the influent to the CFA STP (CFA-LS1) were below levels typically classified as "weak" municipal wastewater [biological oxygen demand (BOD) < 110, TSS < 100, total N < 20 mg/L].[47] This is consistent with the significant portion of wastewater that is derived from noncontact cooling water from air conditioners and heating systems at CFA.

Treatment in the CFA STP lagoons was sufficient to produce good quality effluent for land application. This is indicated by the significant reduction in the average concentrations of total nitrogen, BOD, COD, and TSS between influent (CFA-LS1) and effluent concentrations (CFA-STF).

5.2.2.2 Idaho Chemical Processing Plant. The primary discharges to the environment at ICPP include the effluent from the STP to rapid infiltration trenches (CPP-773) and effluent from the service waste system to the percolation ponds. WLAPs were issued for these systems in September 1995. The permits specify effluent monitoring locations, frequencies, and parameters. WLAP monitoring of the STP was conducted as part of the Liquid Effluent Monitoring Program beginning in October 1995. Prior to this date, STP monitoring was conducted by ICPP Operations.

The ICPP generates 5.7 to 9.5 ML/day (1.5 to 2.5 MG/day) of process wastewater during normal operations. This service waste is discharged to Percolation Ponds 1 or 2 via the service waste system. The Percolation Ponds are used only to receive the discharge of nonhazardous wastewater. The service waste discharge to the Percolation Ponds was monitored by ICPP Operations during 1997, and data are not included in this report. Service waste sampling included the WLAP monitoring and monthly composite samples for radiological and nonradiological parameters. Effluent constituent concentrations were within normal ranges, and the annual flow volume was within permit limits. Required ICPP data are reported in the *1997 Annual Wastewater Land Application Site Performance Reports for the Idaho National Engineering and Environmental Laboratory*,[42] and in the *ICPP Environmental Monitoring Report*.[48]

The STP at ICPP is used to treat and dispose of sanitary and other related wastes at the ICPP. It consists of two aerated lagoons, two quiescent, facultative stabilization lagoons, four rapid infiltration trenches, and six weir boxes (control stations) that move the sewage through the desired lagoons and trenches. During September 24 and 25, Cell No. 1 was bypassed so that the influent flow meter weir plate could be replaced in CPP-769 Control Station in an effort to resolve discrepancies between the influent and effluent flow meter readings. In order to prevent potential tears in the liner due to wildlife entering the pond, a chain-link fence was installed around the the pond area in October 1997.

Automatic, flow-proportional composite samplers are located at control stations CPP-769 and CPP-773 (Figure A-8). The WLAP for the STP sets the following limits for effluent prior to the infiltration trenches (CPP-773):

- TSS of 100 mg/L averaged monthly
- Total nitrogen (NO_3-N + NO_2-N + TKN) of 20 mg/L averaged monthly [with interim limits (through September 1997) of less than 40 mg/L averaged monthly and yearly average of less than 26 mg/L]
- Flow to rapid infiltration trenches of 30 million gallons annually.

For 1997, the STP effluent did not exceed the 100 mg/L total suspended solids (TSS) or the flow limit set forth in the permit. However, the total nitrogen limit of 20 mg/L was exceeded in the December sample (24.4 mg/L). The annual average concentration was 16.1 mg/L. Influent and effluent total nitrogen concentrations from October 1995 through 1997 are shown in Figure 5-4. Effluent total nitrogen levels appear to fluctuate with seasonal temperatures as shown by the decreasing nitrogen levels in the summer months and increasing concentrations in winter. Microbial activity in the lagoons is reduced during periods of cold temperatures and results in decreased nitrification/denitrification processes. Further sampling will be conducted in early 1998 to determine whether elevated nitrogen levels remain. IDEQ was notified of the exceeded levels when data were received. As a result, efforts are underway to determine alternative treatment systems or methodologies that will ensure the total nitrogen levels remain below 20 mg/L. An engineering evaluation is being conducted to determine whether operational changes, such as increasing pond depth or recirculation will provide adequate treatment. Other treatment options being considered include breakpoint chlorination or addition of a carbon source.

Monthly TSS concentrations exceeded the Level 2 statistical control limit 5 times during 1997 (Table 5-4). The Level 2 limits were based on historical monthly sample data obtained under Environmental Monitoring Program procedures since permit required monitoring was implemented (October 1995 through 1996). The average TSS concentration obtained during this historical period was 7.1 mg/L, compared to an average of 21.4 mg/L in 1997. Although none of the 1997 monthly concentrations approached the 100 mg/L permit limit, these excursions indicate a deviation from normal operations since the permit was issued. TSS concentrations are also obtained by the STP operators on a weekly basis for operational purposes. A review of these data collected from 1994 through 1996 showed that the monthly average concentrations ranged from 2.0 to 81.3 mg/L, with annual averages of 32.2 mg/L in 1994, 20.3 mg/L in 1995, and 7.3 mg/L in 1996. When historical operator data are considered, the 1997 TSS concentrations are within the historical levels for this effluent. TSS concentrations will continue to be evaluated as more post-permit data are collected to determine normal operating levels and to monitor for upward trends.

Overall, treatment in the ICPP STP lagoons was sufficient to produce good quality effluent for land application to the rapid infiltration trenches. This is evidenced by the significant reduction in average concentrations of total nitrogen, TSS, and BOD as determined from the differences between influent and effluent concentrations.

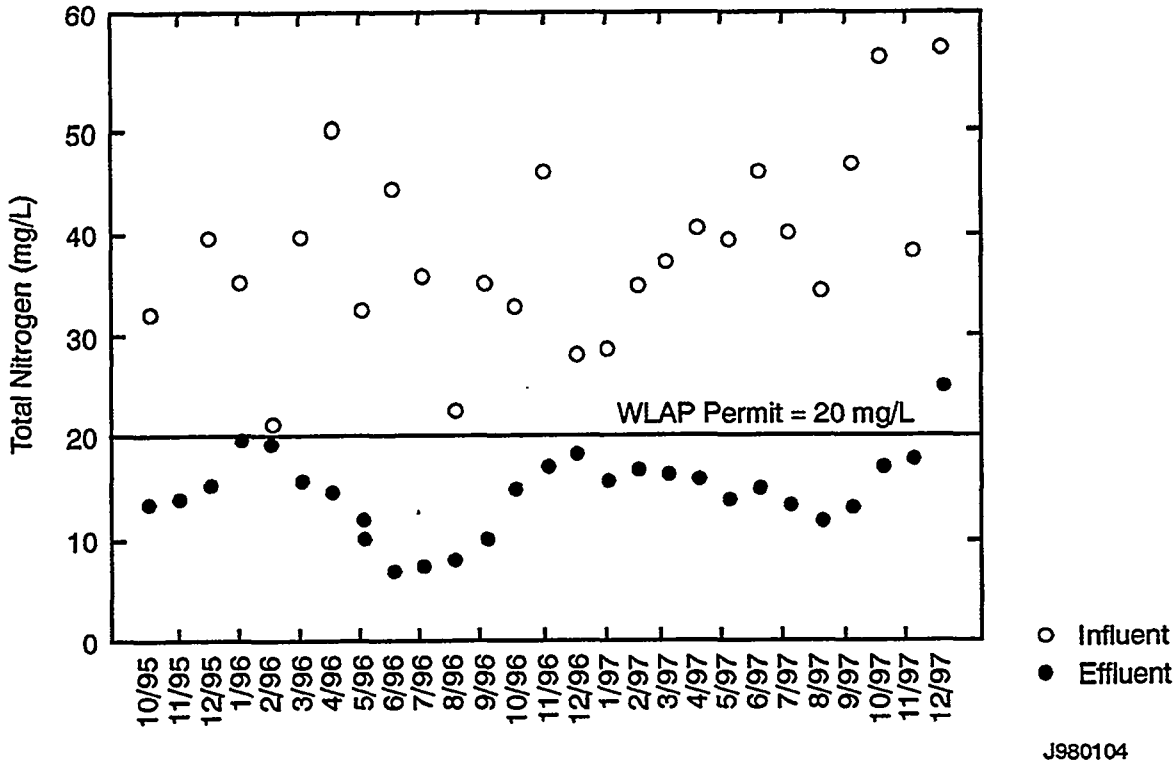


Figure 5-4. ICPP total nitrogen levels in the STP from 1995 through 1997 (J980104).

Table 5-4. TSS data exceeding Level 2 control limits of 20.5 mg/L.

Stream	Sample Date	Concentration (mg/L)
CPP-773	05/07/97	31.80
	07/08/97	44.00
	08/21/97	51.00
	09/16/97	29.00
	10/09/97	21.00

5.2.2.3 Idaho Falls Facilities. Sixteen Waste Acceptance Forms have been issued for 27 buildings operated by LMITCO. Administrative controls are in place at the IRC and WCB to ensure discharges from individual operations at these facilities are in compliance with the City discharge limits.

Industrial Wastewater Acceptance Forms for the IRC and the WCB specify semiannual monitoring requirements to demonstrate compliance with City sewer limits. In addition, monthly self-monitoring was conducted as a pollution prevention practice and reported to the city until March 1997. Monthly self-monitoring was discontinued based on a statistical analysis of historical data, indicating a low probability of exceeding a limit. With concurrence from the city, monitoring at the semiannual compliance points was reduced to only permit-required parameters in September 1997. Table D-5 lists the 1997 concentration limits for discharges to the City of Idaho Falls sewer system.

No contaminants were detected above the City of Idaho Falls limits in IRC or WCB effluent discharges during 1997.

5.2.2.4 Radioactive Waste Management Complex. Samples were routinely collected from the lined sewage lagoons at the RWMC (Figure A-12). The lagoons received sanitary sewage effluent from support facilities at the RWMC. The Liquid Effluent Monitoring Program began collecting wastewater samples at the RWMC sewage lagoons in April 1995, shortly after the lagoons were constructed. All analytes detected in water samples from the RWMC lagoons were below applicable release levels in 1997.

5.2.2.5 Test Area North. The primary discharges to the environment monitored at TAN include the final effluent to the TAN/TSF Disposal Pond (TAN-655) and the effluent to the WRRTF STP sewage lagoon and process pond (WRRTF-1 and WRRTF-2).

5.2.2.5.1 Effluent to the TAN/TSF Disposal Pond (TAN-655)—The TAN/TSF disposal pond is an unlined percolation pond. The pond receives wastewater discharges from the TSF STP and process wastewater. The TAN/TSF STP receives wastewater from sanitary sewage drains throughout the TSF area. The STP and process wastewater combine in the TAN-655 sump before being discharged to the pond. The TAN/TSF STP was constructed in 1956. The facility consists of a sewage collection lift station, Imhoff tank, sludge drying beds, trickle filter and settling tank, contact basin, and infiltration disposal pond. The TAN/TSF disposal pond was constructed in 1971; prior to that, treated wastewater was disposed via an injection well.

Process wastewater contributed to the pond includes boiler blowdown, such as that generated in the Service Building, which is expected to contribute inorganic salts concentrated from feedwater (calcium and magnesium salts, chlorides, and sulfates), corrosion products (metal oxides), and any chemical additives. Wastewater from the demineralizer system is expected to contribute mineral salts from makeup water and excess regenerant chemicals (sodium-hydroxide and sulfuric acid). Data from 1987 through 1997 were consistent with these anticipated discharges.

A WLAP was issued for this system in May 1996. The permit specifies effluent monitoring requirements for the TAN-655 location. The WLAP sets the following limits for effluent prior to discharge to the TSF Pond (TAN-655):

- TSS of 100 mg/L averaged monthly
- Total nitrogen (NO_3-N + NO_2-N + TKN) of 20 mg/L averaged monthly
- Flow volume of 34 million gallons annually.

The annual flow volume and average monthly concentrations for total nitrogen and TSS were below permit limits.

5.2.2.5.2 Effluent to the WRRTF Sewage Lagoon and Process Pond (WRRTF-1 and WRRTF-2)—The WRRTF Sewage Lagoon receives effluent from sanitary drains from the WRRTF facility. Sewage passes through a septic tank and sand filter before being discharged to the pond. Due to limited personnel at WRRTF, this discharge was low-volume and intermittent. Data collected from 1992 to 1997 were comparable to data obtained from other STP effluents on-Site.

The WRRTF Process Pond receives low-volume, intermittent discharges from secondary cooling water and boiler blowdown, and rarely receives demineralizer regenerant solutions. Data from 1987 to 1997 were consistent with these anticipated discharges.

5.2.2.6 Test Reactor Area. At TRA, all wastewaters are handled as either nonradioactive (cold), low-level radioactive (warm), or highly radioactive (hot) waste. Cold waste is released to a percolation pond (Cold Waste Pond), and warm wastewater is discharged to a lined, evaporation pond (Warm Waste Pond). A tanker trailer contains the hot waste and is transported to ICPP for evaporation. Nonradioactive, sanitary waste is discharged to the STP, and nonradiological demineralizer waste is discharged to a percolation pond (Chemical Waste Pond).

The primary effluent discharges to the environment monitored at TRA during 1997 include: (a) effluent to the Cold Waste Pond (TRA-764), (b) effluent to the Chemical Waste Pond (TRA-708), and (c) effluent to the STP Lagoons (TRA-LS1 and TRA-STF). A more detailed discussion of these effluents is provided below.

5.2.2.6.1 Effluent to the Cold Waste Pond (TRA-764)—Effluent to the Cold Waste Pond (TRA-764) is generated by the 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 operation. The largest volume of wastewater received by the Cold Waste Pond is secondary cooling water from the ATR 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 from 1987 through 1997 indicated that the cold waste effluent is fairly homogenous, and in 1997, met applicable release levels for all parameters monitored.

5.2.2.6.2 Effluent to the Chemical Waste Pond (TRA-708)—The TRA effluent to the Chemical Waste Pond is generated by water treatment processes at the TRA demineralizer facility. The ion-exchange process uses electrically-charged resin beads to attract and adsorb oppositely charged ions from the water until the resin exchange sites are filled with ions from the water. When the exchange capacity of the resin is saturated, the resin bed is regenerated by rinsing the resin with an appropriate chemical solution. Cation-exchange regeneration, which uses sulfuric acid as a regenerant, is performed approximately every other day. Anion-exchange regeneration uses a sodium-hydroxide regenerant and is performed approximately every third day. The waste streams are neutralized before being discharged to the Chemical Waste Pond. The neutralization took place in the brine pit (TRA-731A) until September 1995, when an above-ground tank (TRA-708C) was put into operation for neutralization. During 1997, the neutralized waste stream was sampled from the sampling point in TRA-708C. The field pH measurement range for 1997 was 6.67 to 9.77.

Ion-exchange regeneration waste streams typically contained mineral salts removed from the water, excess regenerant chemicals, and rinse waters from the regeneration process. Specific waste stream constituents anticipated in regeneration wastewater include calcium, sodium and magnesium salts, iron, copper, zinc, aluminum, manganese, potassium, chlorides, sulfates, mercury, and sodium-hydroxide. Constituents with elevated levels are discussed in the following paragraphs. All others were below concern levels.

Water quality data from 1987 to 1997 were consistent with the large quantities of dissolved salts in demineralizer effluents. The high historical mean conductivity (21,365 μS) and total dissolved solids (TDS) (21,074 mg/L) resulted from the elevated levels of dissolved salts and free ions introduced during the regeneration process. The high historical mean concentrations for sodium (3,835 mg/L) and sulfate (17,339 mg/L) resulted from the sodium-hydroxide and sulfuric acid used in the regeneration process. Average concentrations in 1997 exceeded risk-based release levels for sulfate (by 15 times), TDS (by 10 times), and sodium (by 12 times). The high levels of these constituents have the potential to degrade groundwater and represent an environmental concern. A reverse osmosis system is scheduled to replace the existing demineralizer system in 1999. This will eliminate discharge of these contaminants to the Chemical Waste Pond.

5.2.2.6.3 Effluent from the Sewage Treatment Plant (TRA-LS1 and TRA-STF)—The TRA STP lagoons receive wastewater from sanitary sewage drains throughout TRA. The old plant was replaced by two lined treatment lagoons in December 1995. Beginning in 1996, influent to the lagoons was sampled from the new lift station (TRA-LS1).

During 1996, it was determined that the liner in lagoon no. 2 was leaking. Beginning in September 1996, samples were collected from the transfer structure at lagoon no. 1. Sampling results were used to develop a WLAP application for a temporary irrigation system to be operated while the lagoon liner was being repaired. A temporary WLAP was issued for the system on July 8, 1997. However, daily wastewater flow rates were somewhat lower than estimated during the repair period; so, lagoon no. 1 never reached capacity, and no wastewater was ever applied to the land application site. Monitoring was discontinued in October 1997, and the permit was cancelled.

5.2.3 Special Studies

The WLAP for the CFA STP requires annual soil sampling inside the irrigation area. These results are reported in the Annual WLAP Site Performance Reports.[42] In addition to permit-required soil sampling, additional soil and soil pore-water sampling was initiated in 1997 as part of a special study. The primary objective of this study is 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 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 WLAP (with the exception of phosphorous) inside the irrigated area, and compare them to similar measurements made immediately outside the irrigated area in the same plant community. Lysimeters were also installed for the purpose of extracting soil pore-water at the same locations and depth intervals as the soil samples.

Sampling locations were chosen based on their proximity to the ESRF'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 5 neutron probes within the irrigation area and 5 neutron probes in an adjacent control area during the summer of 1997. Soil pore-water sampling will begin at these locations in the spring of 1998; a time at which snow-melt and rainfall are most likely to produce conditions conducive to soil pore-water extraction. Soil sampling at the same depths and areas will occur 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 WLAP permit compliance.

Compared to the adjacent control area outside the irrigation area, results of November 1997 soil sampling indicate an increase in soluble salts inside the irrigation area. Both conductivity and the sodium absorption ratio are elevated in the 0–30 cm (0–12 in.) interval within the irrigation area. The soil electrical conductivity and sodium absorption ratio in this depth interval are approaching that of the applied wastewater. Ca and Mg concentrations are approximately twice as high at all depth intervals inside the irrigation area than they are outside the irrigation area. Na concentrations are much higher in the 0–30 cm (0–12 in.) interval inside irrigation area, but much lower at 30–60 cm (12–24 in.) and 60–90 cm (24–35 in.) intervals. Although there is soluble salt buildup near the surface, it is well below levels considered detrimental to plant growth and soil permeability.

Ammonia concentrations within the soil profile have not increased significantly due to irrigation. It is likely that most of the ammonia is volatilized upon application, and the remaining ammonia is quickly utilized by plants. Nitrate and TKN concentrations in the surface intervals are lower within the irrigation area than the control area. 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. Nitrogen levels are slightly higher at deeper depth intervals (below root zone) within the irrigation area. These higher nitrogen levels may be consistent with reduced uptake by plants from deeper depth intervals.

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.

Additional data will be collected and statistical analyses 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.

5.2.4 Quality Assurance/Quality Control

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. One hundred percent of the effluent duplicates for volatile organic analysis achieved this goal; 95.6% of duplicates analyzed for metals achieved this goal; 86.7% of duplicates analyzed for inorganics achieved this goal; 100% of duplicates analyzed for radionuclides achieved this goal. 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, which has a negative effect on any statistical analyses performed on the data set.

Blind standards (QA/QC field blinds) are submitted approximately quarterly. Blind standard sample solutions are purchased from a supplier of laboratory QC standards. The samples are prepared by the supplier of the standards using bottles and labels supplied by Environmental Monitoring Program. After preparing the blind standards, the supplier ships the prepared samples back to the Environmental Monitoring where they are repackaged and shipped to the analytical laboratory. The standard labeling and sample numbering scheme is used so that there is no indication to the analytical laboratory that the samples are QC samples.

First quarter field blind spikes sent to the analytical laboratory consisted of trace metals, inorganics, phenolics, cyanide, and volatile organics. Results were consistently biased low except for phenolics,

which were within the certified value range. Second quarter blind spikes sent to the laboratory consisted of trace metals and inorganics. Acceptable results were achieved for trace metals and most inorganics, except for the analysis for cyanide, which was far outside the performance acceptance limits. Third and fourth quarter blind spike results for metals, TDS, fluoride, sulfate, phenolics, cyanide, nitrate-nitrite, TKN, and volatile organics were within performance acceptance limits but results for BOD, COD, TSS, and chloride were outside performance acceptance limits.

Low bias in results of analyses performed on blind QC samples may indicate that the results of effluent samples collected in the same time period may also be biased low. Data remains usable as long as this possibility is taken into account. 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. No trip blank contamination was observed in1997.

The LMITCO Sample Management Office reviewed all blind standards data and discussed possible issues with the contract laboratory personnel, but could find no specific problems. The raw data submitted showed no irregularities.

The primary contract laboratories used by the Liquid Effluent Monitoring Program include Recra Lab-Net Philadelphia and Paragon Analytics. Recra Lab-Net Philadelphia participates in the DOE Mixed Analyte Performance Evaluation Program and in the DOE Integrated Performance Evaluation Program, which integrates QC data obtained by the EPA Water Pollution Laboratory Performance Evaluation Program. These programs send blind QC spikes to participating laboratories in order to evaluate their performance. The parameters evaluated in the program studies include inorganic trace metals, VOCs, pesticides, PCBs, nutrients, oil and grease, cyanide, chemical and biochemical demands, and others. Recra Lab-Net Philadelphia has consistently demonstrated acceptable accuracy and precision for the majority of analytical parameters. Under the Integrated Performance Evaluation Program, the laboratory occasionally has provided unacceptable results for sulfate, nitrate, total organic carbon, and TSS.

For effluent radiological analyses, inter-laboratory comparison samples (blind spikes) are sent to participating laboratories (including Paragon Analytics) by the EPA-Las Vegas Performance Evaluation Program, the DOE Mixed Analyte Performance Evaluation Program, and the DOE Environmental Measurements Laboratory Quality Assessment Program. The INEEL Drinking Water Program also sent blind spike samples to Paragon on a quarterly basis. The laboratory has demonstrated acceptable accuracy and precision for these analyses.

5.3 Storm Water Monitoring Program

The EPA NPDES rules for the point source discharges of storm water to waters of the U.S. require permits for discharges from industrial activities and construction sites. The permits require implementation of pollution prevention plans to reduce pollutants in storm water discharges. Additional requirements apply to water priority chemicals above a threshold quantity. Also, groundwater protection is required by a special condition included by the State of Idaho.

For regulatory purposes, surface water at the INEEL includes the Big Lost River, Little Lost River, Birch Creek, spreading areas, playas, and tributaries, which comprise the Big Lost River System (BLRS) (Figure 5-5). Groundwater could be influenced by storm water through deep injection wells located at CFA, PBF, and TAN.

On September 9, 1992, the EPA issued the NPDES General Permit for Storm Water Discharges from Construction Sites[49] with an effective date of October 1, 1992. To meet the requirements of the permit, DOE-ID prepared the *INEEL Storm Water Pollution Prevention Plan for Construction Activities*.[50] The plan provides for pollution prevention practices and inspections, but monitoring is not required.

On September 9, 1992, the EPA issued the NPDES General Permit for Storm Water Discharges Associated with Industrial Activity[2] with an effective date of October 1, 1992. To meet the requirements of the permit, DOE-ID prepared the *INEEL Storm Water Pollution Prevention Plan for Industrial Activities*[51] (SWPPP-IA). The SWPPP-IA is applicable to all the facilities and includes pollution prevention teams, descriptions of potential sources of pollution, measures and controls, evaluation requirements, and monitoring requirements. Practices to minimize storm water pollution are evaluated annually, and the plan is revised accordingly. In 1997, monitoring of stormwater that enters deep injection wells was transferred from the USGS to LMITCO.

5.3.1 Program Design Basis

The Storm Water Monitoring Program meets the NPDES General Permit requirements by conducting required monitoring. In addition, the program monitors storm water runoff to deep injection wells because the State of Idaho stipulated a special condition in the NPDES General Permit concerning the protection of groundwater and to comply with State of Idaho injection well permits.

Storm water monitoring involves collecting and analyzing samples to determine the pollutants in storm water discharges. Storm water has the potential to transport pollutants to surface water or groundwater. Sources of pollutants include fallout from industrial air emissions, contaminated soil, pesticide and fertilizer application, vehicle and equipment wash and repair areas, parking lots, material handling areas, spills or leaks, illicit connections to the storm drain system, refueling operations, vehicular emissions, and material storage areas.

Parameters for all sites were based on specific facility operations. Sampling of snow melt and rain runoff began in 1993 at various facilities at the INEEL. Permit-required data are submitted to the EPA in the Annual Discharge Monitoring Report.[52] Additionally, all data are reported in the annual updates to the SWPPP-IA.

During 1996, current monitoring, regulations, other DOE programs nationwide, and historical storm water data were evaluated. Based on the evaluation, the 1997 monitoring network was reduced from 1996 levels, and parameters were streamlined to include indicator parameters that could be compared across sites.

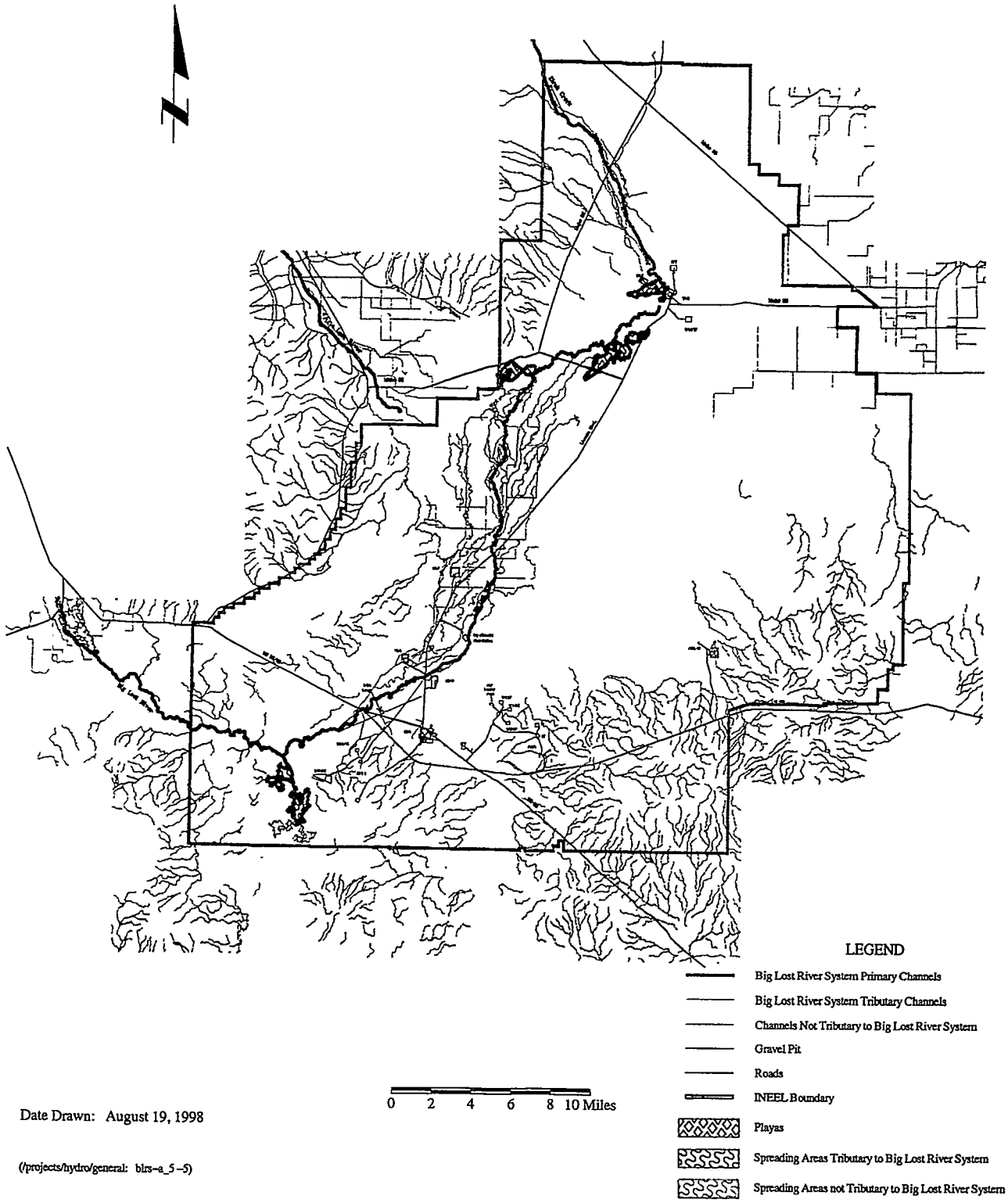


Figure 5-5. Big Lost River System.

A total of 16 sites (Table 5-5) at eight INEEL areas (Appendix A) were designated as storm water monitoring locations based upon drainage patterns and proximity to potential sources of pollutants. Four facilities met the conditions for semiannual monitoring required by the NPDES General Permit when discharges occur to the Big Lost River System (CFA Landfill #3, ICPP Coal Pile, ICPP retention basin, and RWMC SDA). Seven locations at deep injection wells were included in the monitoring network. Storm water runoff not specifically required by the permit was also monitored to evaluate the effectiveness of storm water pollution prevention practices.

During 1997, the Storm Water Monitoring Program attempted to collect samples at the deep injection well basins, whether water was discharged down the injection well or not, to provide an indication if storm water could pose a threat to the aquifer. The Storm Water Monitoring Program was also responsible for collecting samples from water discharging down the deep injection wells for demonstration of compliance with the State of Idaho injection well regulations[53] and permits.

Samples were collected from snow melt or storms that left at least 0.25 cm (0.1 in.) of precipitation preceded by at least 72 hours without precipitation to allow pollutants to build up and then be flushed from the drainage basin. Because sampling occurs in response to unique meteorological conditions, advance schedules cannot be developed. The NPDES General Permit requires two samples per year for the four locations that are subject to the permit requirements. An attempt was made to sample all locations twice a year. Samples were either grab samples or composite samples. Permit-required grab samples were collected within the first 30 minutes of discharge, if possible, or within the first hour if not. Permit-required composite samples were collected by collecting flow-proportional aliquots every 15 to 20 minutes during the first three hours of discharge or when the storm ended, whichever was shortest. Basin grab samples were collected in the place of composites if the storm water was not discharged from the basin within 24 hours. Because of unique meteorological conditions, not all sites may be sampled every year.

The storm duration and amount were recorded for all precipitation events along with the duration between the storm event sampled and the end of the previous storm. The NPDES General Permit requires these measurements, as well as total discharge volume, for storms resulting in a discharge to the BLRS.

5.3.2 Data Summary and Assessment by Facility

During 1997, a total of eight sampling events took place. A sampling event is defined as samples being obtained from one of the 16 monitoring locations for a single storm. Five of the 16 sites were sampled during rainfall events, and three were sampled during rainfall events with snow melt runoff. A total of six sites had at least one sample collected. Table 5-6 shows sampling dates and locations for the storm water events in 1997.

No flow was observed during 1997 at six monitoring points and seven injection wells (Table 5-5); therefore, no samples were collected at those locations.

The number of sampling events in 1997 was significantly lower than in 1996 due to less snow melt runoff. There was also slightly less precipitation [0.89 cm (0.35 in.) less at CFA] and fewer storms that produced greater than 0.25 cm (0.10 in.) in 24 hours (31 storms in 1996 versus 24 in 1997 at CFA). Additionally, in 1997, the dry periods between storms were longer causing more infiltration and less runoff.

Table 5-5. 1997 storm water monitoring locations and frequencies.

Site ID	Site Description	Parameters[a]	Number of Sampling Events in 1997
CFA-MP-2[b]	CFA Landfill #3 near entrance	RCRA metals[c] + total and dissolved Mg, inorganics[d] + TOC, TDS, TKN, CN, Whole Effluent Toxicity, and radiological parameters[e]	0
CFA-MP-3	CFA Disposal Well near junction of Lincoln and Wyoming	Drinking water metals,[f] inorganics + TDS, CN, coliform, and radiological parameters	0
CPP-MP-1[b]	East Perimeter Road at culvert to retention basin	Inorganics + BOD, TKN, total P, and radiological parameters	1
CPP-MP-2[b]	South side of coal pile at discharge to ditch	Cu, Ni, Zn, TSS, COD, and TOG, and radiological parameters	1
PBF-MP-2	SPERT Disposal 1	Drinking water metals, inorganics + CN, TDS, coliform, and radiological parameters	0
PBF-MP-3	SPERT Disposal 2	Drinking water metals, inorganics + CN, TDS, coliform, and radiological parameters	0
PBF-MP-4	SPERT Disposal 3	Drinking water metals, inorganics + CN, TDS, coliform, and radiological parameters	0
RWMC-MP-2[b]	Outflow from the SDA at the sump by culvert C-12	RCRA metals + total and dissolved Mg, inorganics + TDS, TKN, CN, radiological parameters + Np-237, U-234, -235, -238, Am-241, Pu-238, -239/240, and VOCs or Whole Effluent Toxicity	2
SMC-MP-1	West side of SMC on Taylor Creek Road	Inorganics + BOD and radiological parameters	2
TRA-MP-1	Culvert C-11 north of TRA-602	Inorganics and radiological parameters	0
TRA-MP-2	Culvert C-10 north of TRA-601	Inorganics and radiological parameters	0
TSF-MP-1	TAN drainage disposal 1, corner of Lincoln and Nile	Drinking water metals, inorganics + CN, TDS, coliform, and radiological parameters	0
TSF-MP-2	TAN drainage disposal 2, discharge to basin TAN-782	Drinking water metals, inorganics + CN, TDS, coliform, and radiological parameters	0
TSF-MP-3	TAN drainage disposal 3, basin northwest of TSF	Drinking water metals, inorganics + CN, TDS, coliform, and radiological parameters	0

Table 5-5. (continued).

Site ID	Site Description	Parameters[a]	Number of Sampling Events in 1997
WRF-MP-1	Catch basin, east side of WERF	RCRA metals + total and dissolved Mg, inorganics + TDS, TOC, TKN, and radiological parameters	1
WRF-MP-2	Catch basin, south side of WERF	RCRA metals + total and dissolved Mg, inorganics + TDS, TOC, TKN, and radiological parameters	1

a. All locations are sampled for field parameters including pH, electrical conductivity, and temperature.

b. This location has specific permit monitoring requirements.

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

d. Inorganics include COD, TOG, TSS, and NNN.

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

f. Drinking water metals include antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, lead, mercury, nickel, selenium, sodium, and thallium.

Table 5-6. 1997 storm water sampling events.

Location	Date	Event[a]	Precipitation (cm)	Discharge to Big Lost River System	Flow Rate (L/sec)
Compliance Monitoring Points					
CPP-MP-1	06/10/97	RR	0.89	No	4.82
CPP-MP-2	06/10/97	RR	0.89	No	0.57
RWMC-MP-2	01/02/97	RR/SM	1.93	No	NF[b]
RWMC-MP-2	06/10/97	RR	0.97	Yes	25.2
Surveillance Monitoring Points					
WRF-MP-1	01/02/97	RR/SM	1.88	No	NM[c]
WRF-MP-2	01/02/97	RR/SM	1.88	No	NM
SMC-MP-1	04/24/97	RR	1.32	No	NF
SMC-MP-1	06/10/97	RR	1.24	No	0.20

a. SM = snow melt, RR = rain runoff.

b. NF = no measurable flow at the time of sampling.

c. NM = not measured.

Storm water was discharged to the BLRS from RWMC SDA (RWMC-MP-2) in June and was sampled in compliance with the NPDES Permit. The discharge was to the man-made channel that connects to the Big Lost River approximately 4.83 km (3 mi) away, and therefore, the channel is considered part of the BLRS. Water infiltrated within a short distance of the discharge point. All other samples were collected for surveillance purposes because they are either not permit-required locations or did not result in a discharge to the BLRS.

Storm water monitoring results were compared to a number of criteria as a method of evaluating the quality of storm water discharges. The NPDES General Permit does not have numeric limitations for the required analytical parameters, with exception of the runoff from coal piles. The pH of runoff from the coal pile at ICPP must be within the range of 6 to 9. Only the pH in runoff from the coal pile is a regulatory limit, all other criteria were used for comparison purposes only. Nonradiological concentrations were compared to EPA Benchmarks from the *1995 Multi-Sector Storm Water Permit.*[54] Radiological concentrations were compared to DCGs found in DOE Order 5400.5. The benchmarks and DCGs are pollutant concentrations above which EPA and DOE determined represents a level of concern. The level of concern is a concentration at which a storm water discharge could potentially impair or contribute to impairing water quality or affect human health from ingestion of water or fish. EPA benchmarks have been used by EPA 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.

Volatile organic analytes were not detected in any of the samples, and therefore, are not discussed. Table 5-7 summarizes the analytical results that exceeded the guideline comparison level during 1997. No permit or regulatory limits were exceeded.

Minimum, maximum, and mean concentrations for 1997 sample events were calculated, and snow melt and rain runoff samples were averaged together to calculate the mean. Historical and 1997 summary data for permit-required monitoring locations are presented in Appendix F.

5.3.2.1 Zinc and Total Suspended Solids Concentrations. Of the contaminants that exceeded the EPA Benchmarks in 1997, zinc and TSS were the most frequently detected. Figures 5-6 through 5-9 show zinc concentrations for INEEL storm water runoff samples from 1993 through 1997. No samples were collected from ANL-W, CFA, and PBF during 1997, and zinc was not analyzed in samples from the TAN monitoring locations during 1997. Figures 5-6 and 5-9 show historical data for comparison purposes only.

From 1978 to 1983, the EPA conducted the Nationwide Urban Runoff Program (NURP).[55] The objective of the study was to characterize discharges from separate storm sewers that drained residential, commercial, and light industrial areas. The NURP average zinc concentration was used to determine how INEEL storm water compares nationally. The total average zinc concentration from the NURP study was 0.353 mg/L, compared to the 1993 through 1997 average for INEEL of 0.227 mg/L.

According to the EPA,[54] heavy metals (especially copper, lead, and zinc) are by far the most prevalent priority pollutant metals that occur in urban runoff. High concentrations of copper and zinc at some NURP project sites were attributed to the effect of acid rain on materials used for gutters, culverts, etc. Other sources[56] list tire wear as a primary source of zinc in highway runoff. Gutters, culverts, fences, piping, and galvanized sheet metal used in various structures, as well as runoff from roadways may contribute to zinc contamination in storm water runoff at INEEL facilities. Average zinc concentrations

Table 5-7. 1997 storm water/snow melt data exceeding comparison levels.

Monitoring Point	Parameter	Sample Date	Measured Concentration (mg/L)	EPA Benchmark (mg/L)
ICPP-MP-1/1-G	TSS	06/10/97	360	100
RWMC-MP-2/1-G	Nitrogen, nitrate + nitrite	06/10/97	1.20	0.68
RWMC-MP-2/1-G	TSS	01/02/97	421	100
RWMC-MP-2/1-G	Iron	06/10/97	1.29	1.00
RWMC-MP-2/1-G	Zinc	01/02/97	0.14	0.117
RWMC-MP-2/1-G	Zinc	06/10/97	0.42	0.117
WRF-MP-2/1-G	Total phosphorous	01/02/97	8.70	2.00

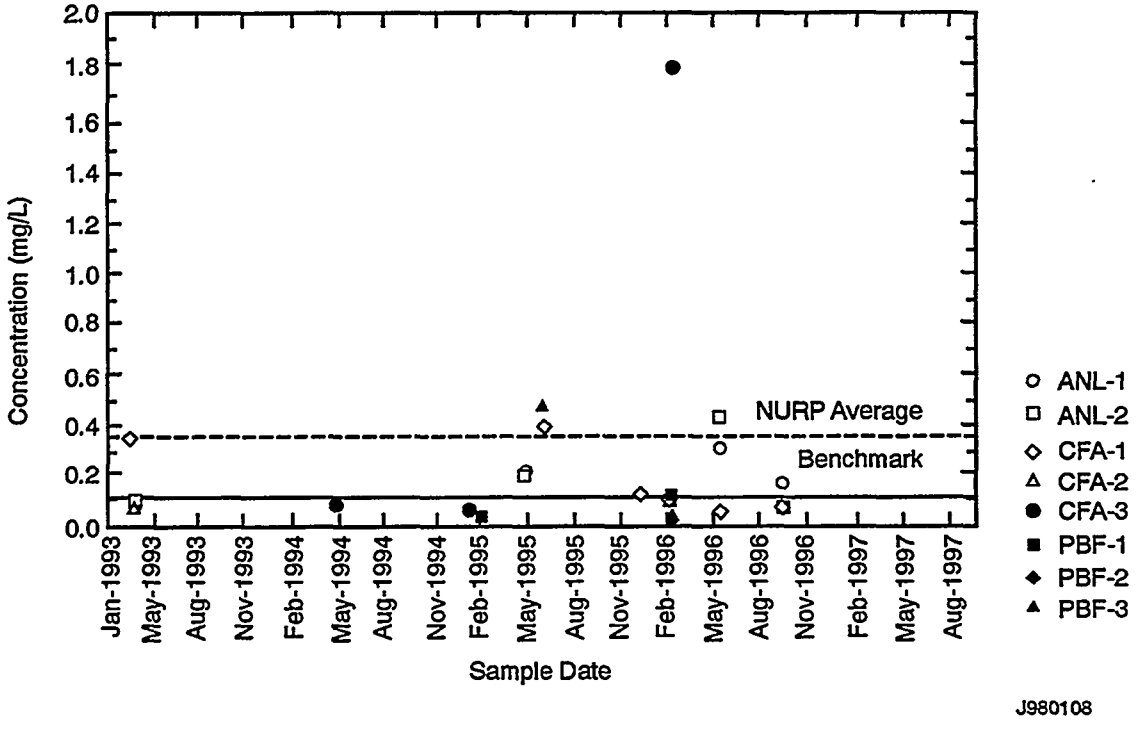


Figure 5-6. Zinc concentrations for ANL-W, CFA, and PBF monitoring points (J980108).

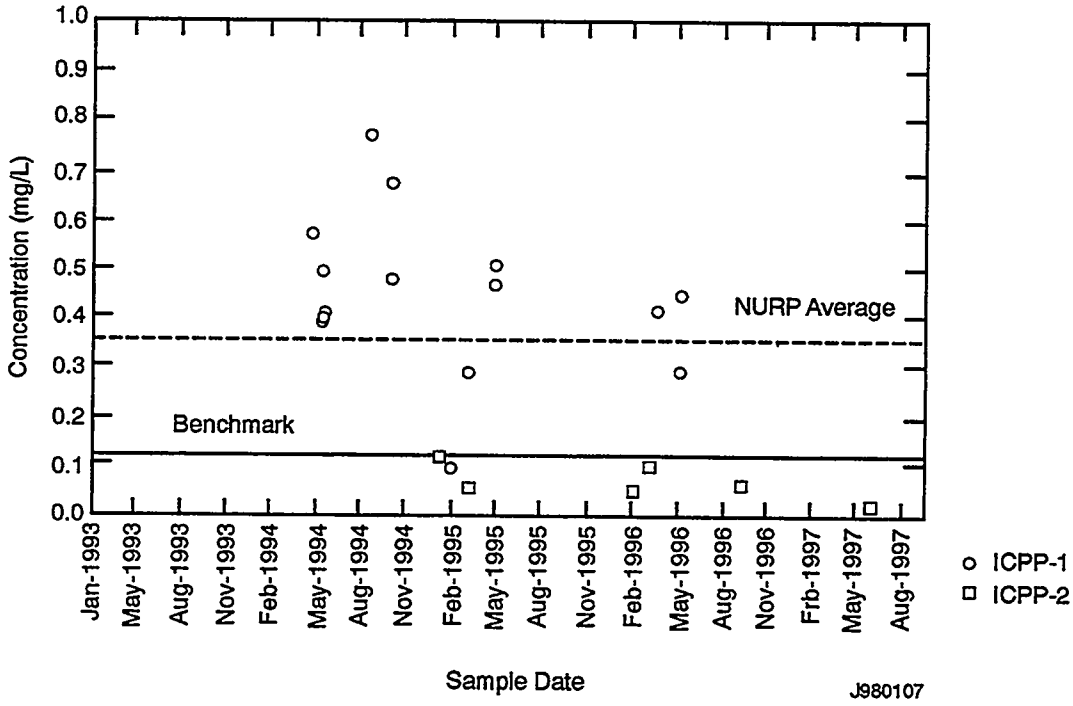


Figure 5-7. Zinc concentrations for ICPP monitoring points (J980107).

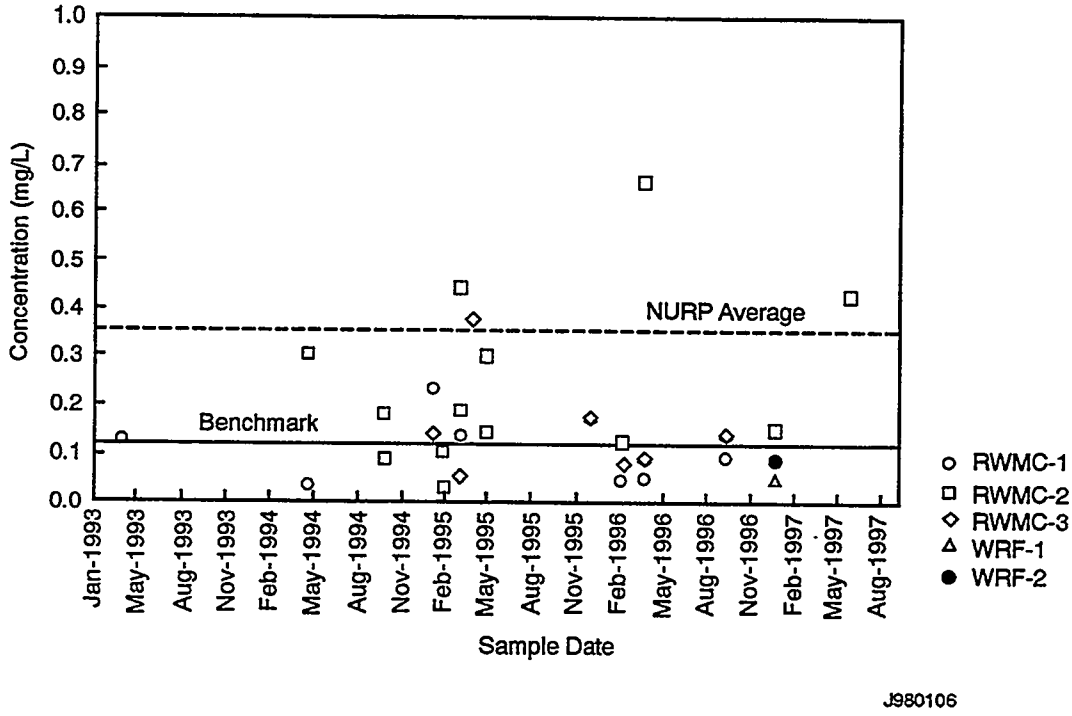


Figure 5-8. Zinc concentrations for RWMC and WERF monitoring points (J980106).

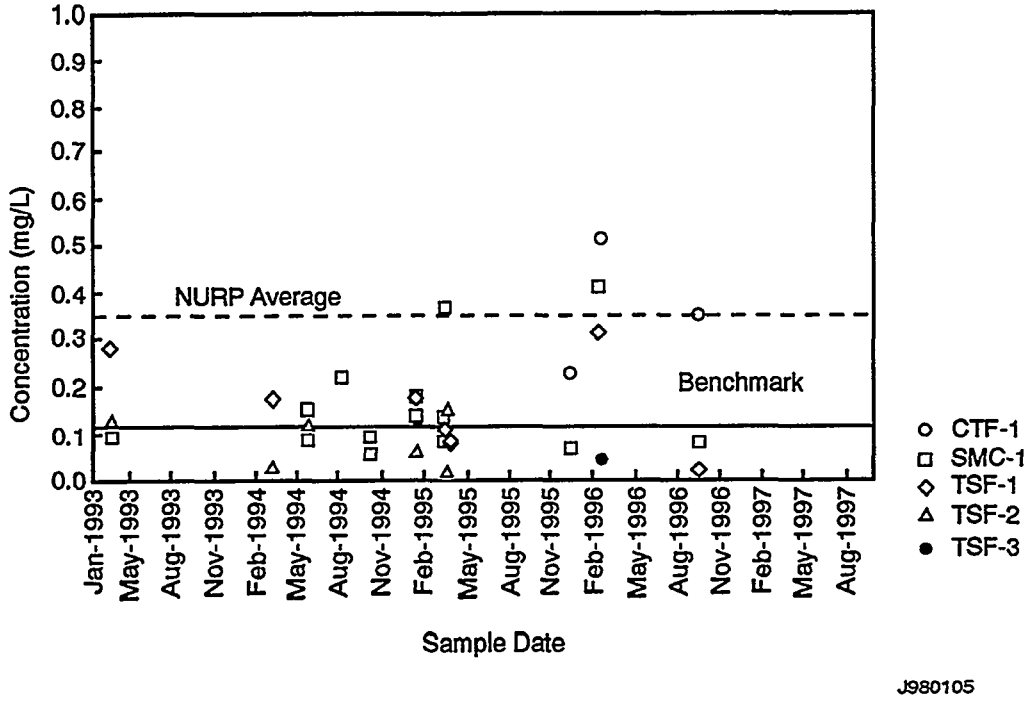


Figure 5-9. Zinc concentrations for TAN monitoring points (J980105).

were lowest at PBF (0.055 mg/L) and highest at ICPP (0.385 mg/L) from 1993-1997. The PBF monitoring locations are the least likely to capture runoff from developed areas, while runoff at ICPP is primarily from developed areas, indicating that the sources listed above could be contributing zinc to runoff at developed INEEL areas.

Some correlation exists between TSS concentrations and zinc concentrations. Rood et al.[46] reported background zinc concentrations in INEEL soils of 147 mg/kg at the upper 95% tolerance level. This background soil concentration was used to compute estimated zinc concentrations in storm water runoff from suspended sediments using the following equation:

$$C'_{sw} = \frac{C_{bk}}{10^6} \times TSS \qquad (1)$$

where

C'_{sw} = the estimated concentration in runoff (mg/L)

C_{bk} = the concentration in background soil (mg/kg)

TSS = total suspended solids concentration in runoff (mg/L).

The amount of zinc in storm water runoff that could be attributed to natural background concentrations of suspended sediment in the sample averaged 21.8% of the measured zinc concentration. This indicates that anthropogenic sources may contribute to zinc in INEEL storm water.

Suspended solids are considered a pollutant when they significantly exceed natural concentrations and have a detrimental effect on water quality. TSS is a good indicator of pollutant removal efficiency and is

used to evaluate storm water pollution prevention practices. Instances of high suspended solids may indicate that erosion control was not adequate at some facilities.

Although EPA benchmark concentrations were exceeded in several samples, the EPA stressed that exceeded levels do not imply that an actual violation of standards will exist in the receiving water body in question. This is particularly the case at INEEL; where in 1997, RWMC was the only location that discharged to a man-made channel that is a tributary of the Big Lost River, and runoff did not reach the Big Lost River.

5.3.2.2 Idaho Chemical Processing Plant. The ICPP has two monitoring locations (Figure A-8); both of these locations are required by the NPDES General Permit. One grab sample was collected from the culvert into the retention basin (ICPP-MP-1), and all parameters were reported below EPA Benchmarks and DCGs, except for TSS. However, no discharge to the Big Lost River System occurred, and water quality was not impacted.

Maintenance of the storm water drainage system is scheduled at ICPP to control erosion of ditches and clean out culverts. The first phase will include spreading gravel on the banks of ditches most susceptible to washing out and is scheduled to be completed in July 1998. Annual preventive maintenance of the storm water drainage system will be implemented.

All analytes for the coal pile runoff (ICPP-MP-2) were below EPA Benchmarks and DCGs and within permit limits; pH was 6.93, which was within the range of 6 to 9, as specified in the NPDES General Permit. Historical and summary data for both locations are presented in Appendix F.

5.3.2.3 Power Burst Facility. There are five monitoring locations at PBF (Figure A-16). Three of the locations (PBF-MP-2, -3, and -4) are at injection well basins, and two are at WERF (WRF-MP-1 and -2). The WERF locations were added in 1997 to gather baseline characterization data. One grab sample was collected from each location during January 1997. The results were below the applicable Benchmarks, with the exception of total phosphorous. No discharge to the Big Lost River System occurred, and water quality was not impacted. A review of spill reports for PBF did not identify a source for the elevated phosphorus concentrations.

5.3.2.4 Radioactive Waste Management Complex. The RWMC has one monitoring location (Figure A-12) at the RWMC SDA (RWMC-MP-2) that is a permit-required location.

One sample was collected from a rainfall/snow melt event in January and a rainfall event in June. Storm water from the June event was discharged to the man-made channel that is part of the Big Lost River System. Therefore, this sample is considered a permit compliance sample. The discharge volume was 6,000 gallons.

The January sample exceeded the EPA Benchmarks for TSS and zinc. The June sample exceeded the benchmark for nitrate + nitrite, iron, and zinc. Water quality in the Big Lost River was not impacted because the discharge infiltrated in the man-made channel within a short distance of the discharge point. Reseeding projects in the SDA do not involve the use of fertilizers; therefore, fertilizer runoff did not contribute to the elevated nitrate concentrations. Monitoring for parameters exceeding benchmark concentrations will continue in 1998 to determine whether upward trends exist.

Multiple soil disturbing projects are ongoing at RWMC as part of operations, construction, and remediation. These activities contribute to the elevated TSS concentrations in storm water runoff. Although soil stabilization practices are implemented, the effectiveness of revegetation may not be fully realized for years after reseeding due to poor growing conditions. Soil stabilization efforts will continue to be monitored and assessed for improvement.

Average yearly concentrations of total and soluble magnesium (5.8 and 5.7 mg/L, respectively) were lower than the historical average (20.3 and 12.4 mg/L, respectively). RWMC personnel applied magnesium chloride salts to roads for dust suppression prior to 1994. Residual salts are the suspected source of the elevated magnesium concentrations. All radiological concentrations were below DCGs. Historical and 1997 summary data for the RWMC SDA (RWMC-MP-2) are presented in Appendix F.

5.3.2.5 Test Area North. TAN has four monitoring locations (Figures A-5 and A-13). Samples were collected at SMC-MP-1 from storm events in April and June. Parameters in samples collected from the SMC-MP-1 were below EPA Benchmarks and DCGs. The TAN drainage disposal wells were not sampled due to lack of runoff in the basin.

5.3.3 Quality Assurance/Quality Control

The Storm Water Monitoring Program uses the results of the effluent monitoring QC Program (Section 5.2.4). In addition, trip blanks are routinely submitted with storm water samples to be analyzed for volatile organic analysis. No trip blank contamination was detected in 1997.

5.4 Groundwater Monitoring Program

This section summarizes results from the 1997 groundwater compliance monitoring activities for WLAP facilities at the INEEL and the surveillance groundwater monitoring activities at the RWMC. Groundwater compliance monitoring was conducted by the LMITCO Environmental Monitoring Program to ensure that the INEEL WLAP facilities were in compliance with State of Idaho permits. Surveillance monitoring was conducted at the RWMC by the USGS to assess the migration of contaminants to the aquifer.

5.4.1 Program Design Basis

The groundwater monitoring sampling locations, frequency, and analyses required by WLAPs were negotiated with the State of Idaho during permit approval. Based upon the hydrogeology of the area, wells were selected to determine the impact of discharging liquid effluent to ponds to the aquifer. For the ICPP percolation ponds, two wells USGS-121 (sited upgradient from the facility) and USGS-48 (sited immediately upgradient from the percolation ponds) were chosen for surveillance monitoring. USGS-112 and USGS-113, both down gradient from the ponds, serve as compliance points. USGS-121 is also the upgradient aquifer well for the ICPP STP. In addition, a perched well (ICPP-MON-PW-24) is located immediately adjacent to the ponds and is completed approximately 70 ft below land surface. The point of compliance (USGS-52) is located downgradient from the STP. TANT-MON-A-001 was selected as the upgradient facility well for the TAN/TSF STP. Three aquifer wells located downgradient of the STP (TAN-10A, TAN-13A, and TANT-MON-A-002) serve as compliance points.

The USGS INEEL Project Office has been the lead organization for conducting independent regional hydrogeological regime analyses and groundwater monitoring at the INEEL since 1949. The three primary tasks of the hydrogeological regime analyses are (a) analysis of the natural groundwater system, (b) analysis of the effects of groundwater pumping and recharge, and (c) monitoring of the migration and attenuation of contaminant solutes. The wells selected for monitoring at the RWMC were sited to determine the migration of contaminants in the subsurface to the aquifer.

5.4.2 Data Summary and Assessment by Facility

The following sections provide observations and discussions of the compliance monitoring at the ICPP Percolation Ponds, the ICPP STP, the TAN/TSF STP, and the surveillance monitoring at the RWMC.

5.4.2.1 ICPP Percolation Ponds Compliance Monitoring. In order to assess potential percolation pond impacts to groundwater, the WLAP requires that groundwater samples be collected from two upgradient surveillance wells (USGS-121 and -48) and two downgradient compliance wells (USGS-112 and -113) (Figure A-8). Sampling must be conducted semiannually and must include a number of specified parameters for analysis. Contaminant concentrations in the USGS-112 and -113 are limited by maximum allowable concentrations (MACs) specified in IDAPA 16.01.02[40] and secondary maximum contaminant level (SMCL) standards established by IDAPA 16.02.08.[30] Variances from these standards are made for TDS and chloride, which have specific permit limits set at 800 mg/L and 350 mg/L, respectively.

During the 1997 reporting period, groundwater sampling was conducted in April and October. Water levels (recorded prior to purging and sampling) and analytical results for those parameters that were consistently greater than the analytical detection limits are shown in Tables G-1 and G-2. No permit limits were exceeded during this reporting period, although similar to previous years, elevated levels of sodium, chloride, and TDS were observed in USGS-112 and -113 relative to the two wells upgradient

from the percolation ponds. This is due to the quantity of sodium, chloride, and TDS discharged to the percolation ponds as a result of the ICPP water softening and treatment processes.

As seen in Figures 5-10, 5-11, and 5-12 for sodium, chloride, and TDS, respectively, groundwater concentrations for these contaminants appear to be on a slightly increasing trend. (Sodium and chloride data prior to 1995 were retrieved from the files of other INEEL programs, including the USGS; little historical data are available for TDS.) This slightly increasing trend does not follow the trends observed in the effluent to the percolation ponds. The average concentrations for sodium, chloride, and TDS in the effluent appear to be remaining steady or decreasing slightly, particularly since 1993. It is generally expected that groundwater concentrations for these three parameters would follow the trends exhibited by the effluent concentrations, with the exception of lower concentrations due to mixing in the aquifer and a time lag and dampening effect due to the impacts of a thick vadose zone through which the contaminants must pass prior to reaching the aquifer. This relationship is not currently being observed, indicating that other factors may be influencing the groundwater regime at ICPP. Some of these factors may include Big Lost River impacts, the complex vadose zone, and the erratic nature of releases to the percolation ponds. Groundwater flow gradients have likely been altered due to the flow in the Big Lost River, causing changes to the capture zone for each monitoring well. The heterogeneous vadose zone, composed of fractured basalt intermixed with sedimentary interbeds, stores and accumulates contaminants in perched water zones and surrounding sediments, as well as affects transport times from the ponds to the aquifer. In addition, percolation pond discharge volumes and concentrations may vary dramatically throughout the year, depending on treated water demands by the facility. In January 1997, 58.1 MG of wastewater with a measured TDS concentration of 696 mg/L was discharged to the ponds; whereas in July, only 48.6 MG was discharged with a concentration of 401 mg/L. Some or all of these factors may be responsible for the diverging trends observed for the effluent and groundwater concentrations. These trends will continue to be tracked as a part of the normal WLAP groundwater monitoring activities.

5.4.2.2 ICPP STP Compliance Monitoring. In order to assess potential STP impacts to groundwater, the permit requires that groundwater samples be collected from an upgradient, facility background aquifer well (USGS-121), one well (ICPP-MON-PW-024) immediately adjacent to the STP that has been completed in the perched water zone approximately 70-ft below land surface, and one aquifer well (USGS-52) that serves as the point of compliance (Figure A-8). Sampling must be conducted semiannually and must include a short list of specified parameters for analysis. Contaminant concentrations in USGS-52 are limited by the MAC and SMCL standards.

During the 1997 reporting period, groundwater sampling was conducted in April and October. Water levels (collected prior to purging and sampling) and analytical results for those parameters that were consistently greater than the analytical detection limits are shown in Tables G-3 and G-4. The contaminant levels are largely unchanged from the 1996 reporting period for all wells and parameters. The compliance well continues to exhibit slightly elevated concentrations of chloride, TDS, and nitrate-nitrogen when compared to USGS-121. No parameters exceeded any permit limits. Speciated nitrate-nitrogen are unavailable for the compliance well for October 1997; however, unspeciated nitrate and nitrite-nitrogen levels demonstrated that the nitrate-nitrogen levels would be below the permit limit of 10 mg/L, nitrate as N. The perched water well, which is used as an indicator of treatment efficiency of the soil column rather than a point of compliance, continues to show concentrations of chloride, TDS, and total nitrogen at levels that approximate the effluent concentrations. This indicates that little treatment is taking place in the first 70 ft of soil for these parameters. Beginning in March 1997, the rotation frequency of the infiltration trenches was changed from two weeks to one week in order to allow greater soil wetting and drying in an effort to maximize nitrogen removal. The impact of this change is not yet known. Total nitrogen concentrations in the perched water well decreased from 16.8 mg/L in April to 8.5 mg/L in October, but both values appear to be within the normal variability for that well. Use of the more frequent trench rotation schedule will continue in conjunction with normal groundwater

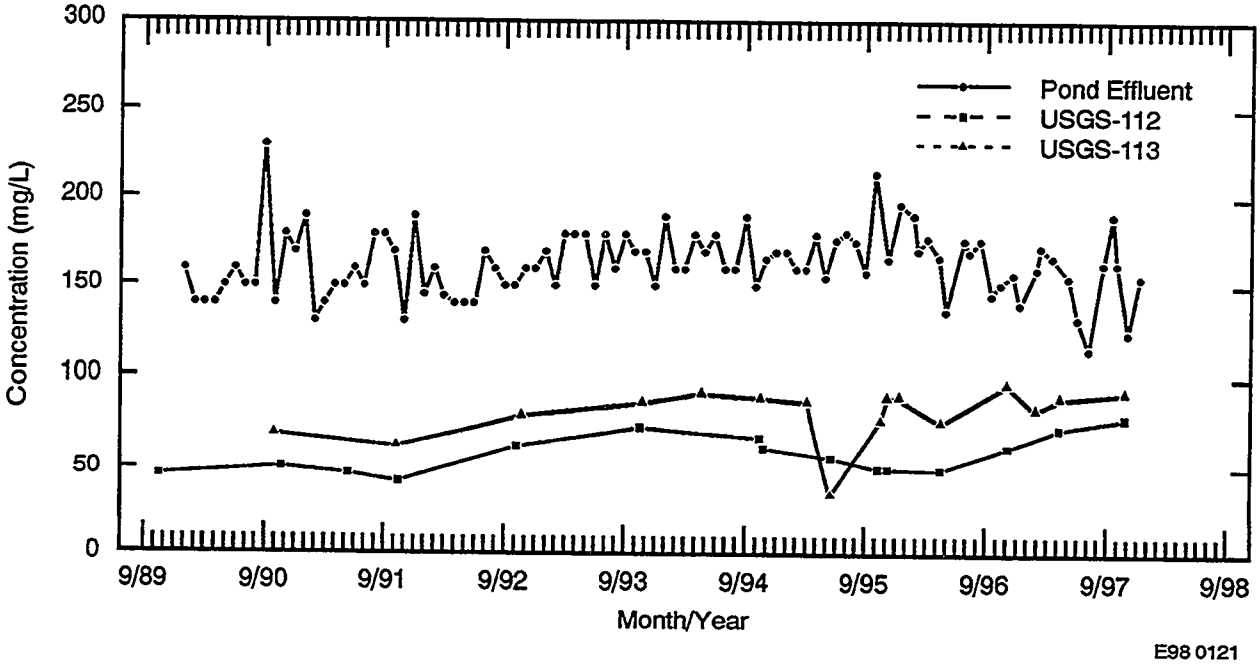


Figure 5-10. Sodium concentrations in the ICPP Percolation Pond effluent and in wells USGS-112 and USGS-113 for the past 10 years (E980121).

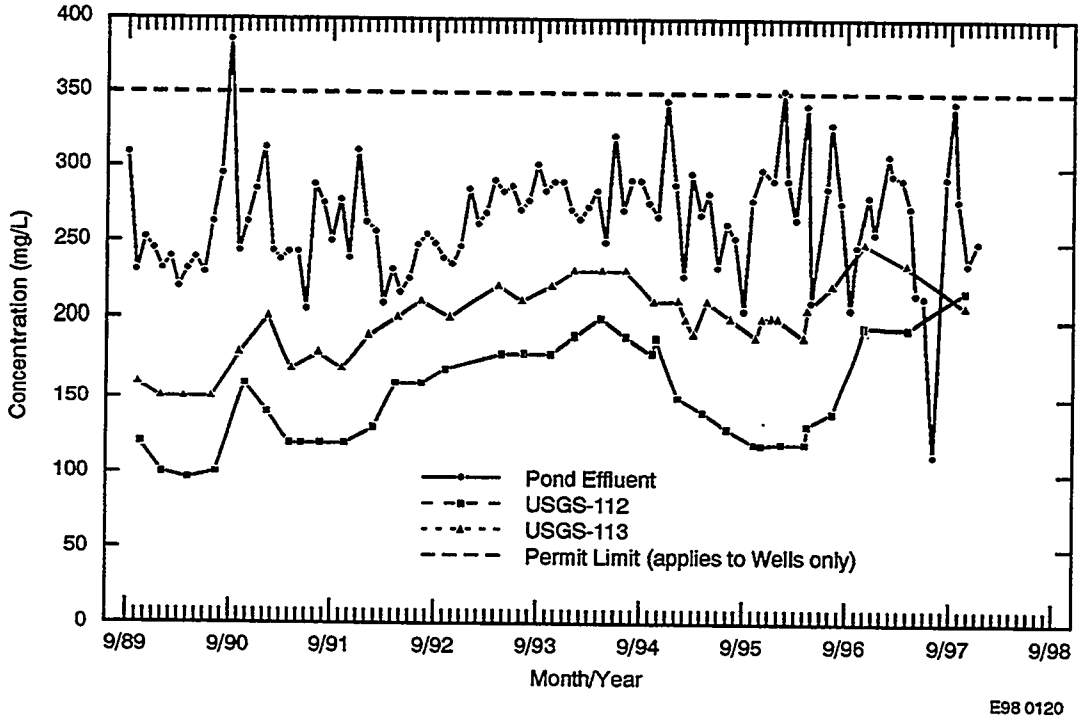


Figure 5-11. Chloride concentrations in the ICPP Percolation Pond effluent and wells USGS-112 and USGS-113 for the past 10 years (E980120).

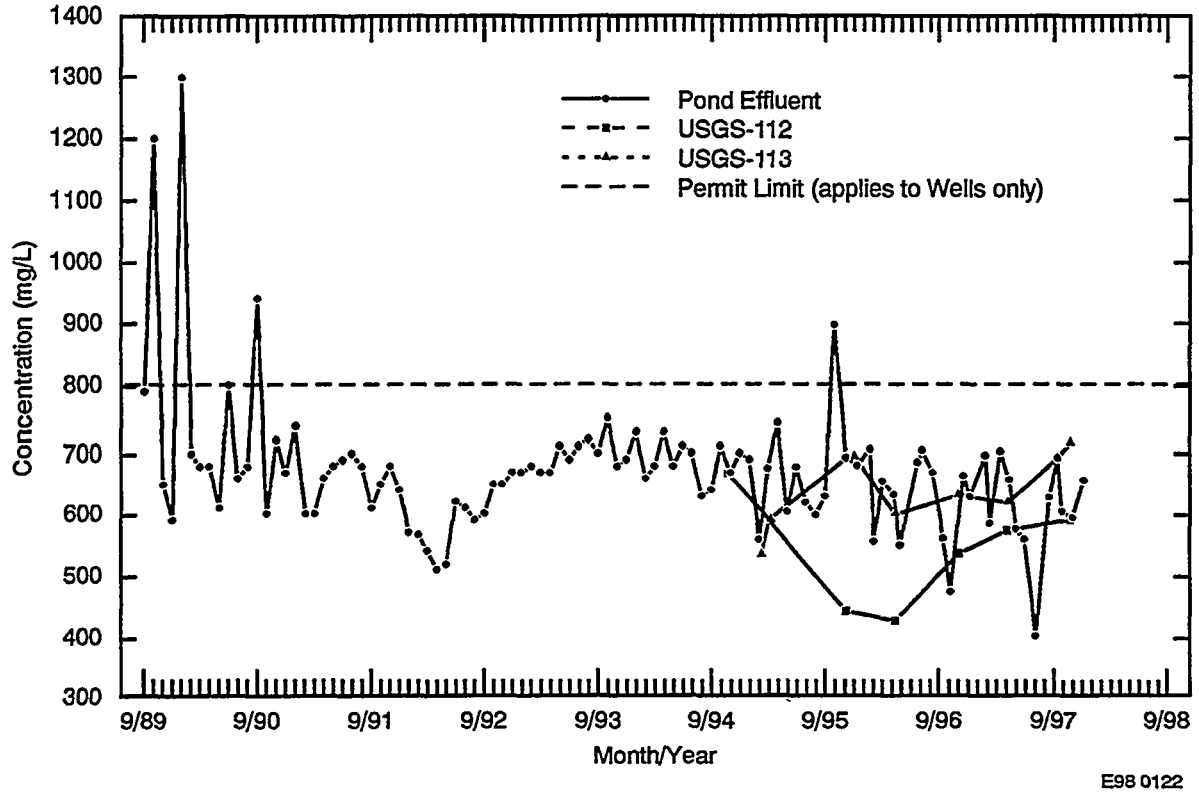


Figure 5-12. TDS concentrations in the ICPP Percolation Pond effluent and in wells USGS-112 and USGS-113 for the past 10 years (E980122).

sampling activities. Total coliform concentrations in the perched water were substantially lower than in the effluent, indicating significant removal of the coliform in the soil.

***5.4.2.3* TAN/TSF STP Compliance Monitoring.** In order to assess potential STP Disposal Pond impacts to groundwater, the permit requires that groundwater samples be collected from a single upgradient surveillance well (TANT-MON-A-001) and three downgradient compliance wells (TAN-10A, TAN-13A, and TANT-MON-A-002) (Figure A-13). Groundwater contaminant concentrations in these compliance wells are limited by the MAC and SMCL standards.

During the 1997 reporting period, groundwater sampling was conducted in January, April, and July. July represented the fourth consecutive quarter of sampling and satisfied the requirement for the first year of permit issuance; hereafter, sampling will be conducted in April and October of every reporting period. Water levels (recorded prior to purging and sampling) and analytical results for those parameters that were consistently greater than the analytical detection limits are shown in Tables G-5, G-6, and G-7.

Results of the groundwater sampling and analysis activities at TAN show that groundwater concentrations exceeded MAC and SMCL standards for iron, sodium, and total coliform during 1997. The groundwater in TAN-10A exceeded the SMCL of 0.3 mg/L for iron in January (0.342 mg/L), April (0.407 mg/L), and July (0.309 mg/L), as well as the MAC suggested optimum of 20 mg/L for sodium with concentrations of 28.9, 34.6, and 34.6 mg/L, respectively, for the same time periods. Total coliform concentrations exceeded the limit of 2 colonies/100 mL in January (8 colonies/100 mL in TANT-MON-A-002) and July (210 colonies/100 mL in TANT-MON-A-002 and 10 col/100 mL in TAN-10A). Iron and sodium concentrations have historically been detected at levels exceeding the SMCL

and MAC standards as was discussed in the WLAP application for the STP, but little historical data are available for coliform bacteria. Elevated concentrations of chloride, TDS, and zinc were also observed in TAN-10A when compared to those found in the upgradient well.

The effluent to the disposal pond has similar levels of iron, sodium, chloride, and TDS as that reported for the groundwater in TAN-10A (as well as high levels of total and fecal coliform), indicating that the disposal pond may be a significant contributor to the contaminants observed in the compliance wells. The presence of zinc in TAN-10A at levels greatly exceeding those found in the effluent to the disposal pond, the presence of coliform in TANT-MON-A-002 (which has no history of impact by the disposal pond), and an absence of fecal coliform in the compliance wells suggest that other sources are also influencing the groundwater quality and contaminant levels in the compliance wells. First, a perched water zone, which is capable of storing and accumulating contaminants, is located below the disposal pond and may have significant influence on the release of contaminants to the groundwater. Second, injectate from an old injection well (located upgradient of the three compliance wells and used for disposal of the same waste streams now discharged to the disposal pond) is still present in the groundwater at TAN and continues to have substantial impact on groundwater quality. And third, groundwater remediation projects and tests now underway at TAN influence local groundwater gradients and contaminant concentrations. Some or all of these factors affect the ability to establish a distinct relationship between the disposal pond and groundwater contaminants and influence the groundwater quality at TAN.

Compliance groundwater monitoring will be continued at TAN in order to satisfy WLAP requirements and identify any changes taking place in the groundwater regime. Additional analytical methods will be used for all compliance coliform samples to enable better speciation in an effort to positively identify the coliform sources. Additional monitoring will be conducted by other groups within the INEEL in support of groundwater remediation activities to evaluate the impact of sources other than the disposal ponds on groundwater quality.

5.4.2.4 RWMC Surveillance Monitoring. Past waste disposal practices have impacted groundwater in the vicinity of the RWMC. Tritium, specific conductance, dissolved chloride, and sodium and organic compounds are monitored by the USGS to determine the distribution and concentrations of these substances in the groundwater. Table 5-8 lists the wells, frequency, and constituents sampled during calendar year 1997.

5.4.2.4.1 Tritium, Specific Conductance, Dissolved Chloride, and Sodium—Tritium was detected in USGS-87, USGS-90, and in the RWMC Production Well (Table 5-9). The maximum concentration of tritium was 1500 pCi/L in the RWMC Production Well. This concentration is well below the DCG for the public (less than 0.1% of the DCG, as shown in Table 5-9). Tritium concentrations in these wells are plotted in Figure 5-13. The source of tritium is attributed to past disposal of wastewater from operations at the ICPP and TRA.[57] Other radionuclides were not detected in the wells in any quarter.

Since operations began at the INEEL in the 1950s, wastewater disposal has increased the specific conductance of groundwater in the vicinity of INEEL facilities. The background specific conductance of groundwater from the ESRP at the INEEL generally ranges from 179-860 μS/cm.[57] This range was compared to the specific conductance measurements of water samples collected from wells at the RWMC (Table 5-10). These specific conductance measurements are comparable to previous years.

Chloride concentrations (Table 5-10) exceeded background levels (8 to 15 mg/L) in all wells, but were below the SMCL for drinking water, which is 250 mg/L. The lower value reported in USGS-88 for the April sampling event is anomalous. Sodium concentrations exceeded the background level of

Table 5-8. Wells, sampling frequency, and constituents sampled for 1997.

RWMC Well	Specific Conductance	Chloride	Sodium	Tritium	Organics
USGS-89	Quarterly	Quarterly	Annually	Quarterly	Semiannually
USGS-90	Quarterly	Quarterly	Annually	Quarterly	Quarterly
Production Well	Monthly	Quarterly	Annually	Quarterly	Monthly
USGS-87	Quarterly	Quarterly	Semiannually	Quarterly	Quarterly
USGS-117	Quarterly	Quarterly	Annually	Quarterly	Semiannually
USGS-88	Quarterly	Quarterly	Annually	Quarterly	Quarterly
USGS-119	Quarterly	Quarterly	Annually	Quarterly	Semiannually
USGS-120	Quarterly	Quarterly	Semiannually	Quarterly	Quarterly

Table 5-9. USGS tritium analyses from RWMC subsurface water.[a]

RWMC Well	Month Sampled	Concentration[b] (E-6 μCi/mL)	Percentage of DCG[c]
USGS-87	January	1.1 ± 0.3	0.07
USGS-90	January	1.3 ± 0.3	0.08
	April	1.3 ± 0.3	0.07
Production Well	January	1.5 ± 0.3	0.08
	April	1.3 ± 0.3	0.07

a. No radionuclides detected other than tritium. (See Tables B-1 and B-2 for limits of detection for other radionuclides.)

b. Uncertainties are reported as 2 sigma.

c. Derived Concentration Guide values for the public are based on the dose conversion factors provided in DOE Order 5400.5, "Radiation Protection of the Public and the Environment," February 8, 1990.

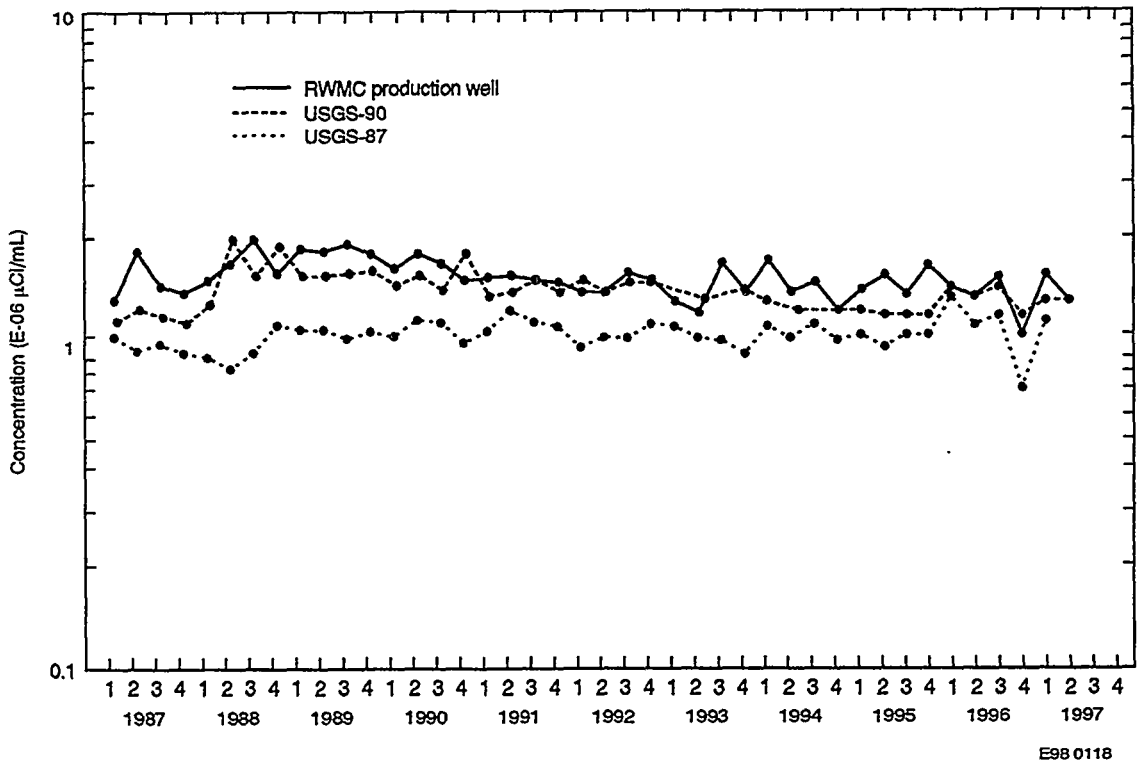


Figure 5-13. Tritium concentrations in RWMC wells (E980118).

Table 5-10. USGS chemical analyses of subsurface water at the RWMC in 1997.

Well	Month Sampled	Specific Conductance μS/cm	Concentration (mg/L)	
			Cl^-	Na^+
USGS-87	January	355	13	—[a]
	April	356	13	10
	July	355	13	—
	October	358	13	10
USGS-88	January	585	86	—
	April	574	29	—
	July	582	84	—
	October	595	85	43
USGS-89	January	384	37	—
	April	385	39	—
	July	380	38	—
	October	382	37	19
USGS-90	January	381	18	—
	April	379	18	—
	July	382	17	—
	October	384	18	8.4
USGS-117	January	279	13	—
	April	278	14	—
	July	276	13	—
	October	280	14	9.9
USGS-119	January	286	9.2	—
	April	267	9.0	—
	July	282	9.1	—
	October	286	9.2	10
USGS-120	January	450	23	—
	April	418	18	22
	July	487	23	—
	October	489	—	—

Table 5-10. (continued).

Well	Month Sampled	Specific Conductance μS/cm	Concentration (mg/L) Cl^-	Concentration (mg/L) Na^+
RWMC Production Well	January	388	20	—
	February	388	—	—
	March	387	—	—
	April	389	18	—
	May	365	—	—
	June	384	—	—
	July	381	15	—
	August	383	—	—
	September	385	—	—
	October	387	17	8.4
	November	389	—	—
	December	—	—	—
Natural background[b] (of aquifer)	—	300–325	8–15	10

a. No sample collected.

b. J. R. Pittman et al., *Hydrologic Conditions at the Idaho National Engineering Laboratory*, Idaho, 1982–1985 update, 89-4008, 1988.

10 mg/L for USGS-88, -89, and -120 (Table 5-10). The drinking water standard (optimum) for sodium is below 20 mg/L. The elevated chloride and sodium concentrations may be attributed to the grout mixtures used during well construction. These wells were pressure-grouted with a sodium-bentonite mixture. Both the chloride and sodium concentrations are comparable to concentrations from previous years.

5.4.2.4.2 Organic Compounds—Organic compounds were first detected in groundwater samples at the RWMC by the USGS in 1987. Carbon tetrachloride, trichloroethylene, 1,1,1-trichloroethane, tetrachloroethylene, chloroform, and toluene were found in aquifer wells. Elevated concentrations of carbon tetrachloride, trichloroethylene, 1,1,1-trichloroethane, tetrachloroethylene, and chloroform were present in the deep perched water zone.

Approximately 334,600 L (88,400 gallons) of organic waste were disposed prior to 1970 at the RWMC. These buried wastes included about 92,365 L (24,400 gallons) of carbon tetrachloride. The remaining volume consisted of approximately 147,630 L (39,000 gallons) of Texaco Regal Oil and 94,635 L (25,000 gallons) of miscellaneous organic wastes (e.g. trichloroethane, trichlororethylene, perchloroehtylene, and used oils, such as lubricating oils).[58] These past waste disposal practices are the suspected source of the organic compounds found in the aquifer at the RWMC.

In 1994, a Record of Decision was signed by DOE, EPA, and the State of Idaho agreeing to use vapor vacuum extraction with treatment as the remediation technology for the vadose zone at the RWMC. The

treatment system was operational on January 11, 1996. During 1997, 9,334 kg (20,577 lbs) of total VOCs were removed from the vadose zone.

Pad A at the RWMC received packaged mixed wastes from 1972 to 1987 primarily from the Rocky Flats Plant in Colorado. Hazardous wastes included evaporator salts (primarily sodium nitrate and potassium nitrate), while radioactive wastes included plutonium, americium, and uranium. Pad A was used for disposal of approximately 10,000 m^3 (13,000 yd^3) of wastes.

A Record of Decision was signed by DOE-ID, EPA, and the State of Idaho in 1994. The selected alternative involved placing plywood or polyethylene over many of the containers and covering them with a 0.9 m (3 ft) soil layer. Recontouring of the pad cover was finished in late 1995. For the post-Record of Decision, maintenance of the pad cover and monitoring started in 1995. Currently, Environmental Restoration personnel are monitoring the soil, surface water, and groundwater. The information is being included in the Waste Area Group 7 comprehensive investigation.

Table 5-11 shows the 1997 concentrations of VOCs at USGS monitoring wells. The 1997 results are comparable to previous USGS and LMITCO drinking water compliance data. No MCLs for VOCs were exceeded for the annual average during 1997. Although no MCLs were exceeded, carbon tetrachloride concentration levels have gradually increased in wells USGS-87, USGS-88 and USGS-90 over the past four years (Figure 5-14). MCLs for carbon tetrachloride were exceeded six times at the RWMC production well. In 1996, the MCL was exceeded twice at this well for carbon tetrachloride. The increase in carbon tetrachloride at the RWMC production well will continue to be monitored and evaluated. In addition, the impact of the spreading areas and vapor vacuum extraction project on the aquifer will be evaluated.

5.4.3 Special Studies

Two groundwater-related special studies were conducted in 1997. First, as a continuation of a 1996 evaluation, a statistical analysis was conducted on filtered and unfiltered groundwater sample results to determine the need for continued collection of both. For the past three years, filtered and unfiltered samples have been collected and analyzed for metals and other inorganics from monitoring wells sampled by LMITCO for compliance and surveillance purposes. Filtered and unfiltered samples were collected and analyzed because of the potential for turbid waters biasing sample results; however, the cost associated with collection and analysis of both has become significant. As a result, a statistical comparison was made of the filtered and unfiltered sample results to determine if the differences between the two are statistically significant, and perhaps more importantly, to determine if collection of both types of samples is beneficial. Pairings of 1,758 filtered and unfiltered sample results were compared from 25 different wells using three indicators of differences and multiple combinations of well groupings. The results of this internal, unpublished study indicated that there were statistically significant differences between filtered and unfiltered sample results for selected analytes (iron, lead, chromium, barium, zinc, aluminum, manganese, and sodium) in multiple wells. For the remainder of the analytes, there was no difference, or there were insufficient data with which to draw a conclusion. Based on the results, unfiltered samples will be collected for all analytes, but filtered samples will be collected at the discretion of the sampling project manager. At a minimum, it is recommended that filtered samples be collected for those analytes and wells in which the unfiltered results are approaching levels of concern and a statistical difference was recognized (or inconclusive).

The second special study focused on the effect of purge water on metals concentrations in soils. Soil samples were collected from around nine groundwater monitoring wells at the INEEL to measure leachable and total metals concentrations in the soil. The samples were collected to determine whether

Table 5-11. USGS data for concentrations (μg/L) of selected volatile organic compounds in groundwater.

Well	Date Sampled	Carbon Tetra-chloride	Chloro-form	1,1,1-Trichloro-ethane	Trichloro-ethylene	Tetrachlo-roethylene	Dichloro-difluoro-methane	Toluene	1,1-Dichloro-ethane	1,1-Dichloro-ethylene
USGS-87	01/97	2.1	<0.2	0.2	0.5	<0.2	<0.2	<0.2	<0.2	<0.2
	04/97	2.3	<0.2	0.2	0.6	<0.2	<0.2	<0.2	<0.2	<0.2
	07/97	2.2	<0.2	0.2	0.6	<0.2	<0.2	<0.2	<0.2	<0.2
	10/97	2.3	<0.2	0.2	0.6	<0.2	<0.2	<0.2	<0.2	<0.2
USGS-88	01/97	2.0	0.5	0.2	0.8	<0.2	<0.2	<0.2	<0.2	<0.2
	04/97	2.4	0.5	0.3	0.9	<0.2	<0.2	<0.2	<0.2	<0.2
	07/97	2.1	0.5	0.2	0.9	<0.2	<0.2	<0.4	<0.2	<0.2
	10/97	1.6	0.4	<0.2	0.7	<0.2	<0.2	<0.2	<0.2	<0.2
USGS-89	01/97	—[a]	—	—	—	—	—	—	—	—
	04/97	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	07/97	—	—	—	—	—	—	—	—	—
	10/97	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
USGS-90	01/97	3.0	0.4	0.4	1.4	<0.2	<0.2	<0.2	<0.2	<0.2
	04/97	3.2	0.4	0.4	1.4	<0.2	<0.2	<0.2	<0.2	<0.2
	07/97	3.1	0.4	0.4	1.4	<0.2	<0.2	<0.2	<0.2	<0.2
	10/97	2.6	0.4	0.3	1.2	<0.2	<0.2	<0.2	<0.2	<0.2
USGS-117	01/97	—	—	—	—	—	—	—	—	—
	04/97	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	07/97	—	—	—	—	—	—	—	—	—
	10/97	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
USGS-119	01/97	—	—	—	—	—	—	—	—	—
	04/97	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	07/97	—	—	—	—	—	—	—	—	—
	10/97	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2

Table 5-11. (continued).

Well	Date Sampled	Carbon Tetra–chloride	Chloro-form	1,1,1–Trichloro–ethane	Trichloro–ethylene	Tetrachlo–roethylene	Dichloro–difluoro–methane	Toluene	1,1–Dichloro–ethane	1,1–Dichloro–ethylene
USGS-120	01/97	1.2	<0.2	<0.2	<0.3	<0.2	<0.2	<0.2	<0.2	<0.2
	04/97	0.6	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	07/97	1.5	<0.2	<0.2	0.4	<0.2	<0.2	<0.2	<0.2	<0.2
	10/97	3.8	0.6	0.4	1.4	<0.2	<0.2	<0.2	<0.2	<0.2
RWMC Production Well	01/97	5.2	0.9	0.7	2.6	0.2	<0.2	<0.2	<0.2	<0.2
	02/97	5.2	0.9	0.7	2.6	0.3	<0.2	<0.2	<0.2	<0.2
	03/97	4.9	0.8	0.6	2.4	0.2	<0.2	<0.2	<0.2	<0.2
	04/97	5.1	0.9	0.7	2.7	0.3	<0.2	<0.2	<0.2	<0.2
	05/97	5.2	0.8	0.7	2.5	0.2	<0.2	<0.2	<0.2	<0.2
	06/97	4.6	0.7	0.6	2.2	0.2	<0.2	<0.2	<0.2	<0.2
	07/97	4.6	0.6	0.6	2.1	0.2	<0.2	<0.2	<0.2	<0.2
	08/97	5.1	0.7	0.6	2.4	0.2	<0.2	<0.2	<0.2	<0.2
	09/97	5.8	0.9	0.7	2.8	0.3	<0.2	<0.2	<0.2	<0.2
	10/97	4.8	0.8	0.6	2.4	<0.2	<0.2	<0.2	<0.2	<0.2
	11/97	4.5	0.7	0.6	2.0	<0.2	<0.2	<0.2	<0.2	<0.2
	12/97	4.0	0.6	0.5	2.0	0.2	<0.2	<0.2	<0.2	<0.2

a. No samples were collected.

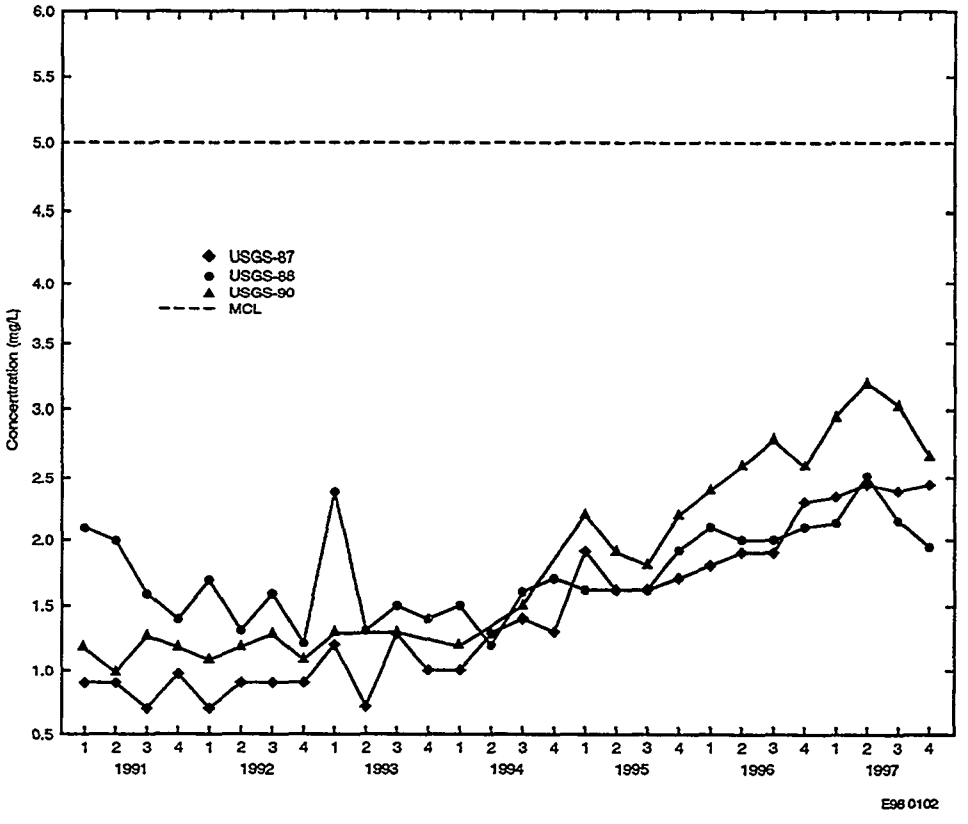


Figure 5-14. Carbon tetrachloride concentrations in USGS-87, -88, and -90 (E980102).

metals were accumulating in soils around monitoring wells where purge water has been repeatedly discharged to the ground surface one to four times a year for up to 20 years. Data for leachable metals were compared to toxicity characterization leaching procedure concentrations that define RCRA characteristic hazardous waste. The only metal that was detected in the leachate was barium at concentrations of 1–2% of the hazardous waste criteria. Total metals concentrations were compared to estimates of background soil concentrations of metals derived from other studies conducted at the INEEL. There was no indication that metals around wells were elevated relative to background metals, with a few possible exceptions. Lead was elevated at well USGS-98 and a number of metals were elevated at USGS-83. The samples from well USGS-83 were collected from drill cuttings rather than surface soils, consequently the data are not comparable to data on background soil concentrations. Concentrations of aluminum, cobalt, copper, magnesium, manganese, nickel, potassium, sodium, and zinc are elevated in soils at the surface relative to concentrations at a depth of 0.6–0.9 m (2–3 ft.) Calcium and arsenic are depleted at the surface relative to concentrations at a depth of 0.6–0.9 m (2–3 ft.) This may be a result of natural weathering reaction of soil minerals as the difference in concentrations is directly related to the abundance of the metals in the soil, and not related to the abundance in groundwater. No relation between elevated groundwater concentrations and soil concentrations was observed in the data. No evidence of the accumulation of metals in soils around monitoring wells was found in this study.

5.4.4 Quality Assurance/Quality Control

The QA program for the USGS includes the use of standardized procedures, collection and analysis of QA samples, review of analyses, performance audits, and corrective actions. USGS's National Water

Quality Laboratory QA/QC procedures are described in its National Water Quality Laboratory.[59] All USGS field collection and handling procedures are described in an internal USGS QA plan.

The groundwater sampling activities associated with WLAP compliance sampling follow established procedures and analytical methodologies. Field measurements such as pH, temperature, water level, 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, $\leq 0.5°C$ for temperature, and $\leq 10\,\mu S/cm$ for specific conductance, samples are collected in precleaned and certified containers. 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.

In addition to the regular groundwater samples, field QC samples were collected or prepared during the sampling activity. Because TAN and ICPP are regarded as separate sites, QC samples were prepared for each site. One duplicate 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 sample. Field blanks were collected at the same frequency as the duplicate samples. Deionized water was poured into the prepared bottles at the sampling site and were only analyzed for metals. Equipment blanks (rinsates) were collected from the sample port manifold after decontamination and before use. Trip blanks were prepared and submitted with the samples collected from TAN, where volatile organics are a contaminant of concern.

For data completeness, 494 groundwater samples were to be collected. During the 1997 sampling events, four samples (0.8%) were not collected, and data from seven samples (1.4%) were rejected as unusable during data validation. The data were rejected because laboratory internal QA/QC were not met. Results of the rinsate samples, equipment, trip, and field blanks showed that no contamination was introduced by sampling and handling techniques.

6. SPECIAL REQUEST MONITORING PROGRAM

The Special Request Monitoring Program (SRMP) provides on-call support to facilities and programs to provide characterization of unknown materials and to support waste disposal decisions. Abbreviated sampling and analysis plans (ASAPs) are prepared to obtain representative samples to meet project-specific waste acceptance criteria for disposal.

6.1 Program Design

In accordance with the 40 CFR 260 series, waste must be characterized or adequate historical knowledge must be documented to make waste disposal determinations. The vast majority of SRMP projects are to provide characterization of waste for disposal in accordance with the Resource Conservation and Recovery Act (RCRA). Typical governing regulations or guidance documents include the Toxic Substances Control Act, Land Disposal Restrictions, Universal Treatment Standards, and the INEEL Reusable Property, Recyclable Materials, and Waste Acceptance Criteria.

The SRMP tracks the project from the initial request through preparing the sampling plan, coordinating plan reviews, obtaining laboratory services, scheduling sampling activities, and tracking the resulting data. Upon receipt of the data and validation, if requested, the SRMP summarizes the data and issues a closure report to the project requester. All files are maintained in the SRMP database for future reference. Each ASAP is prepared by an experienced sampler and goes through extensive reviews including peer, project requester, radiological, industrial hygiene, environmental, and transportation reviews, as applicable.

The SRMP provides representative data that meets regulatory and waste acceptance criteria for disposal. Program methods are typically SW-846;[60] QC frequency varies from project to project. Media types may include solids (soils), concentrated liquids, wastewater, and miscellaneous debris. Sampling locations in the SRMP are generally Site-wide but also include off-Site areas. Results are reported separately for each sampling event.

6.2 Activities Summary

One-hundred thirty sampling requests for routine projects were received by the SRMP in 1997 in addition to eighteen requests specifically for the Legacy Sample Disposition Project of 1997 (Table 6-1). The Legacy Sample Disposition Project was a result of site walkthroughs conducted at the INEEL in 1996 and 1997 that identified thousands of samples requiring categorization and if necessary, characterization for appropriate disposal. The Legacy Sample Disposition Project was an intensive effort to characterize legacy samples for Land Disposal Restriction closure in which the SRMP played an integral role. The following is a summary of areas sampled and the corresponding number of requests for 1997:

- Central Facilities Area (CFA)—25
- Idaho Chemical Processing Plant (ICPP)—35
- Power Burst Facility (PBF)—6
- Radioactive Waste Management Complex (RWMC)—11
- Test Area North (TAN)—23
- Test Reactor Area (TRA)—26

- Other (includes Idaho Falls and Fort St. Vrain, etc)—4
- Legacy—18.

Table 6-1. Special request environmental monitoring projects for 1997.

Project Number	Description
EMS-001-97	TAN Fire Station storm water assessment
EMS-002-97	MWSF piping and valves
EMS-003-97	RWMC leaking drums
EMS-004-97	CFA lead bricks
EMS-005-97	PBF Room 609
EMS-006-97	ICPP condensate and snow melt
EMS-007-97	ICPP-626 septic tank
EMS-008-97	ATR canal area filters
EMS-009-97	ICPP-603 basin water treatment
EMS-010-97	ICPP-630 emergency sewage
EMS-011-97	ATR pumps
EMS-012-97	Experimental Test Reactor transformer
EMS-013-97	TRA sandblasting grit
EMS-014-97	ICPP-701 petroleum contaminated soils
EMS-015-97	CFA laboratory waste
EMS-016-97	TRA-681 paint waste
EMS-017-97	TRA hot cells leachate
EMS-018-97	ATR resin beads
EMS-019-97	CFA laboratory activities
EMS-020-97	ATR cask grindings
EMS-021-97	TAN demineralizer
EMS-022-97	RWMC paint chips and grout
EMS-023-97	ICPP septic ST-SFE-100
EMS-024-97	ICPP-659 soils
EMS-025-97	TAN-607 emergency generator preventive maintenance
EMS-026-97	TAN breathing air system
EMS-027-97	TAN-766 oil
EMS-028-97	TRA oil
EMS-029-97	TAN pond characterization
EMS-030-97	RWMC transuranic waste drum filters
EMS-031-97	CFA-674 paint chips
EMS-032-97	ICPP petroleum contaminated soils

Table 6–1. (continued).

Project Number	Description
EMS-033-97	TRA-610 sump
EMS-034-97	ICPP-631 solid debris
EMS-035-97	TAN-629 septic tanks
EMS-036-97	ICPP active septic tanks
EMS-037-97	ICPP vehicle maintenance facility paint
EMS-038-97	TRA hot waste tanks
EMS-039-97	TRA-731 bermed soils
EMS-040-97	ICPP-637 carboys
EMS-041-97	TRA-681 paint wood posts
EMS-042-97	TRA-608 demineralizer system
EMS-043-97	PBF reactor waste
EMS-044-97	ICPP-642 solids/liquids
EMS-045-97	TAN-607 rinsate
EMS-046-97	ICPP-603 basins
EMS-047-97	ICPP-663 calcines
EMS-048-97	PBF reactor room tank
EMS-049-97	CFA-690 paint waste
EMS-050-97	ICPP calcines
EMS-051-97	CFA-674 paint stripper waste
EMS-052-97	ICPP tank emergency
EMS-053-97	CFA WLAP soils
EMS-054-97	CFA rain/snow melt drums
EMS-055-97	TAN tar/soil mixed material
EMS-056-97	ICPP barrier paint waste
EMS-057-97	TAN unknown emergency
EMS-058-97	ICPP steam condensate
EMS-059-97	CFA-1711 unknown solids
EMS-060-97	TRA drill cuttings and purgewater
EMS-061-97	RWMC building characterization
EMS-062-97	TAN-655 Tank #748
EMS-063-97	TRA reactor wastes
EMS-064-97	ICPP fuel condensate
EMS-065-97	ICPP ballast
EMS-066-97	CFA-696 paint booth
EMS-067-97	RWMC Hess-609

Table 6–1. (continued).

Project Number	Description
EMS-068-97	PBF septic tank
EMS-069-97	ICPP drums emergency
EMS-070-97	TAN-607 solids
EMS-071-97	Process Experimental Pilot Plant facility
EMS-072-97	ICPP ventilation duct
EMS-073-97	ICPP cleanout of WM-105 tank
EMS-074-97	TRA lead shot
EMS-075-97	TAN-607 hot shop
EMS-076-97	TAN-666 water
EMS-077-97	Loss of Fluid Test Facility hydrozine system
EMS-078-97	Fort St. Vrain groundwater and soil
EMS-079-97	CFA-696 oil/water separator
EMS-080-97	PBF temporary accumulation area
EMS-081-97	TRA-644 caustic tank contents
EMS-082-97	CFA-1711 temporary accumulation area
EMS-083-97	RWMC certified and segregated building
EMS-084-97	CFA-623 rinsewater emergency
EMS-085-97	TRA sawdust
EMS-086-97	CFA irrigation area
EMS-087-97	TRA tank bottoms
EMS-088-97	CFA-696 crushed oil filters
EMS-089-97	CFA-696 glass beads
EMS-090-97	CFA-697 oil
EMS-091-97	PBF resin and earthen material
EMS-092-97	TRA cooling tower wood
EMS-093-97	ICPP used hydraulic oil
EMS-094-97	TAN oil
EMS-095-97	WCB parking lots
EMS-096-97	ATR cooling tower
EMS-097-97	ICPP Tank VES-WC-119
EMS-098-97	CFA-660 laydown
EMS-099-97	ICPP-602 solvent
EMS-100-97	ICPP insulators
EMS-101-97	CFA landfarm
EMS-102-97	CFA-633 laboratory wastes

Table 6–1. (continued).

Project Number	Description
EMS-103-97	TAN Radioactive Parts Security Storage Area piping and equipment
EMS-104-97	IF-603 used oil
EMS-105-97	ATR laydown area oil
EMS-106-97	TRA oil/water separators in ATR
EMS-107-97	ICPP rare gas plant catalysts
EMS-108-97	CFA-1711 paint cans/soil waste emergency
EMS-109-97	ATR fan room
EMS-110-97	TRA-605 laydown yard tank
EMS-111-97	TRA-625 diesel fuel filters
EMS-112-97	TAN-607 hydraulic fluid
EMS-113-97	ICPP drums
EMS-114-97	CFA-660 oily waste
EMS-115-97	TAN zinc bromide solution
EMS-116-97	Certification and Segregation Building spill cleanup waste
EMS-117-97	Fluorinel Dissolution Process and Fuel Storage basin water deionizer resin
EMS-118-97	TAN-623 air receiver paint
EMS-119-97	WMF chlorine
EMS-120-97	CFA warehouse concrete
EMS-121-97	WMF incinerable waste
EMS-122-97	ICPP-637 emergency
EMS-123-97	WMF-602 tent
EMS-124-97	ICPP-1647 demineralizer system
EMS-125-97	CFA excess compressor emergency
EMS-126-97	RWMC steel beams emergency
EMS-127-97	TAN Process Experimental Pilot Plant mezzanine decontamination
EMS-128-97	Loss of Fluid Test Facility cooling tower
EMS-129-97	WRRTF oil spill
EMS-130-97	CFA-637 water/oil/metal fines mixture
EMS-200-97[a]	Legacy–TAN soil samples
EMS-201-97	Legacy–ICPP liquid samples
EMS-202-97	Legacy–ICPP liquid and solid samples
EMS-203-97	Legacy–TRA soil samples
EMS-204-97	Legacy–TAN initial engine test samples
EMS-205-97	Legacy–ICPP sludge samples
EMS-206-97	Legacy–RWMC soil samples

Table 6–1. (continued).

Project Number	Description
EMS-207-97	Legacy–TAN soil samples
EMS-208-97	Legacy–ICPP solvent samples
EMS-209-97	Legacy–TRA samples
EMS-210-97	Legacy–TRA samples
EMS-211-97	Legacy–TRA Three Mile Island samples
EMS-212-97	Legacy–nuclear operations/Loss of Fluid Test Facility/severe fuel damage samples
EMS-213-97	Legacy–WERF samples
EMS-214-97	Legacy–nuclear operations/severe fuel damage samples
EMS-215-97	Legacy–orphan samples
EMS-216-97	Legacy–TRA miscellaneous samples
EMS-217-97	Legacy–ICPP-602 samples

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Appendix A

Facility Maps with Monitoring Locations

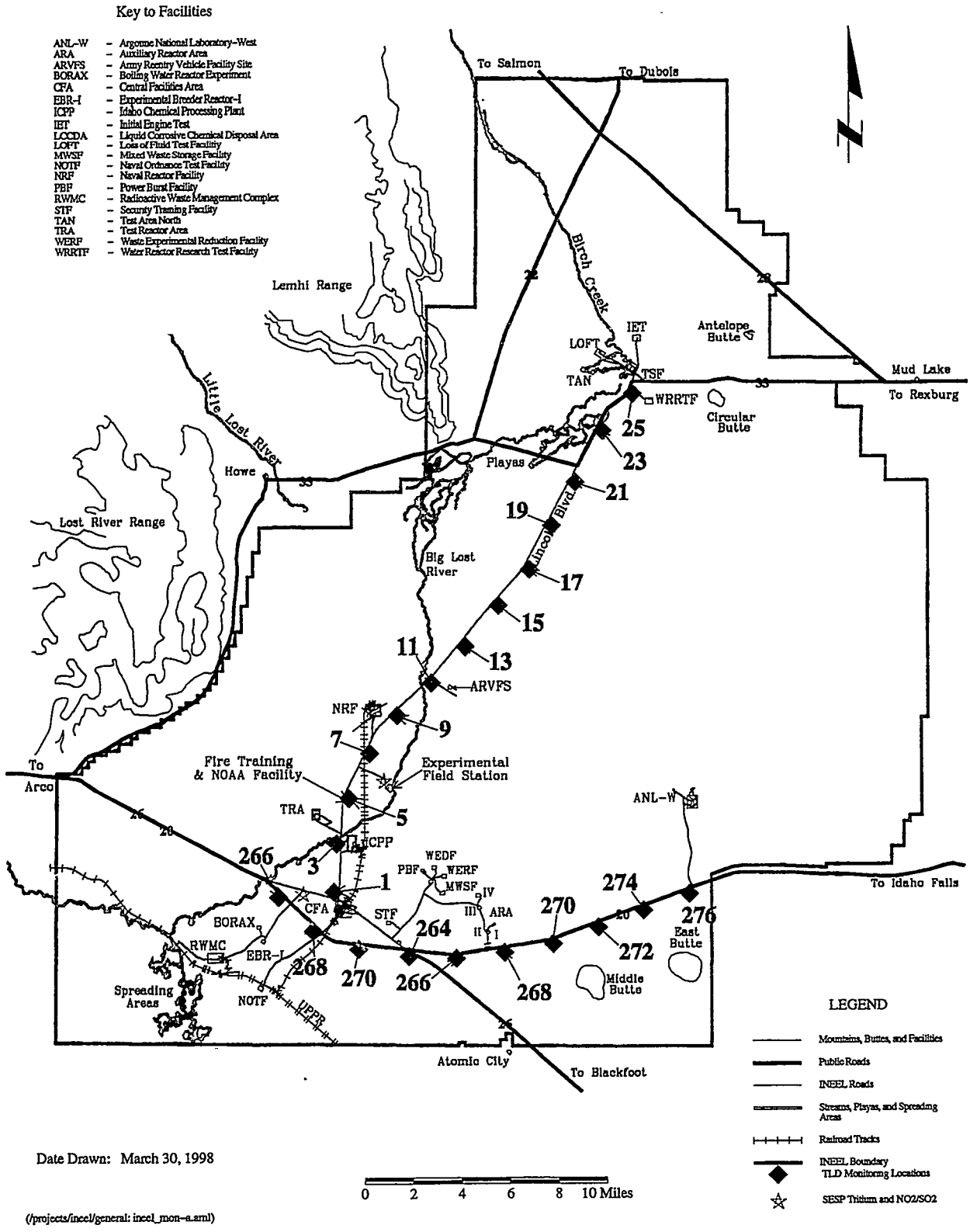

Figure A-1. Idaho National Engineering and Environmental Laboratory (INEEL) monitoring locations.

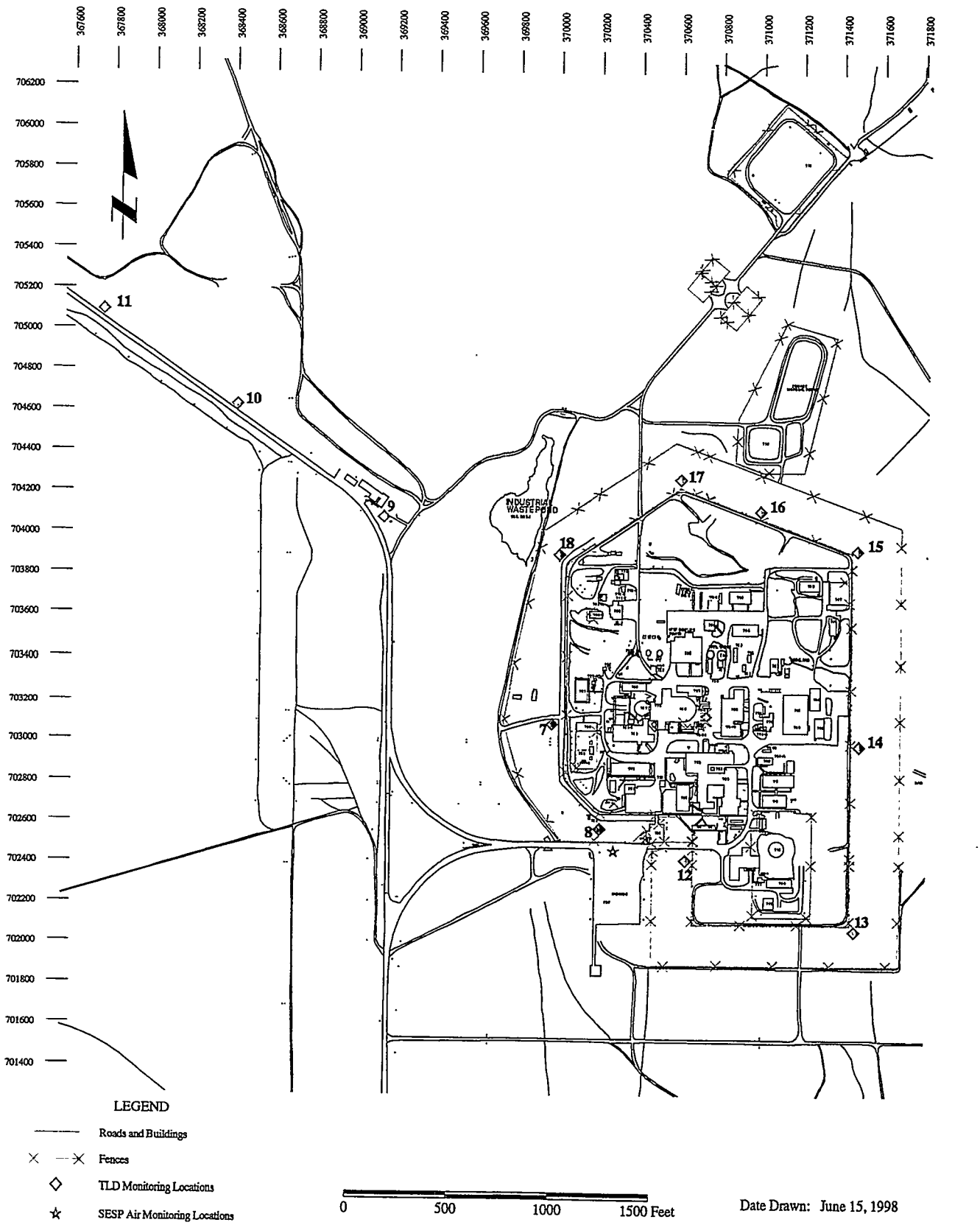

Figure A-2. Argonne National Laboratory–West monitoring locations.

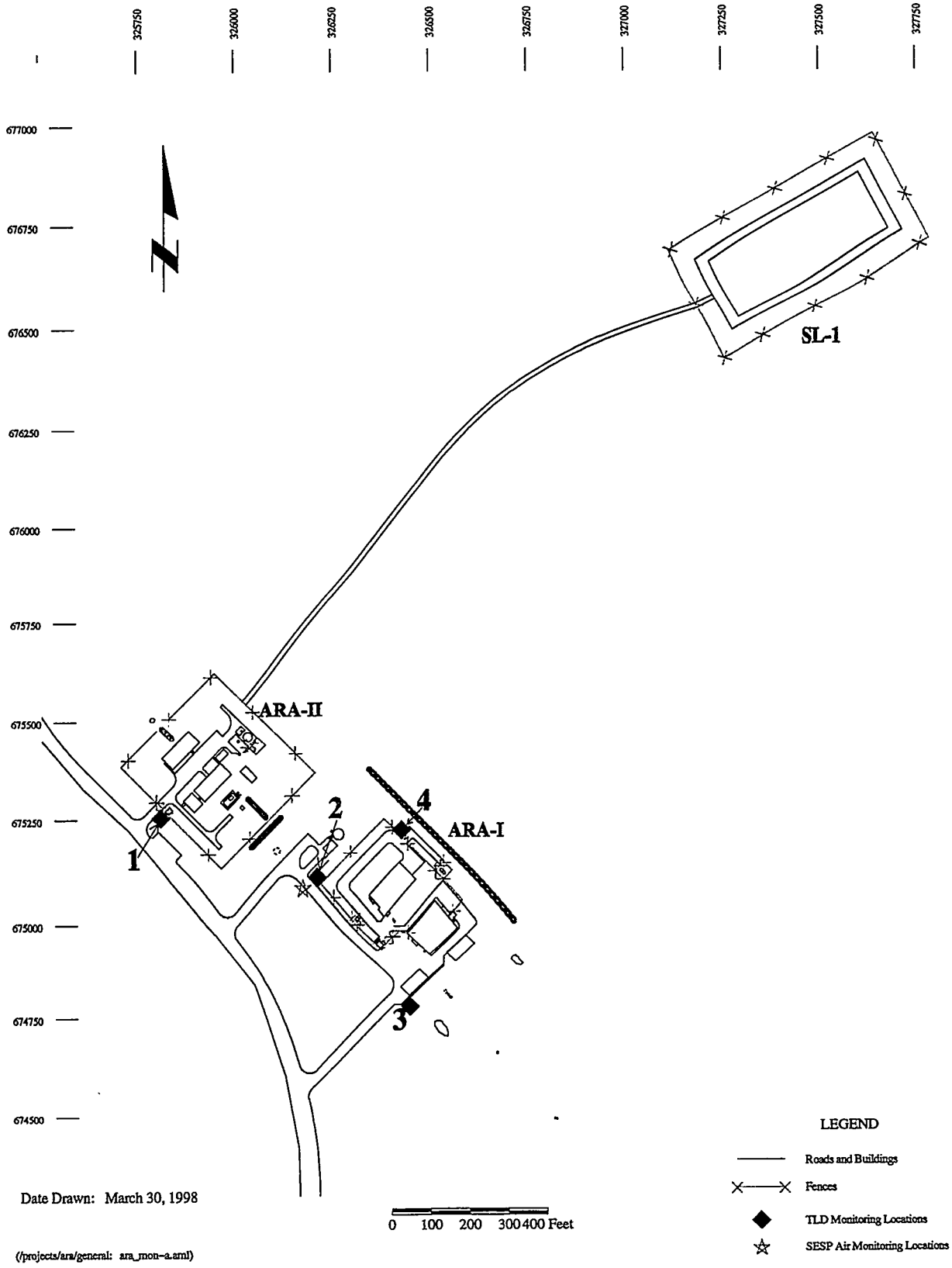

Figure A-3. Auxiliary Reactor Area monitoring locations.

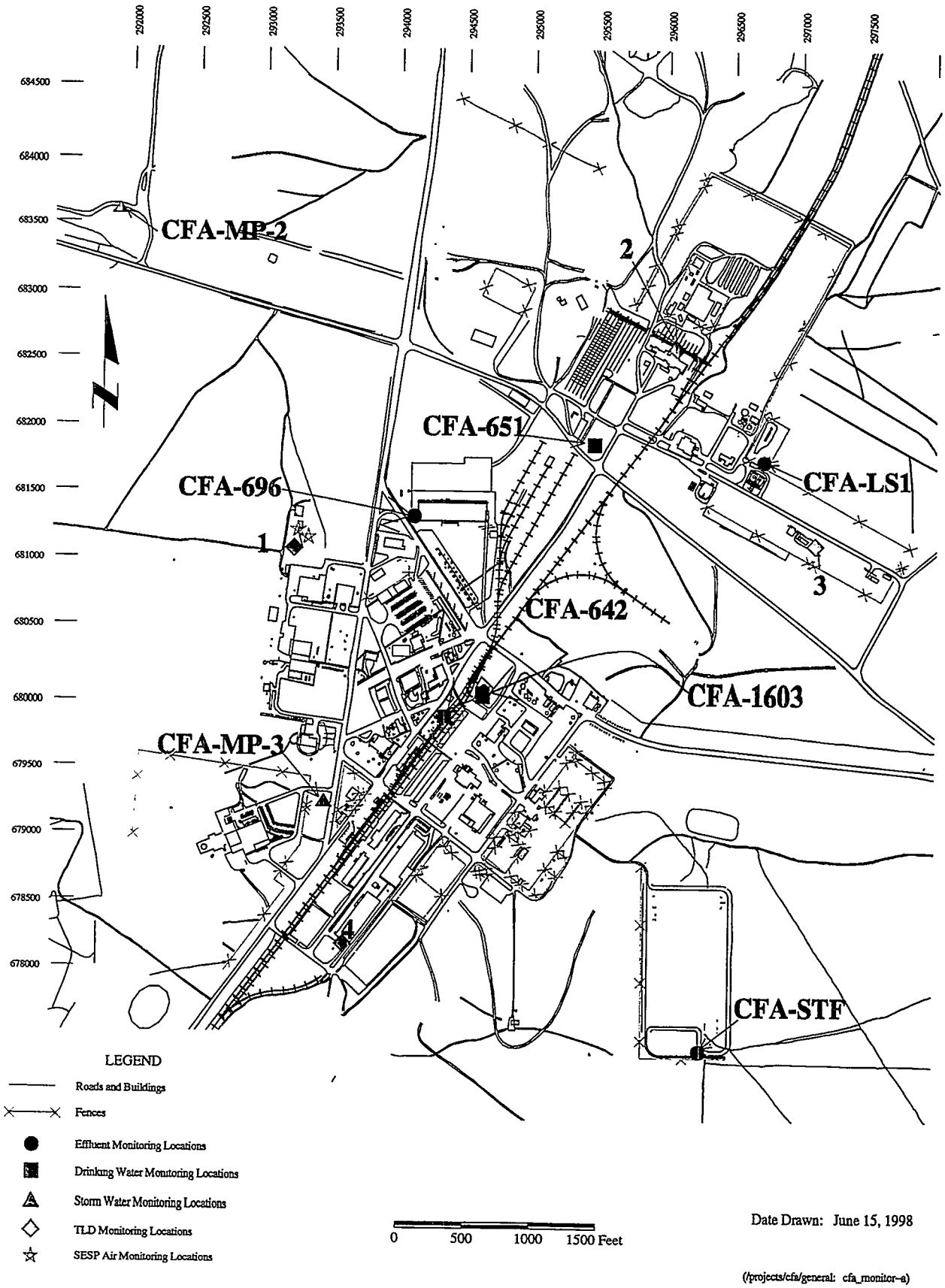

Figure A-4. Central Facilities Area monitoring locations.

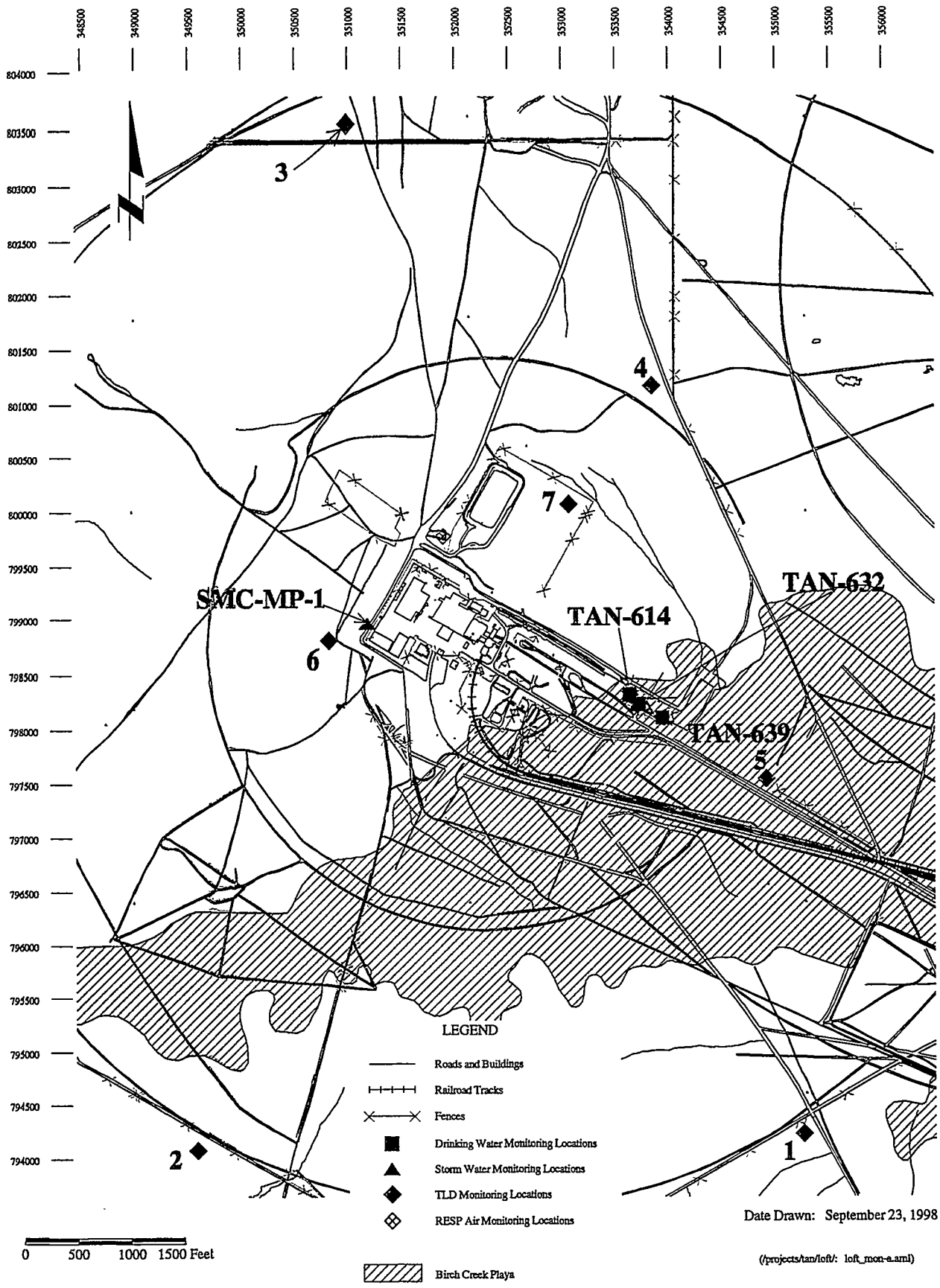

Figure A-5. Containment Test Facility monitoring locations.

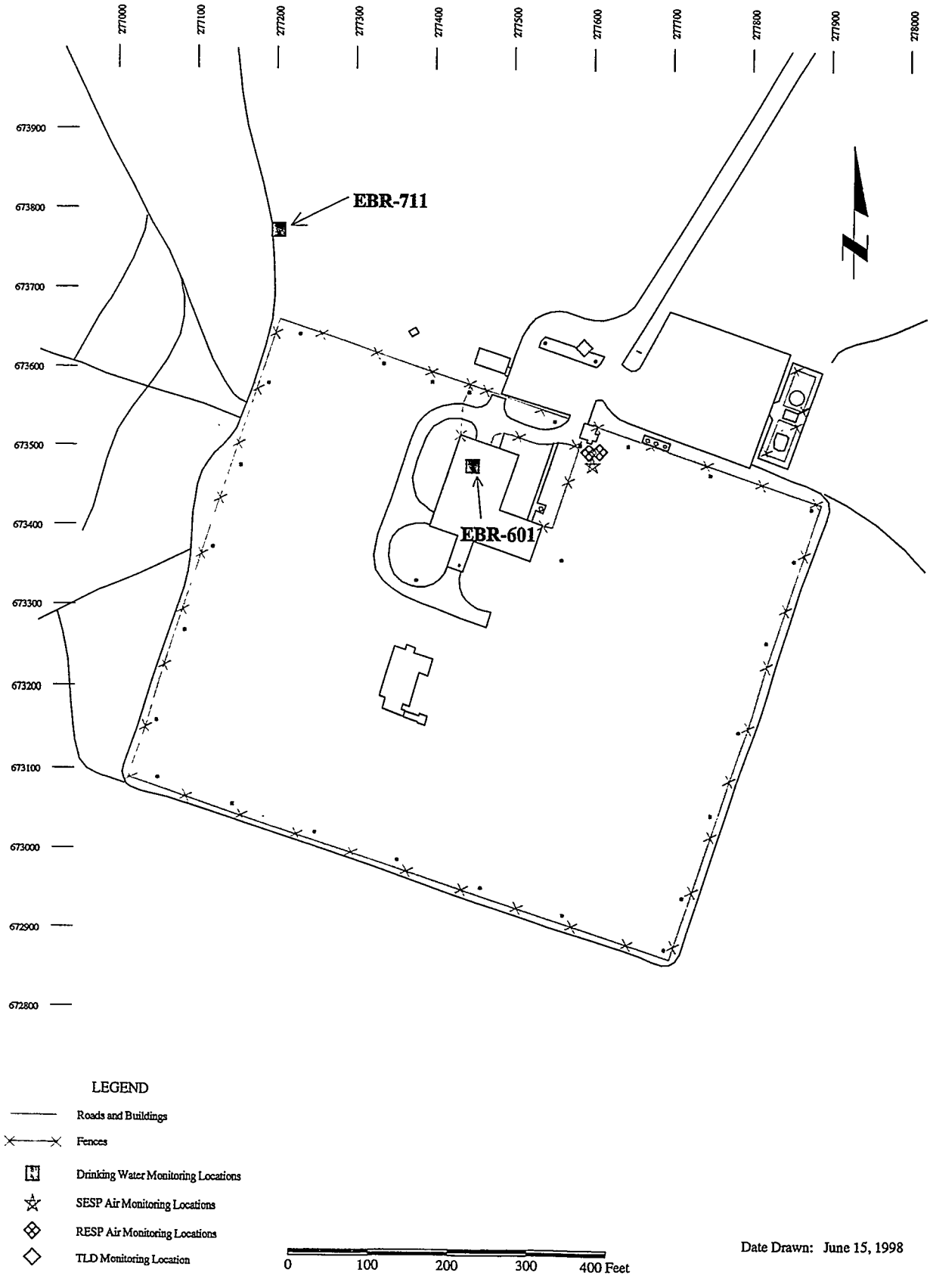

Figure A-6. Experimental Breeder Reactor–I monitoring locations.

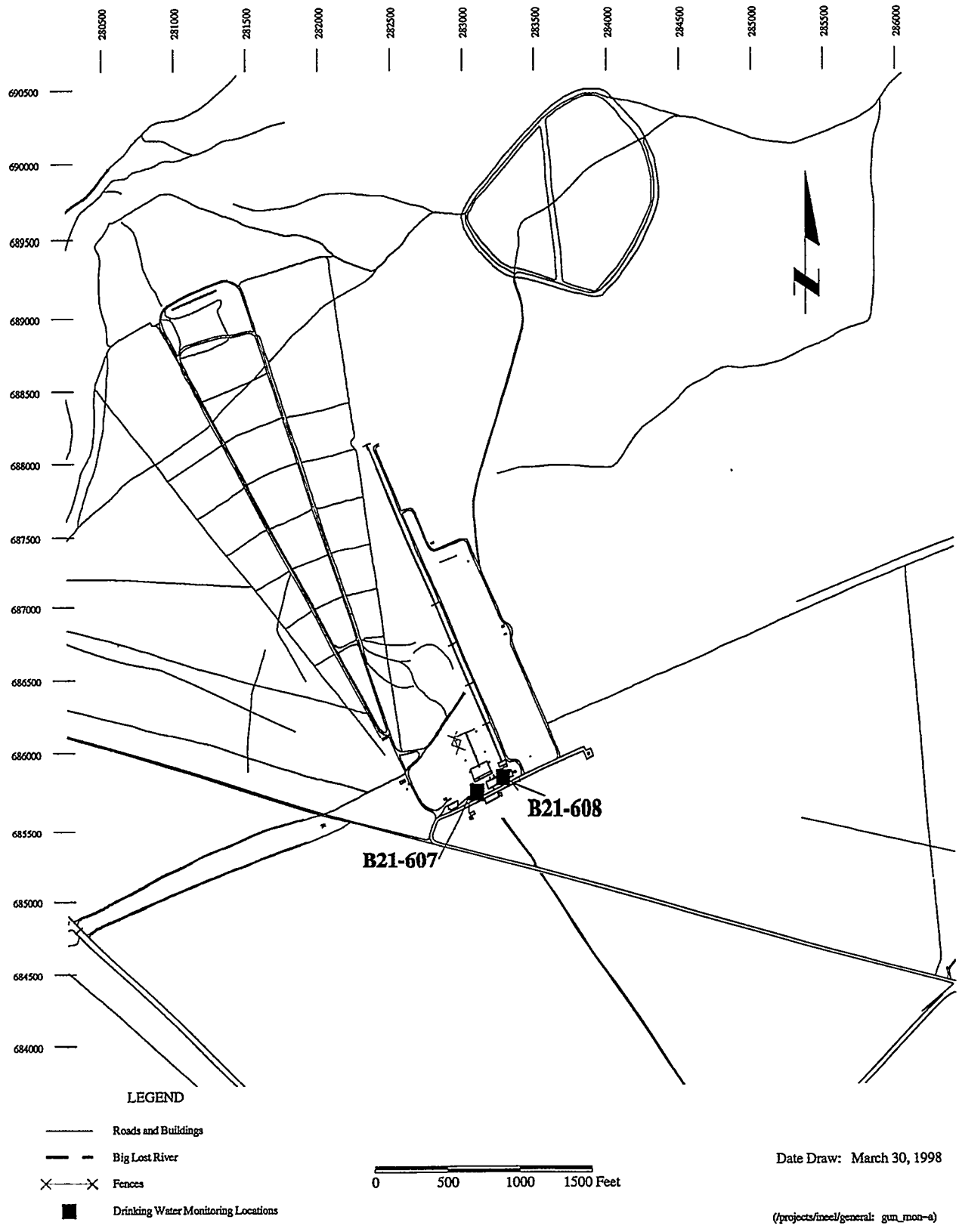

Figure A-7. Gun Range monitoring locations.

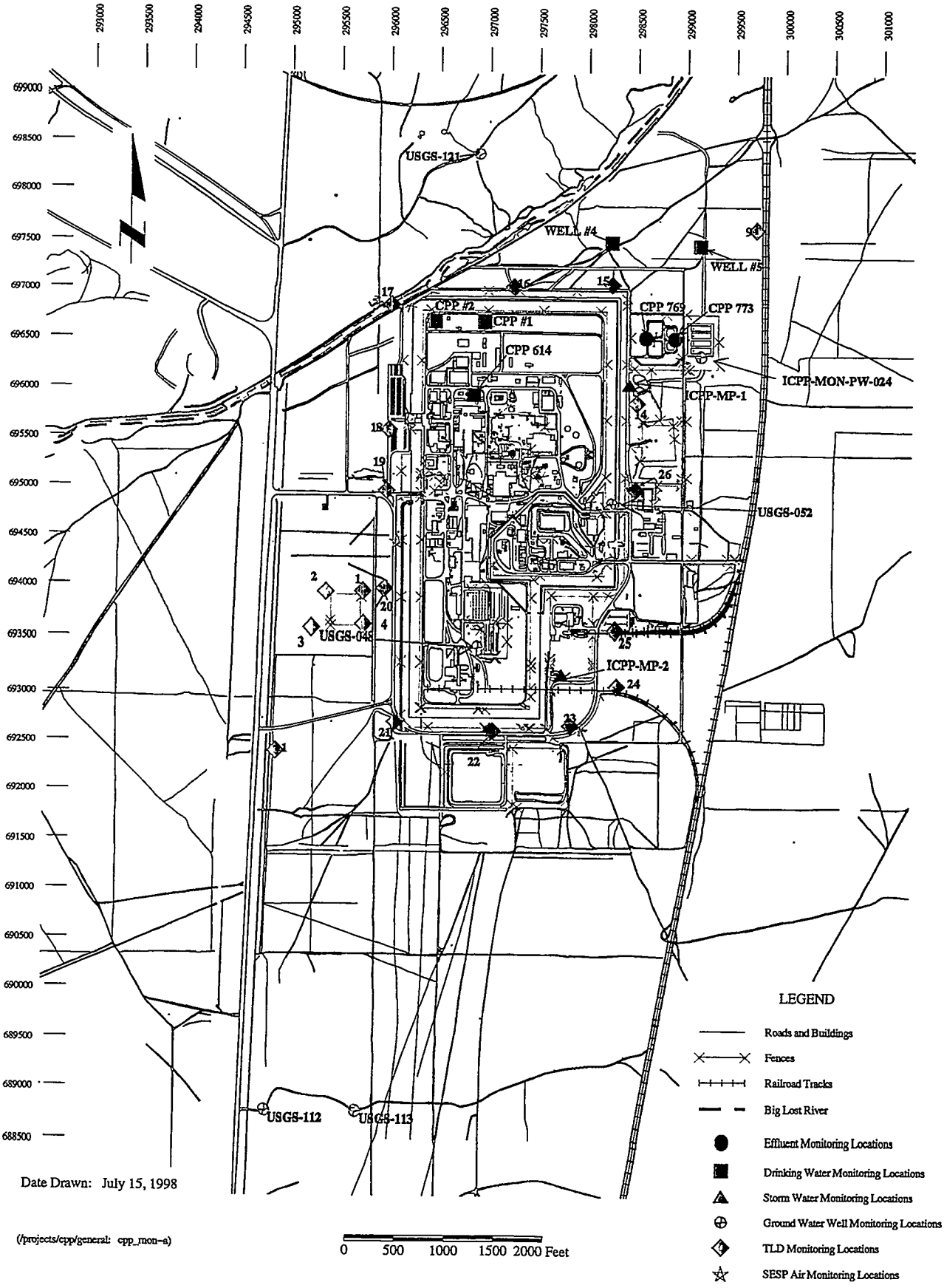

Figure A-8. Idaho Chemical Processing Plant monitoring locations.

Figure A-9. Idaho Falls monitoring locations.

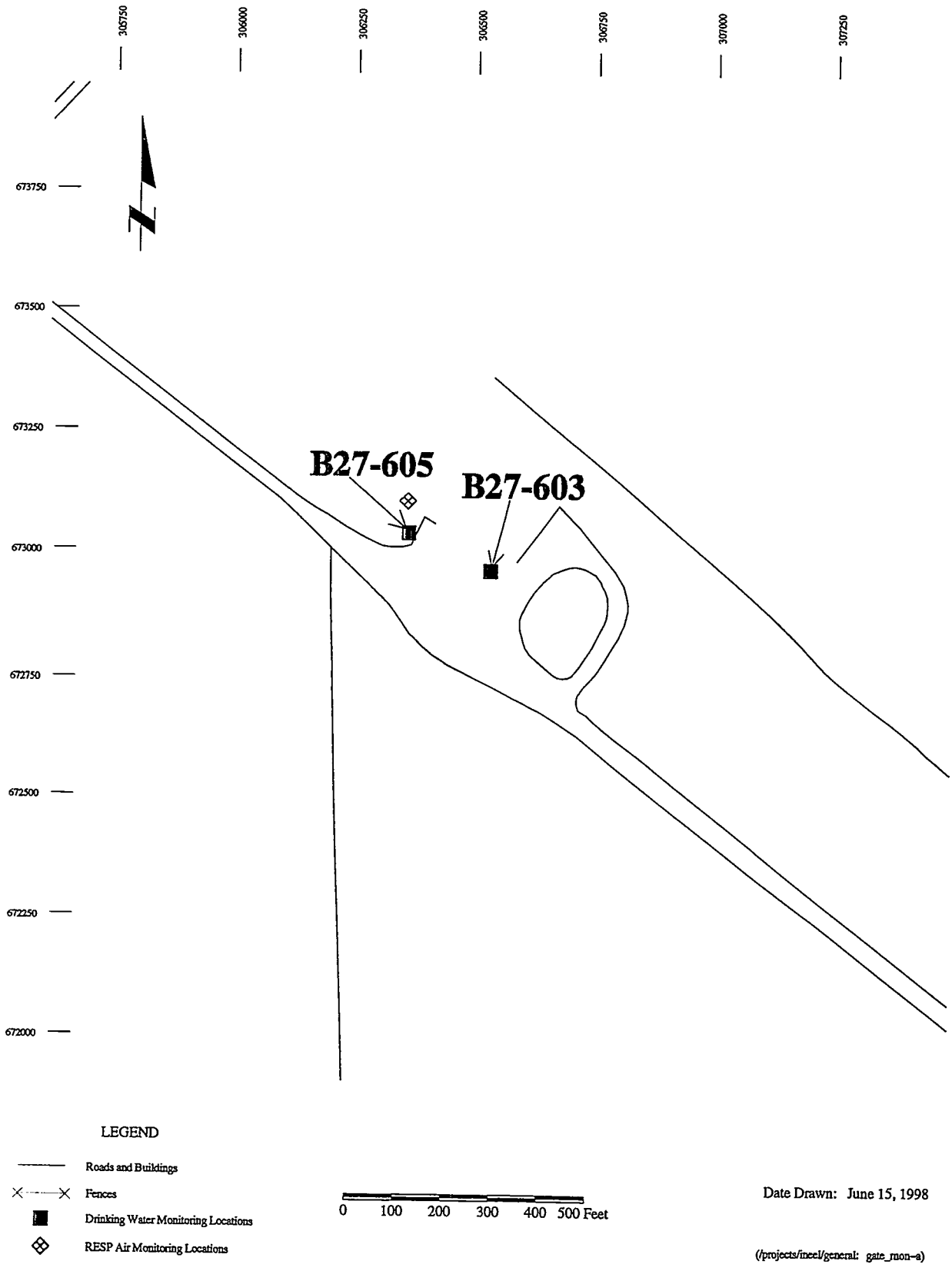

Figure A-10. Main Gate monitoring locations.

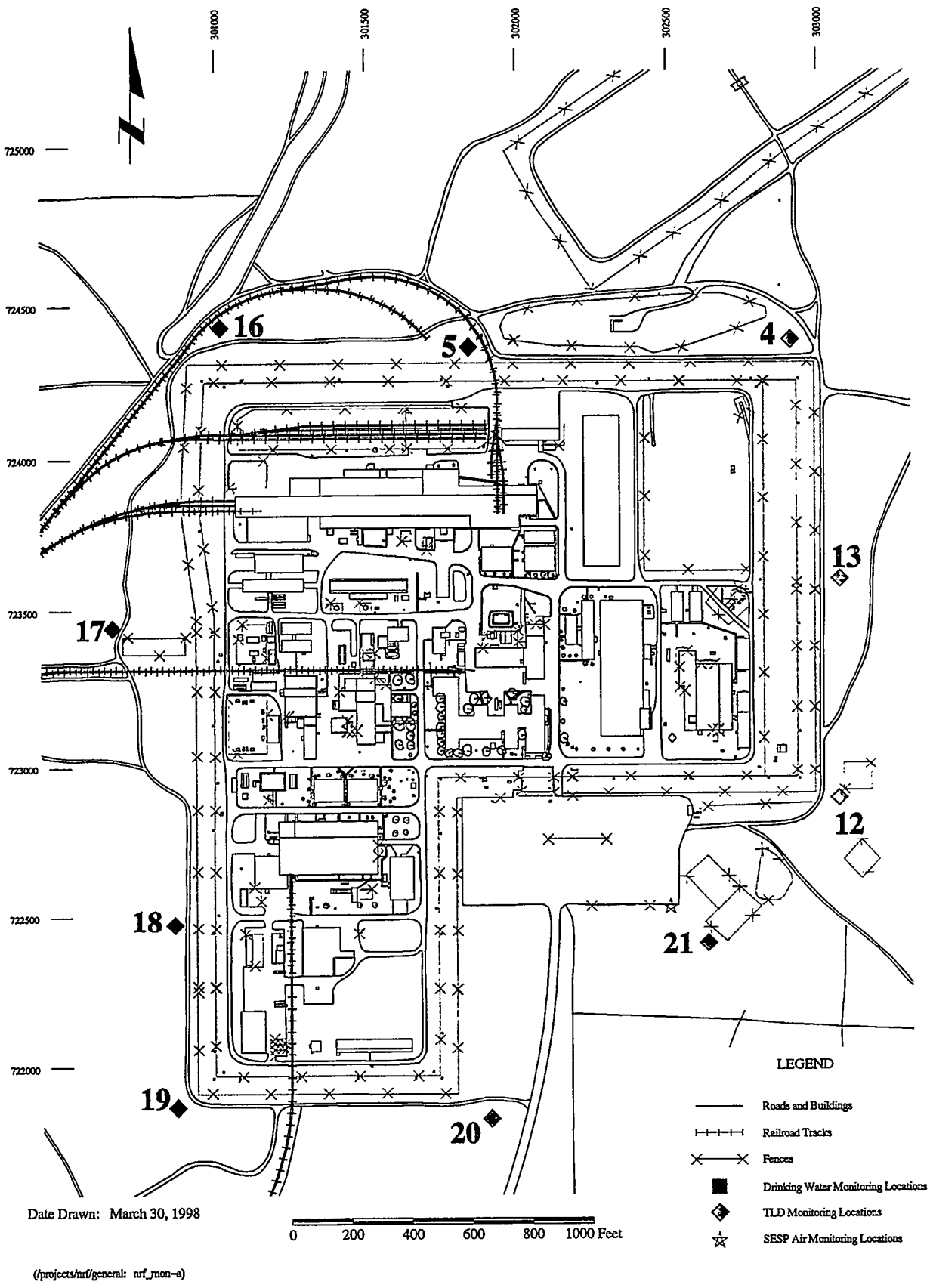

Figure A-11. Naval Reactor Facility monitoring locations.

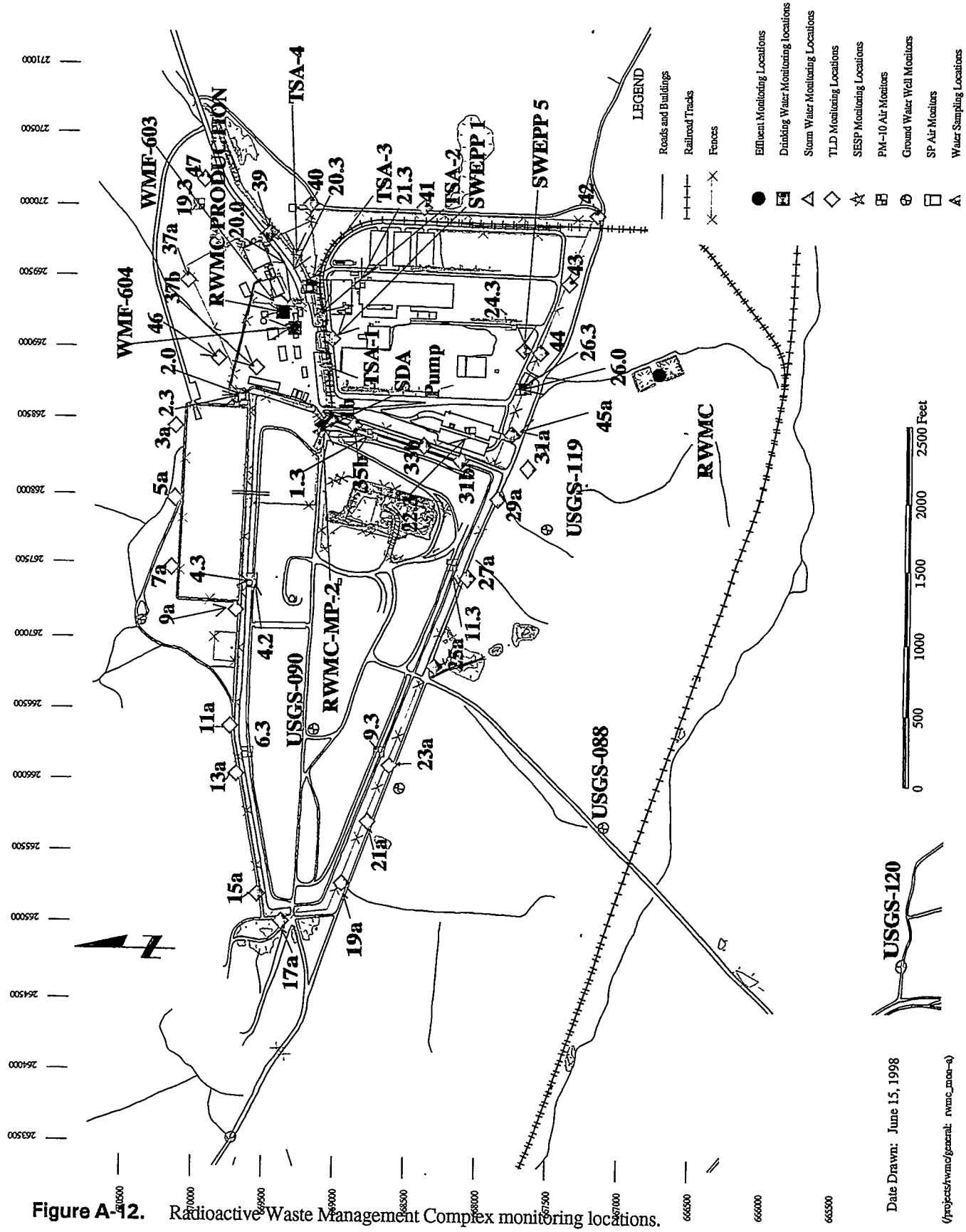

Figure A-12. Radioactive Waste Management Complex monitoring locations.

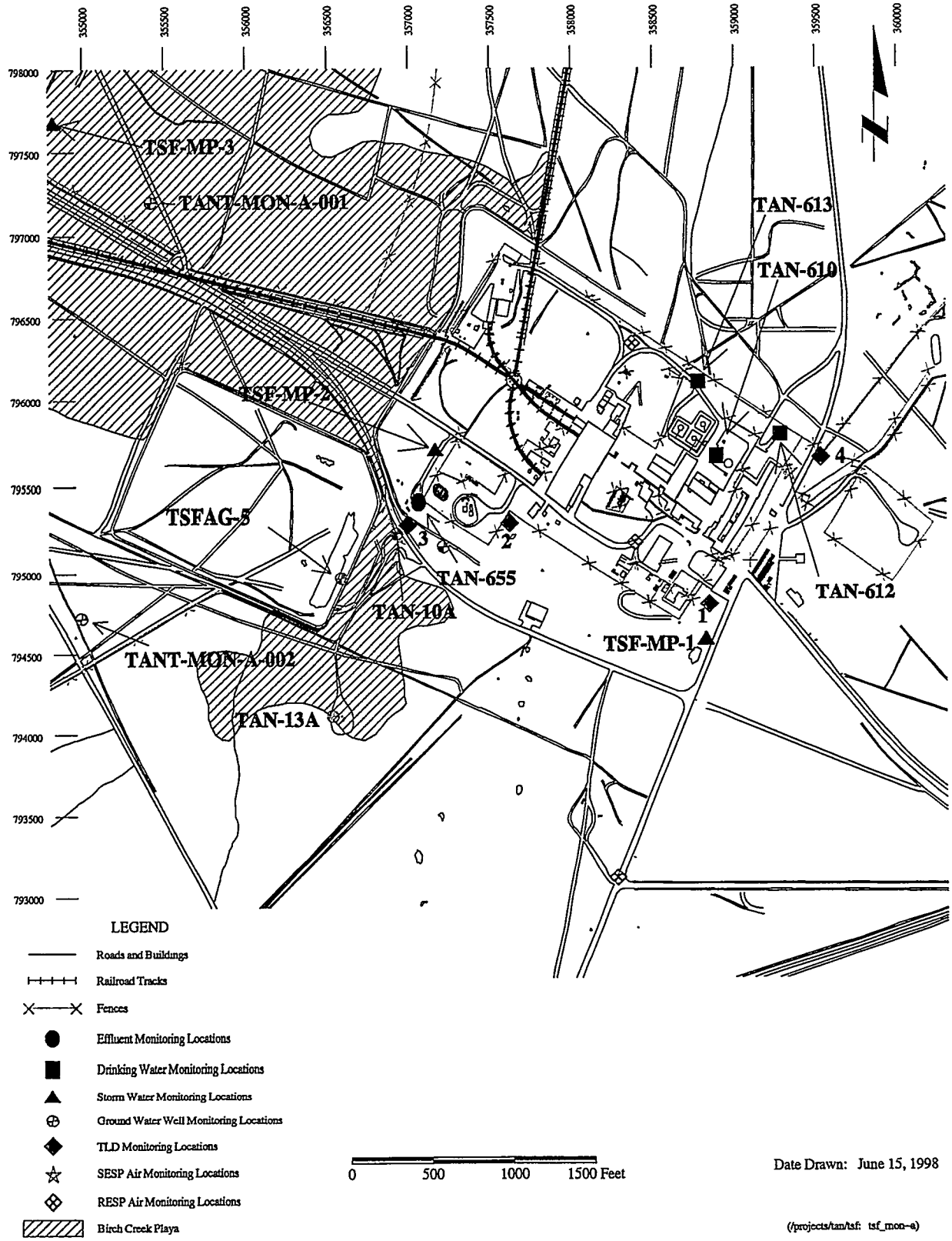

Figure A-13. Technical Support Facility monitoring locations.

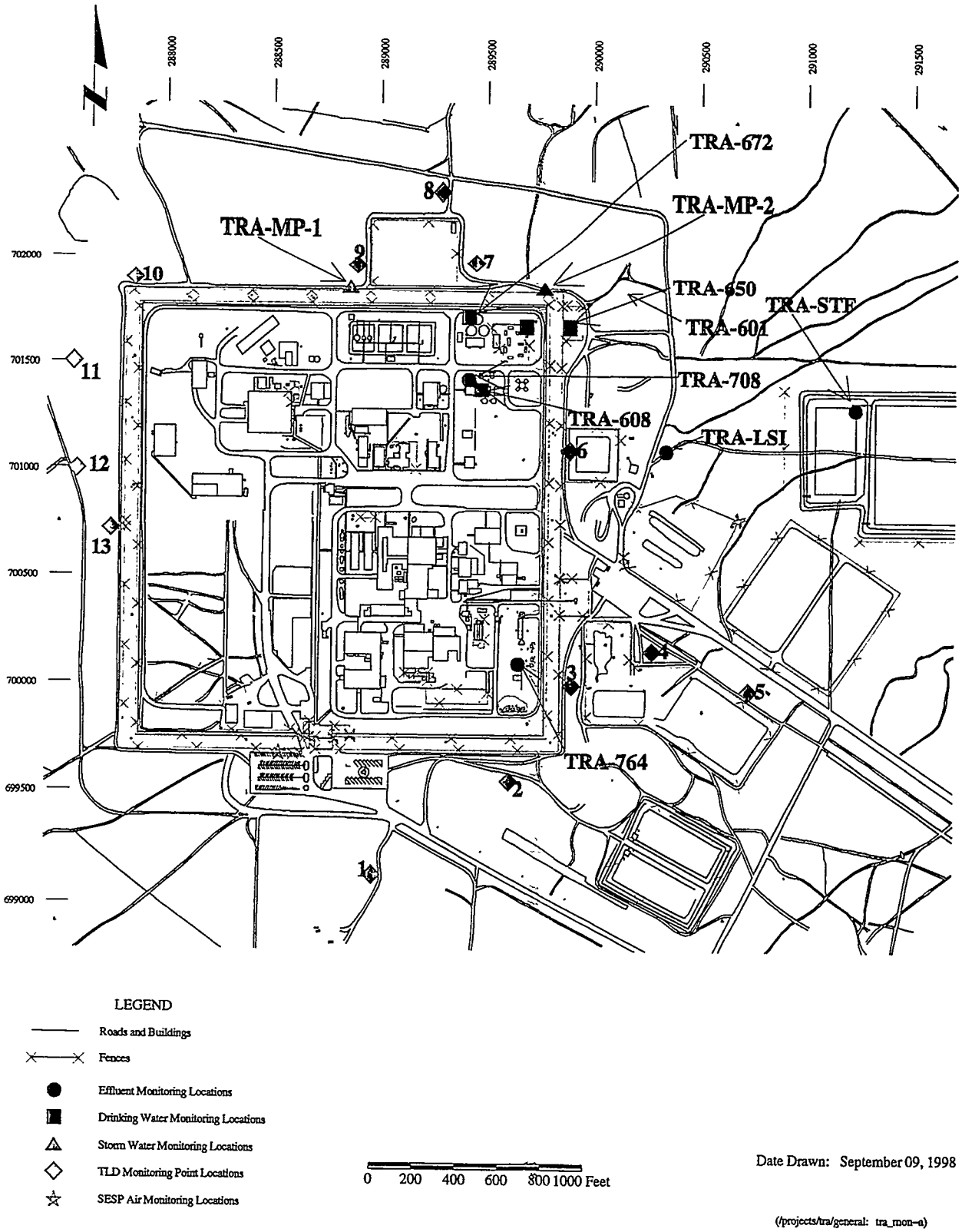

Figure A-14. Test Reactor Area monitoring locations.

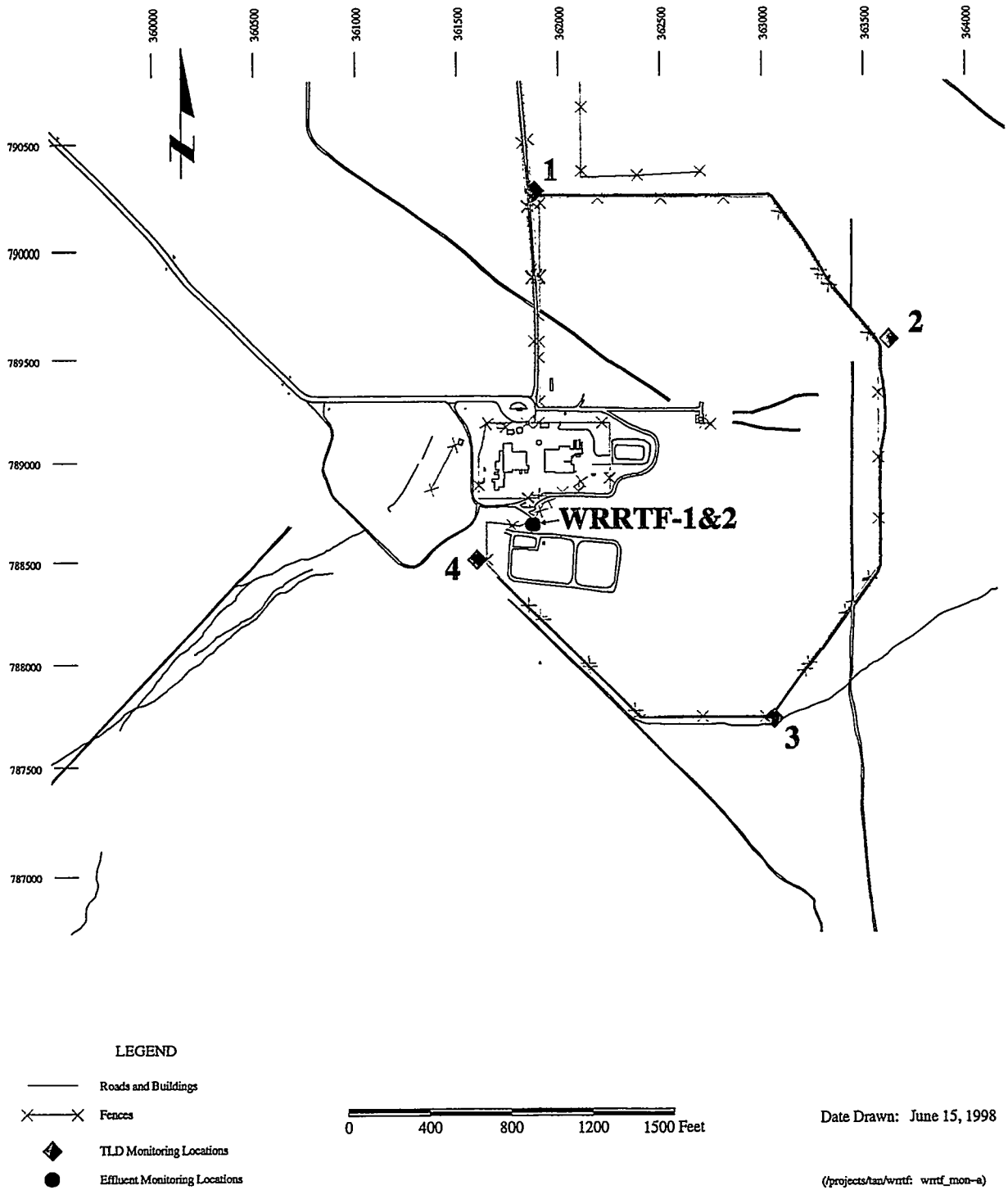

Figure A-15. Water Reactor Research Test Facility monitoring locations.

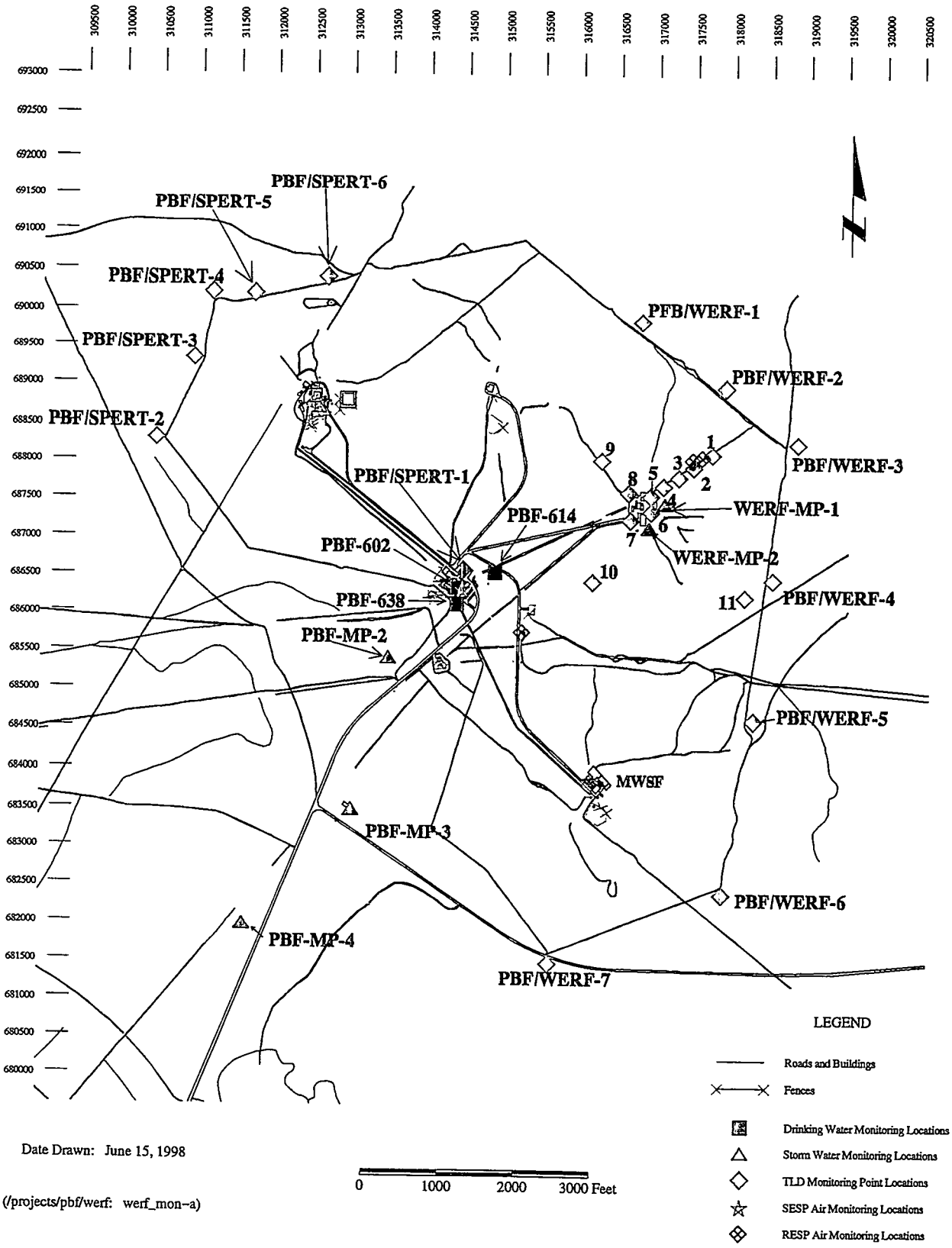

Figure A-16. Waste Experimental Reduction Facility monitoring locations.

Appendix B

Statistical Analysis Methods

Appendix B

Statistical Analysis Methods

General

This appendix summarizes the statistical methods used to analyze the Radiological Environmental Surveillance Program (RESP) airborne particulate and penetrating radiation data presented in this report. Specifically, these methods are used for determining long-term trends and for determining differences between groupings (i.e., by monitor type, by facility, or by season) of data. These methods are detailed in Blackwood.[1]

Data Pretreatment and Validation

Data are screened before statistical analysis to identify gross data errors, such as transcription errors, missing values, out of range data points, and data points that do not meet other specific criteria. Initial screening includes eliminating data from instruments that do not meet the minimum required operating characteristics as specified in the data quality objectives.

Once the basic checks for errors and operating criteria are complete, the data are screened for outliers. Graphical techniques (e.g., 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, which provides results that can be compared.

Trend Analysis

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

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

Comparisons Between Groupings

Penetrating Radiation Data from TLDs

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 since 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 seen 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 RESP locations. Since TLDs are changed out every six months, the significance of the differences in median seasonal exposure values (either spring or fall) is also of interest.

Box and whisker plots are used to graphically display the differences in medial values between groups (either by facility or season). For each grouping, the medial value of all the data is shown on the box and whisker plots, along with a box indicating the 22–75 percentile range based on all the data. The whiskers on the plots indicate the (non-outlier) minimum and maximum values within each grouping. For the box and whisker plots, the work outlier is used to define those data values that are either greater than or less than 1.5 times the range of the box. The intent of using this type of graph is to visually depict differences in the medians of the groupings; therefore, the outliers are not shown since the scale required to show the outliers would mask most of the visual differences in the median values. However, while these values are not shown on the box and whisker plots, they are included in the calculation of the median values.

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 (i.e., gross-alpha or gross-beta and PM_{10} or SP monitor). Differences in groupings are also graphically displayed using the box and whisker plots discussed above.

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Appendix C

Detection Limits

Appendix C

Detection Limits

RADIOCHEMICAL ANALYSIS DETECTION LIMITS

Tables C-1, C-2 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-1 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, and the calculation performed according to the definition of detection limits given by L. A. Currie:

$$\textit{detection limit} = \frac{2.71 + 4.66\ B^{1/2}}{t \times E \times Y \times 2.22E+6}\ \mu Ci \qquad \text{(C-1)}$$

where

B = the total background and blank correction

t = the counting time in minutes

E = the counting efficiency as a fraction

Y = the chemical yield as a fraction

2.22E+6 = the dpm/μCi.

These absolute detection limits, in terms of total microcuries per sample, are approximately 3 E-6 for Sr-90 and approximately 3 E-8 for all alpha-emitting nuclides. To determine the detection limits as activity concentration, as given in Table C-1, the absolute detection limits must be divided by the sample size taken for analysis. 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. RESP samples for radiochemical analysis.

Media	Sample description	Method of treatment	Detection limits (μCi/g or mL)	
Air	Sampled approximately at 4 cfm for 2 weeks on Versapor 1,200 filters, 6 filters per quarter for a total of ~1.7 E+10 cc of air.	Dry ash, dissolve and analyze the total sample of 6 filters.	Sr-90 Pu-238 Pu-239 Am-241	3.5 E-17 2 E-18 2 E-18 2 E-18
Water	4-L collapsible polyethylene container containing 25 mL of conc. HNO_3 and 2 Whatman ashless filter tablets for 4,000 mL water.	Separate and dissolve paper pulp, reconstitute sample, and boil down to 100 mL. Analyze 1/2 sample or 2–L equivalent.	Sr-90 Pu-238 Pu-239 Am-241	3 E-10 2 E-11 2 E-11 2 E-11
Soil	At least 25 g in appropriate container. Larger quantities are permissible if convenient.	Analyze 10-g sample.	Sr-90 Pu-238 Pu-239 Am-241	6 E-8 3 E-9 3 E-9 3 E-9
Vegetation	16-oz squat jar filled to rim below threads (avg wt 150 g).	Dry ash and dissolve the total sample completely. Analyze the equivalent of 50 g of original sample.	Sr-90 Pu-238 Pu-239 Am-241	1.2 E-8 6 E-10 6 E-10 6 E-10
Animal Tissue	16-oz squat jar containing 10 dried deer mice, or 1 dried ground squirrel (avg wts: mice, 170 g; squirrel, 100 g).	Dry ash, dissolve, and analyze the equivalent of 50 g of the original sample.	Sr-90 Pu-238 Pu-239 Am-241	1.2 E-8 6 E-10 6 E-10 6 E-10

Table C-2. RESP 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
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							
Gross Alpha	3.3							

Table C-3. RESP biotic samples for gamma spectrometry.

Radionuclide	Small Mammals		Vegetation	
	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

GAMMA SPECTROMETRIC ANALYSIS DETECTION LIMITS

Tables C-2 and C-3 give absolute detection limits in the right-hand column for each sample type. The absolute detection limits are the total activities that should be present in the sample aliquot taken for analysis. 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:

$$detection\ limit = \frac{2.71 + 4.66\ B^{1/2}}{t \times E \times P \times 2.22} \quad \text{(C-2)}$$

where

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

t = the counting time in minutes

E = the counting efficiency as a fraction

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

2.22 = the 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. Because the absolute detection limits must remain constant for a given counting time and efficiency, the detection limits in terms of concentrations become higher or lower as the sample size actually used in the analysis becomes smaller or larger. Table C-4 presents descriptions of environmental monitoring samples for gamma spectrometry analysis and counting conditions for stated detection limits.

Table C-4. Description of RESP samples for gamma spectrometry analysis.

Media	Sample Description	Counting Conditions
Air	Sampled at approximately 4 cfm for 2 weeks on 4-in. Versapor 1200 membrane filters for a total of 3×10^9 cc per filter.	Monthly composite samples of two 4-in. filters containing a total of about 6×10^9 cc of air are held flat over the detector and counted for 12 to 16 hours depending on the detector system used.
Water	4-L collapsible polyethylene container containing 25 mL of conc. HNO_3 and two Whatman ashless filter paper tablets for 4000 mL of water.	The sample is shaken vigorously to dislodge all material from the sides and bottom of the container and filter. The filtrate is transferred to a 4-L Marinelli beaker and counted for 16 hours. The filter and paper pulp are also counted for 16 hours in contact with detector. Sample size, 4000 mL.
Soil	16-oz squat jar filled to the bead below the threads after settling.	The sample is counted in the squat jar for 2 hours with the jar being rotated as close to the detector as possible. Sample size approximately 700 g.
Vegetation	16-oz squat jar filled to the bead below the threads after settling.	The dry sample is counted in the squat jar for 16 hours with the jar being rotated as close to the detector as possible. Sample size about 150 g, average.

Appendix D

Environmental Standards

Appendix D

Environmental Standards

RADIOLOGICAL SURVEILLANCE AT WASTE MANAGEMENT FACILITIES

Radionuclide concentrations in air and groundwater samples collected at MWSF, RWMC, and WERF are compared with derived concentration guide (DCG) values for air and water.[1] The DCG values listed are provided as reference values for conducting radiological protection programs at operational DOE facilities and sites.

Table D-1 lists applicable DCGs. The DCGs 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 DCGs are used as a point of reference only. Comparing individual measurements to the DCGs 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 DCG 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, DCGs are rarely, if ever, exceeded for even a short period of time 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]

Table D-2 lists environmental concentration guidelines for the radionuclides in soil that are most likely to be found in environmental samples collected at the RWMC. The concentration guides in Table D-2 are based on a homestead scenario. This scenario considers the radiation dose to the homesteader from inhalation and ingestion of 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 at the RWMC.

WATER

The environmental regulations that apply to the Drinking Water Program are as follows: the Federal Safe Drinking Water Act,[3] Code of Federal Regulations (40 CFR Parts 141–143);[4,5,6] the Idaho Regulations for Public Drinking Water Systems, IDAPA 16.01.08000–.08999;[7] DOE Order 5400.5;[8] and *Environmental Compliance Planning Manual.*[9]

In addition to the 21 regulated VOCs (see Table D-3), unregulated organic compounds are monitored and reported.

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	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	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 DCGs based on concentrations that could be continuously inhaled or ingested, respectively, and do not exceed an effective dose equivalent of 100 mR/yr.

b. DCGs apply to radionuclide concentrations in excess of those occurring naturally or due to fallout.

c. The DCGs 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 DCGs.

Table D-2. Environmental concentration guidelines for common radionuclides found in environmental soil samples collected at the RWMC.

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 of facility. This concentration assumes uniform contamination of an area adequate for subsistence farming.

Table D-3. Standards for volatile organic compounds.[a]

Parameter	Maximum Contaminant Level (mg/L)
REGULATED VOCs	
Benzene	0.005
Vinyl Chloride	0.002
Carbon Tetrachloride	0.005
1,2-Dichloroethane	0.005
Trichloroethylene	0.005
1,1-Dichloroethylene	0.007
1,2,4-Trichlorobenzene	0.07
1,1,1-Trichloroethane	0.200
1,1,2-Trichloroethane	0.005
para-Dichlorobenzene	0.075
cis-1,2-Dichloroethylene	0.07
1,2-Dichlorpropane	0.005
Dichloromethane	0.005
Ethylbenzene	0.7
Monochlorobenzene	0.1
O-Dichlorobenzene	0.6
Styrene	0.1
Tetrachloroethylene	0.005
Toluene	1.0
Trans-1,2-Dichloroethylene	0.1
Xylenes (total)	10.0

UNREGULATED VOCs WITH NO MCL

Chloroform	O-Chlorotoluene
Chlorobenzene	P-Chlorotoluene
Bromodichloromethane	Bromobenzene
Chlorodibromomethane	1,3-Dichloropropene
Bromoform	1,2,4-Trimethylbenzene
M-Dichlorobenzene	1,2,4-Trichlorobenzene
1,1-Dichloropropane	1,1-Dichloroethane
1,1,1,2-Tetrachloroethane	1,1,2,2-Tetrachloroethane
Chloroethane	1,3-Dichloropropane
2,2-Dichloropropane	Chloromethane
Bromomethane	Isopropylbenzene
1,2,3-Trichlorobenzene	Tert-Butylbenzene
N-Butylbenzene	SEC-Butylbenzene
N-Propylbenzene	Fluorotrichloromethane
Naphthalene	Dichlorodifluoromethane
Hexachlorobutadiene	Bromochloromethane
1,3,5-Trimethylbenzene	1,2,3-Trichloropropane
4-Isopropyltoluene	

a. These standards come from 40 CFR 141.24, "Organic chemicals other than total trihalomethanes, sampling and analytical requirements," July 31, 1997.

The INEEL is a nuclear facility, which implies that radiological contamination of the drinking water is possible. Because of the possibility of radiological contaminants, gross alpha, gross beta, and tritium are monitored (see Table D-4), as recommended in IDAPA 16.01.08100,06.

The City of Idaho Falls has 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-5 lists the 1997 concentration limits for discharges to the City of Idaho Falls sewer.

Table D-4. Applicable radiological drinking water standards.

Parameter	Maximum Contaminant Level (pCi/L)
Gross Alpha	15
Gross Beta	50
Tritium	20,000

Table D-5. City of Idaho Falls Sewer Code effluent concentration limits for 1997.

Parameter	Sewer Limit (mg/L)
pH	5.5–9.0
Arsenic	0.07
Cadmium	0.69
Chromium, total	2.77
Copper	3.38
Cyanide	1.20
Lead	0.62
Mercury	0.25
Methylene chloride	0.1
Phenol	0.5
Nickel	3.98
Silver	0.45
Tetrachloroethylene	0.099
Total heavy metals	5.0
Oil and grease (petroleum or mineral oil products)	100
Oil and grease (animal and vegetable based)	250
Trichloroethylene	0.099
Zinc	2.61
Stoddard Solvent	0.099

REFERENCES

1. DOE Order 5400.5, "Radiation Protection of the Public and the Environment," 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. Code of Federal Regulations, 40 CFR 141, "National Primary Drinking Water Standards," Office of the Federal Register, June 18, 1996.

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

6. Code of Federal Regulations, 40 CFA 143, "National Secondary Drinking Water Regulations," Office of the Federal Register, June 18, 1996.

7. Idaho Regulations for Public Drinking Water Systems, IDAPA 16.01.08000–.08999, 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. *Environmental Compliance Planning Manual*, U.S. Department of Energy Idaho Operations Office, May 1995.

Appendix E

Effluent Sampling Analyses Results

Table E-1. Historical and 1997 effluent data summary for CFA Sewage Treatment Plant Influent (CFA-LS1).

Parameter[a]	Units	Historical Average[b,c]	1997 Average[c]	1997 Minimum	1997 Maximum[d]	Number of Samples[e]	Guideline
Biological Oxygen Demand	mg/L	26.51	16.64	5.00	76.00	11/11	NA[f]
Conductivity	μS	653	383	266	670	12/12	NA
pH		7.37	7.34	6.71	7.98	12/12	2.5-12[g]
Chemical Oxygen Demand	mg/L	110	97.93	9.00	835.00	12/12	NA
Nitrogen, Nitrate+Nitrite	mg-N/L	0.996	0.433	0.020 U[h]	1.300	12/9	NA
Nitrogen Total Kjeldahl	mg/L	13.35	10.47	5.10	16.30	12/12	NA
Total Phosphorus	mg/L	1.87	1.574	0.640	4.200	10/10	NA
TSS	mg/L	175	23.32	6.00	123.00	12/12	NA
Gross Alpha	pCi/L	2.85 ± 0.39[i]	3.02 ± 0.83	3.02 ± 0.83 J[j]	3.02 ± 0.83 J	1/1	30[k]
Gross Beta	pCi/L	9.53 ± 0.58	9.23 ± 1.47	9.23 ± 1.47	9.23 ± 1.47	1/1	1,000[k]
H-3	pCi/L	14,541.60 ± 413.80	12,600.00 ± 1,642.00	12,600.00 ± 1,624.00	12,600.00 ± 1,642.00	1/1	2,000,000[k]

a. Only parameters detected in 1997 are presented.
b. Historical averages were calculated from data available through 1996. Non-detectable values from samples prior to 1991 were not included in these averages.
c. For nonradiological parameters with analyte concentrations less than the detection limit, half the detection limit was used in calculating the average. Radiological averages (and associated uncertainties) are weighted and include available less than detected values.
d. Maximum detectable concentration.
e. Number of samples collected/number of detectable results for 1997.
f. NA = not applicable.
g. RCRA Limit.
h U flag indicates that the result was below the detection limit.
i. Uncertainties shown are the associated 2 sigma uncertainty.
j. J flag indicates an estimated value.
k. Derived concentration guide.

Table E-2. Historical and 1997 effluent data summary for CFA Sewage Treatment Plant Effluent (CFA-STF).

Parameter[a]	Units	Historical Average[b,c]	1997 Average[c]	1997 Minimum	1997 Maximum[d]	Number of Samples[e]	Guideline[f]
Biological Oxygen Demand	mg/L	3.11	1.38	1.00 U[g]	3.00	4/3	NA[h]
Conductivity	μS	661	485	304	670	4/4	NA
pH		8.61	9.44	9.26	9.62	4/4	2.5-12[i]
Chloride	mg/L	194	258	258	258	1/1	910
Chemical Oxygen Demand	mg/L	26.93	64.05	9.20	210.00	4/4	NA
Fluoride	mg/L	0.24	0.26	0.260	0.260	1/1	13
Nitrogen, Nitrate + Nitrite	mg-N/L	0.215	0.013	0.020 U	0.020 U	4/1	NA
Nitrogen Total Kjeldahl	mg/L	2.03	1.128	0.880	1.400	4/4	NA
Total Phosphorus	mg/L	0.306	0.163	0.080	0.240	4/4	NA
Sulfate	mg/L	41.47	52.90	52.90	52.90	1/1	910
TDS	mg/L	497	800	800	800	1/1	1,800
Barium	mg/L	0.100 U	0.088	0.087	0.089	2/2	15
Chromium	mg/L	0.005 U	0.005	0.004 U	0.007	2/1	0.37
Copper	mg/L	0.013 U	0.004	0.004 U	0.006	2/1	61
Iron	mg/L	0.178	0.049	0.043	0.054	2/2	220
Potassium	mg/L	5.02	8.17	8.15	8.19	2/2	NA
Magnesium	mg/L	18.20	22.95	21.40	24.50	2/2	NA
Manganese	mg/L	0.012 U	0.002	0.002	0.002	2/2	8.1
Sodium	mg/L	80.43	98.65	93.30	104.00	2/2	6,700
Lead	mg/L	0.003	0.022	0.027	0.034 U	2/1	5
Zinc	mg/L	0.029	0.005	0.004	0.007	2/2	64
Gross Beta	pCi/L	2.15 ± 0.33[j]	7.67 ± 1.43	7.33 ± 2.54	7.83 ± 1.73	2/2	1,000[k]

a. Only parameters detected in 1997 are presented.
b. Historical average were calculated from data available through 1996. Non-detectable values from samples prior to 1991 were not included in the averages.
c. For nonradiological parameters with analyte concentrations less than the detection limit, half the detection limit was used in calculating the average. Radiological averages (and associated uncertainties) are weighted and include available less than detected values.
d. Maximum detectable concentration.
e. Number of samples collected/number of detectable results for 1997.
f. Guidelines shown are from the risk-based release level,[45,46] unless otherwise noted.
g. U flag indicates that the result was below the detection limit.
h. NA= not applicable.
i. RCRA Limit.
j. Uncertainties shown are the associated 2 sigma uncertainty.
k. Derived concentration guide.

Table E-3. Historical and 1997 effluent data summary for ICPP Sewage Treatment Plant influent (CPP-769).

Parameter[a]	Units	Historical Average[b,c]	1997 Average[c]	1997 Minimum	1997 Maximum[d]	Number of Samples[e]	Guideline[f]
Biological Oxygen Demand	mg/L	81.33	71.08	10.00	140.00	12/12	NA[g]
Conductivity	μS	633	327	208	519	12/12	NA
pH		8.09	8.12	7.65	8.48	12/12	2.5-12
Nitrogen as Ammonia	mg/L	24.00	24.60	24.60	24.60	1/1	NA
Nitrogen, Nitrate + Nitrite	mg-N/L	—[h]	0.09	0.030	0.17	12/12	NA
Nitrogen Total Kjeldahl	mg/L	35.39	41.07	28.40	56.30	12/12	NA
Total Phosphorus	mg/L	5.05	6.48	1.00 U[i]	23.50	12/11	NA
TSS	mg/L	48.81	78.71	29.00	123.00	12/12	NA

a. Only parameters detected in 1997 are presented.
b. Historical averages were calculated from data available through 1996.
c. For nonradiological parameters with analyte concentrations less than the detection limit, half the detection limit was used in calculating the average.
d. Maximum detectable concentration.
e. Number of samples collected/number of detectable results for 1997
f. RCRA TCLP Limit, unless otherwise specified.
g. NA = not applicable.
h. Historical data not available.
i. U flag indicates that the result was below the detection limit.

Table E-4. Historical and 1997 effluent data summary for ICPP Sewage Treatment Plant Effluent (CPP-773).

Parameter[a]	Units	Historical Average[b,c]	1997 Average[c]	1997 Minimum	1997 Maximum[d]	Number of Samples[e]	Guideline[f]
Biological Oxygen Demand	mg/L	12.67	14.58	4.00	30.00	12/12	NA[g]
Conductivity	μS	647	253	169	488	12/12	NA
pH		8.19	8.00	7.34	8.61	12/12	2.5-12[h]
Chloride	mg/L	109	99.76	43.20	165.00	12/12	430
Fluoride	mg/L	—[i]	0.192	0.15	0.260	10/10	6.8
Nitrogen as Ammonia	mg/L	3.80	13.40	13.40	13.40	1/1	NA
Nitrogen, Nitrate + Nitrite	mg-N/L	—	3.45	1.20	6.80	12/12	NA
Nitrogen, as Nitrate	mg-N/L	5.53	1.80	1.80	1.80	1/1	NA
Nitrogen Total Kjeldahl	mg/L	7.86	12.65	6.70	21.70	12/12	NA
Total Phosphorus	mg/L	3.18	3.40	1.00 U[j]	6.10	12/11	NA
Sulfate	mg/L	—	40.06	25.70	97.40	10/10	430
TDS	mg/L	437	451	330	560	12/12	850
TSS	mg/L	7.14	21.40	7.00	51.00	12/12	NA
Barium	mg/L	—	0.075	0.061	0.104	6/6	7.1
Calcium	mg/L	—	49.97	45.10	56.60	3/3	NA
Cadmium	mg/L	—	0.002	0.003	0.004 U	6/1	0.0085
Chromium	mg/L	—	0.004	0.003	0.007	6/3	0.17
Copper	mg/L	—	0.009	0.006	0.015	6/6	1.9
Iron	mg/L	—	0.198	0.075	0.461	6/6	5.5
Potassium	mg/L	—	11.97	10.00	13.30	6/6	NA
Magnesium	mg/L	—	15.73	14.10	17.20	6/6	NA
Manganese	mg/L	—	0.016	0.010	0.027	6/6	0.18
Sodium	mg/L	—	68.58	49.90	80.80	6/6	140
Lead	mg/L	—	0.016	0.23 U	0.036 U	6/1	0.11
Antimony	mg/L	—	0.019	0.027 U	0.042	6/1	0.021
Tallium	mg/L	—	0.019	0.025 U	0.035	6/1	0.041
Zinc	mg/L	—	0.017	0.009	0.025	6/6	9
Eu-152	pCi/L	—	1.95 ± 4.30[k]	-2.05 ± 5.44 U	19.90 ± 13.24	5/1	44

Table E-4. (continued).

Parameter[a]	Units	Historical Average[b,c]	1997 Average[c]	1997 Minimum	1997 Maximum[d]	Number of Samples[e]	Guideline[f]
Gross Alpha	pCi/L	—	1.01 ± 0.44	0.50 ± 0.76 U	1.48 ± 1.15	5/1	30[l]
Gross Beta	pCi/L	—	10.82 ± 1.00	9.45 ± 1.96	12.30 ± 1.91	5/5	1,000[l]

a. Only parameters detected in 1997 are presented.
b. Historical average were calculated from data available through 1996.
c. For nonradiological parameters with analyte concentrations less than the detection limit, half the detection limit was used in calculating the average. Radiological averages (and associated uncertainties) are weighted and included available less than detected values.
d. Maximum detectable concentration.
e. Number of samples collected/number of detectable results for 1997.
f. Guidelines shown are from the risk-based release level,[45,46] unless otherwise noted.
g. NA = not applicable.
h. RCRA Limit.
i. Historical data not available.
j. U flag indicates that the result was below the detection limit.
k. Uncertainties shown are the associated 2 sigma.
l. Derived concentration guide.

Table E-5. Historical and 1997 effluent data summary for IRC (IFF-603B).

Parameter[a]	Units	Historical Average[b,c]	1997 Average[c]	1997 Minimum	1997 Maximum[d]	Number of Samples[e]	Guideline[f]
Conductivity	μS	358	323	158	724	8/8	NA[g]
pH		7.66	7.50	7.15	7.73	8/8	5.5-9.0
Phenols	mg/L	0.010	0.004	0.005 U[h]	0.011	8/2	0.5
Total Oil & Grease	mg/L	23.75	4.60	4.60	4.60	1/1	100
Barium	mg/L	0.096	0.072	0.071	0.074	2/2	100
Calcium	mg/L	69.25	69.40	69.40	69.40	1/1	NA
Chromium	mg/L	0.004 U	0.005	0.005	0.006	2/2	2.77
Copper	mg/L	0.041	0.038	0.038	0.039	2/2	3.38
Iron	mg/L	—[i]	0.074	0.065	0.083	2/2	NA
Potassium	mg/L	—	5.00	4.54	5.45	2/2	NA
Magnesium	mg/L	18.15	18.85	18.80	18.90	2/2	NA
Manganese	mg/L	0.003	0.006	0.006	0.007	2/2	NA
Sodium	mg/L	47.45	29.45	27.70	31.20	2/2	NA
Tallium	mg/L	0.001 U	0.028	0.035 U	0.038	2/1	NA
Zinc	mg/L	0.043	0.032	0.028	0.036	2/2	2.61
Benzene	μg/L	2.50 U	1.00	1.00 J[j]	1.00 J	1/1	500[k]

a. Only parameters detected in 1997 are presented.
b. Historical averages were calculated from data available through 1996. Non-detectable values from samples prior to 1991 were not included in these averages.
c. For nonradiological parameters with analyte concentrations less than the detection limit, half the detection limit was used in calculating the averages. Radiological averages (and associated uncertainties) are weighted and include available less than detected values.
d. Maximum detectable concentration.
e. Number of samples collected/number of detectable results for 1997.
f. City of Idaho Falls Sewer Code Limit.
g. NA = not applicable.
h. U flag indicates that the result was below the detection limit.
i. Historical data not available.
i. J flag indicates an estimated value.
k. RCRA Limit

Table E-6. Historical and 1997 effluent data summary for Willow Creek Building (IFF-616).

Parameter[a]	Units	Historical Average[b,c]	1997 Average[c]	1997 Minimum	1997 Maximum[d]	Number of Samples[e]	Guideline[f]
Conductivity	μS	726	626	281	876	10/10	NA[g]
pH	mg/L	8.10	8.00	7.45	8.39	10/10	5.5-9.0
Cyanide	mg/L	0.008	0.007	0.005 U[h]	0.022	4/1	1.2
Phenols	mg/L	0.095	0.112	0.063	0.192	8/8	0.5
Total Oil & Grease	mg/L	15.55	23.90	23.90	23.90	1/1	100
Silver	mg/L	1.087	0.017	0.009 U	0.032	4/3	0.45
Barium	mg/L	1.142	0.066	0.055	0.075	4/4	100
Calcium	mg/L	—[i]	70.00	70.00	70.00	1/1	NA
Chromium	mg/L	0.008	0.004	0.005 U	0.006	4/2	2.77
Copper	mg/L	0.090	0.100	0.080	0.130	4/4	3.38
Iron	mg/L	—	1.464	0.658	2.270	2/2	NA
Potassium	mg/L	—	35.55	26.00	45.10	2/2	NA
Magnesium	mg/L	—	19.80	19.60	20.00	2/2	NA
Manganese	mg/L	—	0.031	0.027	0.035	2/2	NA
Sodium	mg/L	—	44.30	43.10	45.50	2/2	NA
Nickel	mg/L	0.015	0.007	0.010 U	0.013	4/1	3.98
Lead	mg/L	0.005	0.021	0.023 U	0.038	4/1	0.62
Zinc	mg/L	0.111	0.352	0.049	1.100	4/4	2.61
Benzene	μg/L	2.50 U	2.00	1.00 J[j]	1.00 J[j]	3/1	500[k]
Chloroform	μg/L	2.67	2.67	3.00 J	3.00 J	3/1	NA

a. Only parameters detected in 1997 are presented.
b. Historical averages were calculated from data available through 1996. Non-detectable values from samples prior to 1991 were not included in the averages.
c. For nonradiological with analyte concentrations less than the detection limit, half the detection limit was used in calculating the averages.
d. Maximum detectable concentration.
e. Number of samples collected/number of detectable results for 1997.
f. City of Idaho Falls Sewer Code Limit, unless otherwise specified.
g. NA = not applicable.
h. U flag indicates that the result was below the detection limit.
i. Historical data not available.
j. J flag indicates an estimated value.
k. RCRA Limit.

Table E-7. Historical and 1997 effluent data summary for TAN-655.

Parameter[a]	Units	Historical Average[b,c]	1997 Average[c]	1997 Minimum	1997 Maximum[d]	Number of Samples[e]	Guideline[f]
Biological Oxygen Demand	mg/L	3.70	4.71	1.00 U[g]	15.00	12/11	NA[h]
Conductivity	μS	518	320	137	912	16/16	NA
pH		7.68	7.66	7.06	8.43	16/16	2.5-12[i]
Chloride	mg/L	76.40	84.61	22.20	276.00	12/12	330
Fluoride	mg/L	0.301	0.24	0.20	0.31	12/12	5.2
Nitrogen, as Ammonia	mg/L	0.250	0.89	0.13	3.60	12/12	NA
Nitrogen, Nitrate + Nitrite	mg-N/L	6.24	5.38	1.70	7.90	12/12	NA
Total Phosphorus	mg/L	1.28	0.64	0.35	1.00	12/12	NA
Sulfate	mg/L	44.54	38.58	32.30	52.50	12/12	330
TDS	mg/L	355	401	270	690	12/12	660
Nitrogen Total Kjeldahl	mg/L	2.12	1.34	0.45	4.40	12/12	NA
TSS	mg-N/L	30.39	5.77	5.00 U	19.00	15/7	NA
Barium	mg/L	0.113	0.093	0.082	0.112	12/12	11
Calcium	mg/L	65.48	53.70	48.30	57.80	5/5	NA
Cadmium	mg/L	0.004	0.002	0.002 U	0.004 U	12/1	0.0067
Chromium	mg/L	0.009	0.006	0.004	0.009	12/9	0.13
Copper	mg/L	0.042	0.012	0.004 U	0.017	10/9	2.3
Iron	mg/L	0.471	0.203	0.071	0.414	12/12	8.3
Mercury	mg/L	0.0008	0.0001	0.0001 U	0.0001	12/1	0.022
Potassium	mg/L	3.20	4.32	3.52	4.94	10/10	NA
Magnesium	mg/L	15.44	14.97	13.30	16.50	10/10	NA
Manganese	mg/L	0.030	0.007	0.003	0.015	12/11	0.27
Sodium	mg/L	43.78	53.74	8.55	173.00	12/12	220
Lead	mg/L	0.015	0.018	0.023 U	0.036 U	12/2	0.17
Zinc	mg/L	0.115	0.035	0.024	0.067	12/11	9.7
Gross Alpha	pCi/L	2.21 ± 0.32[j]	1.86 ± 0.67	0.32 ± 1.41 U	2.94 ± 1.12	4/2	30[k]
Gross Beta	pCi/L	11.86 ± 0.49	16.46 ± 1.50	10.60 ± 2.26	39.40 ± 4.66	4/4	1,000[k]

Table E-7. (continued).

Parameter[a]	Units	Historical Average[b,c]	1997 Average[c]	1997 Minimum	1997 Maximum[d]	Number of Samples[e]	Guideline[f]
Sr-90	pCi/L	1.54 ± 0.16	2.20 ± 0.44	2.20 ± 0.44	2.20 ± 0.44	1/1	1,000[k]

a. Only parameters detected in 1997 are presented.
b. Historical averages were calculated from data available through 1996. Non-detectable values from samples prior to 1991 were not included in the averages.
c. For nonradiological parameters with analyte concentrations less than the detection limit, half the detection limit was used in calculating the averages. Radiological averages (and associated uncertainties) are weighted and include available less than detected values.
d. Maximum detectable concentration.
e. Number of samples collected/number of detectable results for 1997.
f. Guidelines shown are from the risk-based release level,[45,46] unless otherwise noted.
g. U flag indicates that the result was below the detection limit.
h. NA = not applicable.
i. RCRA Limit.
j. Uncertainties shown are the associated 2 sigma.
k. Derived concentration guide.

Table E-8. Historical and 1997 effluent data summary for TRA-708.

Parameter[a]	Units	Historical Average[b,c]	1997 Average[c]	1997 Minimum	1997 Maximum[d]	Number of Samples[e]	Guideline[f]
Conductivity	μS	21,365	4343	775	8,628	4/4	NA[g]
pH		8.27	8.43	6.67	9.77	4/4	2.5-12[h]
Chloride	mg/L	184	93.10	9.90	214.00	4/4	530
Fluoride	mg/L	7.33	0.895	0.110	1.700	4/4	8.5
Nitrogen, Nitrate + Nitrite	mg-N/L	6.47	9.245	0.980	17.800	4/4	NA
Sulfate	mg/L	17,339	7803[i]	4250	11,000	4/4	530
TDS	mg/L	21,074	11,100[i]	7400	13,000	4/4	1,100
Barium	mg/L	0.240	0.109	0.064	0.176	4/4	10
Calcium	mg/L	424	230	217	242	2/2	NA
Chromium	mg/L	0.071	0.032	0.026	0.045	4/4	0.21
Copper	mg/L	0.071	0.006	0.004 U[j]	0.012	4/2	2.5
Iron	mg/L	4.89	1.525	0.769	1.830	4/4	9.6
Mercury	mg/L	0.006	0.0003	0.0001 U	0.0010	4/2	0.022
Potassium	mg/L	23.85	13.03	7.97	19.20	4/4	NA
Magnesium	mg/L	218	117.20	74.60	175.00	4/4	NA
Manganese	mg/L	0.029	0.017	0.009	0.021	4/4	0.25
Sodium	mg/L	3,835	2,700[i]	1,870	3,600	4/4	220
Nickel	mg/L	0.036	0.009	0.011 U	0.013	4/2	1.1
Lead	mg/L	0.021	0.018	0.023 U	0.036 U	4/1	0.16
Zinc	mg/L	0.036	0.007	0.002 U	0.011	4/3	12

a. Only parameters detected in 1997 are presented.
b. Historical averages were calculated from data available through 1996. Non-detectable values from samples prior to 1991 were not included in the averages.
c. For nonradiological parameters with analyte concentrations less than the detection limit, half the detection limit was used in calculating the averages.
d. Maximum detectable concentration.
e. Number of samples collected/number of detectable results for 1997.
f. Guidelines shown are from the risk-based release level,[45,46] unless otherwise noted.
g. NA = not applicable.
h. RCRA Limit.
i. The mean value exceeded the guideline.
j. U flag indicates that the result was below the detection limit.

Table E-9. Historical and 1997 effluent data summary for TRA LS1.

Parameter[a]	Units	Historical Average[b,c]	1997 Average[c]	1997 Minimum	1997 Maximum[d]	Number of Samples[e]	Guideline[f]
Biological Oxygen Demand	mg/L	111	66.22	16.00	150.00	9/9	NA[g]
Conductivity	μS	474	292.44	8.00	462.00	9/9	NA
pH		7.87	7.95	7.56	8.35	9/9	2.5-12
Chemical Oxygen Demand	mg/L	205	192.67	60.00	617.00	9/9	NA
Nitrogen, Nitrate + Nitrite	mg-N/L	0.580	0.319	0.020 U[h]	0.630	9/7	NA
Nitrogen Total Kjeldahl	mg/L	35.05	33.12	6.70	50.50	9/9	NA
Total Phosphorus	mg/L	1.87	6.69	2.00	21.70	8/8	NA
TSS	mg/L	107	57.46	16.00	160.00	9/9	NA
Barium	mg/L	0.094	0.047	0.039	0.055	2/2	100
Calcium	mg/L	48.98	39.00	39.00	39.00	1/1	NA
Chromium	mg/L	0.005	0.005	0.005 U	0.007	2/1	5
Copper	mg/L	0.019	0.018	0.009	0.027	2/2	NA
Iron	mg/L	0.394	0.194	0.155	0.232	2/2	NA
Potassium	mg/L	8.88	12.30	8.69	15.90	2/2	NA
Magnesium	mg/L	17.96	16.70	14.90	18.50	2/2	NA
Manganese	mg/L	0.013	0.014	0.011	0.017	2/2	NA
Sodium	mg/L	23.41	28.50	28.00	29.00	2/2	NA
Tallium	mg/L	0.005 U	0.021	0.027	0.031 U	2/1	NA
Zinc	mg/L	0.143	0.121	0.099	0.144	2/2	NA
Gross Beta	pCi/L	9.31 ± 0.51[i]	10.90 ± 2.08	10.90 ± 2.08	10.90 ± 2.08	1/1	1,000[j]
Sr-89	pCi/L	0.17 ± 0.26	2.01 ± 0.99	2.01 ± 0.99	2.01 ± 0.99	1/1	20,000[j]

a. Only parameters detected in 1997 are presented.
b. Historical averages were calculated from data available through 1996. Non-detectable values from samples prior to 1991 were not included in the averages.
c. For nonradiological parameters with analyte concentrations less than the detection limit, half the detection limit was used in calculating the averages. Radiological averages (and associated uncertainties) are weighted and include available less than detected values.
d. Maximum detectable concentration.
e. Number of samples collected/number of detectable results for 1997.
f. RCRA TCLP Limit, unless otherwise specified.
g. NA = not applicable.
h. U flag indicates that the result was below the detection limit.
i. Uncertainties shown are the associated 2 sigma uncertainty.
j. Derived concentration guide.

Table E-10. Historical and 1997 effluent data summary for TRA-764.

Parameter[a]	Units	Historical Average[b,c]	1997 Average[c]	1997 Minimum	1997 Maximum[d]	Number of Samples[e]	Guideline[f]
Conductivity	μS	972	478	172	763	4/4	NA[g]
pH		7.59	7.36	7.29	7.44	4/4	2.5-12[h]
Chloride	mg/L	23.66	24.95	8.80	45.80	4/4	280
Fluoride	mg/L	0.317	0.270	0.140	0.370	4/4	4.5
Nitrogen Nitrate + Nitrite	mg-N/L	2.20	2.25	1.10	4.00	4/4	NA
Sulfate	mg/L	295	207.68	28.40	386.00	4/4	280
TDS	mg/L	569	541	264	820	4/4	560
Barium	mg/L	0.094	0.079	0.047	0.116	4/4	13
Calcium	mg/L	78.27	94.70	46.40	143.00	2/2	NA
Chromium	mg/L	0.012	0.006	0.005 U[i]	0.008	4/3	0.11
Copper	mg/L	0.020	0.008	0.005	0.012	4/3	2.6
Iron	mg/L	0.198	0.047	0.007	0.104	4/4	8.5
Potassium	mg/L	7.43	4.78	1.41	8.11	4/4	NA
Magnesium	mg/L	29.08	33.15	17.20	49.60	4/4	NA
Manganese	mg/L	0.007	0.0010	0.0008 U	0.0018	4/2	0.32
Sodium	mg/L	14.88	16.28	8.32	25.20	4/4	260
Tallium	mg/L	0.012	0.021	0.025 U	0.037	4/1	0.024
Zinc	mg/L	0.031	0.004	0.002	0.007	4/4	11
Gross Alpha	pCi/L	2.18 ± 0.21[j]	1.35 ± 0.70	-0.40 ± 1.30 U	2.65 ± 1.37	4/1	30[k]
Gross Beta	pCi/L	6.60 ± 0.50	4.62 ± 0.95	2.06 ± 1.80 U	8.31 ± 2.04	4/3	1,000[k]
Ag-108m	pCi/L	-0.37 ± 1.28	-0.68 ± 2.69	-5.97 ± 8.32 U	6.27 ± 5.58	4/1	70

a. Only parameters detected in 1997 are presented.
b. Historical averages were calculated from data available through 1996. Non-detectable values from samples prior to 1991 were not included in the averages.
c. For nonradiological parameters with analyte concentrations less than the detection limit, half the detection limit was used in calculating the averages. Radiological averages (and associated uncertainties) are weighted and include available less than detected values.
d. Maximum detectable concentration.
e. Number of samples collected/number of detectable results for 1997.
f. Guidelines shown are from the risk-based release level,[45,46] unless otherwise noted.
g. NA = not applicable.
h. RCRA Limit.
i. U flag indicates that the result was below the detection limit.
j. Uncertainties shown are the associated 2 sigma uncertainty.
k. Drinking water MCL.

Table E-11. Historical and 1997 effluent data summary for TRA-STF.

Parameter[a]	Units	Historical Average[b,c]	1997 Average[c]	1997 Minimum	1997 Maximum[d]	Number of Samples[e]	Guideline[f]
Biological Oxygen Demand	mg/L	0.833	21.67	1.00	170.00	9/9	NA[g]
Conductivity	μS	172	260	114	460	9/9	NA
pH		8.86	7.79	7.31	8.68	9/9	2.5-12
Chemical Oxygen Demand	mg/L	44.83	134.37	5.00 U[h]	910.00	9/8	NA
Nitrogen, Nitrate + Nitrite	mg-N/L	—[i]	0.59	0.11	1.60	9/9	NA
Nitrogen Total Kjeldahl	mg/L	2.31	11.64	2.90	33.70	9/9	NA
Total Phosphorus	mg/L	0.39	3.39	0.46	14.20	9/9	NA
TSS	mg/L	2.50 U	19.06	5.00 U	57.00	9/6	NA

a. Only parameters detected in 1997 are presented.
b. Historical averages were calculated from data available through 1996. Non-detectable values from samples prior to 1991 were not included in the averages.
c. For nonradiological parameters with analyte concentrations less than the detection limit, half the detection limit was used in calculating the averages.
d. Maximum detectable concentration.
e. Number of samples collected/number of detectable results for 1997.
f. RCRA TCLP Limit, unless otherwise specified. Radiological guideline limits are DCGs unless otherwise noted.
g. NA = not applicable.
h. U flag indicates that the result was below the detection limit.
i. Historical data not available.

Table E-12. Historical and 1997 effluent data summary for WRRTF1.

Parameter[a]	Units	Historical Average[b,c]	1997 Average[c]	1997 Minimum	1997 Maximum[d]	Number of Samples[e]	Guideline[f]
Biological Oxygen Demand	mg/L	5.41	10.00	10.00	10.00	1/1	NA[g]
Conductivity	μS	404	194	194	194	1/1	NA
pH		7.26	7.03	7.03	7.03	1/1	2.5-12[h]
Chloride	mg/L	33.68	34.00	34.00	34.00	1/1	1000
Fluoride	mg/L	0.212	0.200	0.200	0.200	1/1	17
Nitrogen, Nitrate + Nitrite	mg-N/L	3.16	3.50	3.50	3.50	1/1	NA
Nitrogen Total Kjeldahl	mg/L	12.74	14.40	14.40	14.40	1/1	NA
Total Phosphorus	mg/L	1.10	2.90	2.90	2.90	1/1	NA
Sulfate	mg/L	34.76	45.10	45.10	45.10	1/1	1000
TDS	mg/L	351	380	380	380	1/1	2100
Barium	mg/L	0.100	0.073	0.073	0.073	1/1	49
Copper	mg/L	0.013	0.012	0.012	0.012	1/1	7.9
Iron	mg/L	1.33	0.246	0.246	0.246	1/1	76
Potassium	mg/L	11.11	13.00	13.00	13.00	1/1	NA
Magnesium	mg/L	17.68	16.80	16.80	16.80	1/1	NA
Manganese	mg/L	0.117	0.071	0.071	0.071	1/1	1.2
Sodium	mg/L	22.12	21.30	21.30	21.30	1/1	1400
Zinc	mg/L	0.073	0.393	0.393	0.393	1/1	32

a. Only parameters detected in 1997 are presented.
b. Historical averages were calculated from data available through 1996. Non-detectable values from samples prior to 1991 were not included in the averages.
c. For nonradiological parameters with analyte concentrations less than the detection limit, half the detection limit was used in calculating the averages. Radiological averages (and associated uncertainties) are weighted and include available less than detected values.
d. Maximum detectable concentration.
e. Number of samples collected/number of detectable results for 1997
f. Guidelines shown are from the risk-based release level,[45,46] unless otherwise noted.
g. NA – not applicable.
h. RCRA Limit.

Table E-13. Historical and 1997 effluent data summary for WRRTF2.

Parameter[a]	Units	Historical Average[b,c]	1997 Average[c]	1997 Minimum	1997 Maximum[d]	Number of Samples[e]	Guideline[f]
Conductivity	μS	560	545	270	819	2/2	NA[g]
pH		8.03	7.64	7.43	7.85	2/2	2.5-12[h]
Chloride	mg/L	160	435.00	13.00	857.00	2/2	1000
Fluoride	mg/L	0.343	0.280	0.210	0.350	2/2	17
Nitrogen, Nitrate + Nitrite	mg-N/L	1.16	0.875	0.550	1.200	2/2	NA
Sulfate	mg/L	63.50	60.55	44.80	76.30	2/2	1000
TDS	mg/L	555	1135	270	2000	2/2	2100
Total Petroleum Hydrocarbons	mg/L	—[i]	3.80	3.80	3.80	1/1	NA
Barium	mg/L	0.283	0.187	0.085	0.289	2/2	49
Calcium	mg/L	136	48.00	48.00	48.00	1/1	NA
Cobalt	mg/L	0.036	0.007	0.005 U[j]	0.012	2/1	NA
Chromium	mg/L	0.032	0.003	0.004	0.005 U	2/1	0.41
Copper	mg/L	0.456	0.031	0.007	0.055	2/2	7.9
Iron	mg/L	27.37	0.369	0.072	0.666	2/2	76
Potassium	mg/L	5.12	5.31	3.12	7.49	2/2	NA
Magnesium	mg/L	32.84	29.65	16.20	43.10	2/2	NA
Manganese	mg/L	0.294	0.016	0.002	0.030	2/2	1.2
Sodium	mg/L	75.36	190.50	18.00	363.00	2/2	1400
Zinc	mg/L	0.631	0.048	0.021	0.076	2/2	32

a. Only parameters detected in 1997 are presented.
b. Historical averages were calculated from data available through 1996. Non-detectable values from samples prior to 1991 were not included in the averages.
c. For nonradiological parameters with analyte concentrations less than the detection limit, half the detection limit was used in calculating the averages.
d. Maximum detectable concentration.
e. Number of samples collected/number of detectable results for 1997.
f. Guidelines shown are from the risk-based release level,[45,46] unless otherwise noted.
g. NA – not applicable.
h. RCRA Limit.
i. Historical data not available
j. U flag indicates that the result was below the detection limit.

Appendix F

Storm Water Sampling Analyses Results

Table F-1. Historical and 1997 storm water data summary for ICPP Retention Basin (CPP-MP-1).

Parameter[a]	Units	Historical Average[b,c]	1997 Average[c]	1997 Minimum	1997 Maximum[d]	Number of Samples[e]	Guideline[f]
Conductivity	μS	114.14	43.00	43.00	43.00	1/1	NA[g]
pH		7.67	6.93	6.93	6.93	1/1	6.0–9.0
Biological Oxygen Demand	mg/L	6.50	4.00	4.00	4.00	1/1	30
Chemical Oxygen Demand	mg/L	37.79	6.50	6.50	6.50	1/1	120
Nitrogen, as Nitrate	mg-N/L	—[h]	0.490	0.490	0.490	1/1	0.68
Total Phosphorus	mg/L	0.60	1.20	1.20	1.20	1/1	2.0
Nitrogen, Total Kjeldahl	mg/L	2.88	1.10	1.10	1.10	1/1	NA
Total Oil and Grease	μg/L	21.36	1.40	1.40	1.40	1/1	15
TSS	mg/L	303.36	360[i]	360	360	1/1	100
Gross Alpha	pCi/L	9.10 ± 5.73[j]	1.72 ± 1.01	1.72 ± 1.01	1.72 ± 1.01	1/1	30
Gross Beta	pCi/L	16.13 ± 2.87	8.41 ± 2.14	8.41 ± 2.14	8.41 ± 2.14	1/1	1,000

a. Only parameters detected in 1997 are presented.
b. Historical averages were calculated from data available through 1996.
c. For nonradiological parameters with analyte concentrations less than the detection limit, half the detection limit was used in calculating the averages. Radiological averages (and associated uncertainties) are weighted and include available less than detected values.
d. Maximum detectable concentration.
e. Number of samples collected/number of detectable results for 1997.
f. For nonradiological parameters, EPA Benchmarks are shown. For radiological parameters, DCGs are shown.
g. NA – not applicable.
h. Historical data not available
i. The mean value from the detected 1997 data exceeded the associated benchmark.
j. Uncertainties shown are the associated 2 sigma uncertainty.

Table F-2. Historical and 1997 storm water summary data for ICPP Coal Pile (CPP-MP-2).

Parameter[a]	Units	Historical Average[b,c]	1997 Average[c]	1997 Minimum	1997 Maximum[d]	Number of Samples[e]	Guideline[f]
Conductivity	μS	81.30	41.00	41.00	41.00	1/1	NA[g]
pH		7.74	6.98	6.98	6.98	1/1	6.0–9.0[h]
Chemical Oxygen Demand	mg/L	203.20	24.00	24.00	24.00	1/1	120
Total Oil and Grease	mg/L	4.60	1.90	1.90	1.90	1/1	15
TSS	mg/L	161.98	53.00	53.00	53.00	1/1	100
Copper	μg/L	0.022	0.007	0.007	0.007	1/1	0.064
Zinc	μg/L	0.088	0.018	0.018	0.018	1/1	0.117

a. Only parameters detected in 1997 are presented.
b. Historical averages were calculated from data available through 1996.
c. For nonradiological parameters with analyte concentrations less than the detection limit, half the detection limit was used in calculating the averages.
d. Maximum detectable concentration.
e. Number of samples collected/number of detectable results for 1997.
f. For nonradiological parameters, EPA Benchmarks are shown.
g. NA = not applicable.
h. NPDES permit pH limit for coal pile runoff.

Table F-3. Historical and 1997 storm water summary data for Radioactive Waste Management Complex subsurface disposal area (RWMC-MP-2).

Parameter[a]	Units	Historical Average[b,c]	1997 Average[c]	1997 Minimum	1997 Maximum[d]	Number of Samples[e]	Guideline[f]
Conductivity	μS	171.50	100.50	63.00	138.00	2/2	NA[g]
pH		7.91	7.62	7.11	8.13	2/2	6.0-9.0
Chemical Oxygen Demand	mg/L	59.61	22.95	8.30	37.60	2/2	120
Nitrogen, Nitrate+Nitrite	mg-N/L	0.32	1.20[h]	1.20	1.20	1/1	0.68
Nitrogen Total Kjeldahl	mg/L	2.33	3.10	2.00	4.20	2/2	NA
Total Phosphorus	mg/L	4.800	0.640	0.640	0.640	1/1	2.0
TDS	mg/L	243.78	109.00	98.00	120.00	2/2	NA
TOC	mg/L	14.27	5.15	5.10	5.20	2/2	NA
Total Oil & Grease	mg/L	4.38	1.90	1.00 U[i]	3.30	2/1	15
TSS	mg/L	4750.0	220.00[h]	19.00	421.00	2/2	100
Barium	mg/L	0.449	0.196	0.077	0.316	2/2	NA
Calcium	mg/L	—[j]	27.20	27.20	27.20	1/1	NA
Cadmium	mg/L	0.003	0.005	0.004 U	0.009	2/1	0.016
Chromium	mg/L	0.033	0.016	0.005 U	0.029	2/1	NA
Copper	mg/L	0.044	0.021	0.011	0.031	2/2	0.064
Iron	mg/L	—	1.29[h]	1.29	1.29	1/1	1.0
Mercury	mg/L	0.00016	0.00017	0.0001 U	0.00029	2/1	0.002
Potassium	mg/L	—	11.60	11.60	11.60	1/1	NA
Magnesium	mg/L	20.28	5.83	2.31	9.35	2/2	NA
Magnesium, Soluble	mg/L	12.37	5.73	2.11	9.34	2/2	NA
Manganese	mg/L	—	0.060	0.060	0.060	1/1	1.0
Sodium	mg/L	—	7.59	7.59	7.59	1/1	NA
Nickel	mg/L	0.045	0.017	0.011 U	0.029	2/1	1.4
Vanadium	mg/L	0.059	0.039	0.039	0.039	1/1	NA
Zinc	mg/L	0.228	0.282[h]	0.142	0.421	2/2	0.117
Am-241	pCi/L	0.63 ± 0.15[k]	0.12 ± 0.03	-41.70 ± 29.60 U	0.50 ± 0.08	4/1	30
Gross Alpha	pCi/L	6.34 ± 1.75	3.36 ± 1.03	1.24 ± 1.07 U	29.70 ± 3.76	2/1	30
Gross Beta	pCi/L	14.58 ± 3.54	19.69 ± 2.28	13.70 ± 2.54	44.60 ± 5.18	2/2	1000
Pu-239	pCi/L	0.09 ± 0.01	0.04 ± 0.02	0.03 ± 0.03 U	0.04 ± 0.02	2/1	30

Table F-3. (continued).

Parameter[a]	Units	Historical Average[b,c]	1997 Average[c]	1997 Minimum	1997 Maximum[d]	Number of Samples[e]	Guideline[f]
Sr-89	pCi/L	—	0.02 ± 0.55	0.02 ± 0.55 J[l]	0.02 ± 0.55 J	1/1	20000
U-234	pCi/L	0.23 ± 0.07	0.13 ± 0.09	0.13 ± 0.09	0.13 ± 0.09	1/1	500

a. Only parameters detected in 1997 are presented.
b. Historical averages were calculated from data available through 1996.
c. For nonradiological parameters with analyte concentrations less than the detection limit, half the detection limit was used in calculating the averages. Radiological averages (and associated uncertainties) are weighted and include available less than detected values.
d. Maximum detectable concentration.
e. Number of samples collected/number of detectable results for 1997.
f. For nonradiological parameters, EPA Benchmarks are shown. For radiological parameters, DCGs are shown.
g. NA = not applicable.
h. The mean value from the detected 1997 data exceeded the associated Benchmark.
i. U flag indicates that the result was below the detection limit.
j. Historical data not available.
k. Uncertainties are shown as 2 sigma.
l. J flag indicates estimated value.

Appendix G

1997 Groundwater Quality Data

Table G-1. ICPP percolation pond groundwater quality data[a] for April 1997.

	USGS-121	USGS-121[b]	USGS-48	USGS-112	USGS-113	MAC/SMCL[c]
Depth to Water Table (ft)	457.4	457.4	462.5	477.9	478.4	
Sample Date	4/9/97 (mg/L)	4/9/97 (mg/L)	4/9/97 (mg/L)	4/10/97 (mg/L)	4/27/97 (mg/L)	(mg/L)
Chloride	13.9	13.0	25.0	195	233	250(350)[d]
TDS	223	189	281	572	618	500(800)[d]
Sodium	7.16	6.98	11.50	74.60	89.90	20[e]
NO_3-N	0.655	0.677	1.964	2.935	4.245	10
NO_2-N + NO_3-N	0.7 R[f]	0.7 R	2.4	3.5	3.1	NA[g]
Chromium	0.0039	0.0038	0.0079	0.0059	0.0060	0.05
Fluoride	0.2	0.2	0.2	0.2	0.2	2
Iron	0.0450	0.0528	0.0587	0.0981	0.0171	0.3
Copper	0.0010	0.0011	0.0023	0.0039	0.0033	NA
pH	7.25	7.25	7.88	7.00	8.00	6.5–8.5

a. All results are from unfiltered samples, which reflect both suspended and dissolved contaminants in the groundwater.

b. Duplicate sample.

c. Maximum allowable concentrations in groundwater and secondary maximum contaminant levels referenced in IDAPA 16.02.299.05.

d. The permit specifies exceptions for chloride and TDS limits of 350 mg/L and 800 mg/L, respectively, as shown in parenthesis.

e. No maximum established; 20 suggested as optimum.

f. R flag indicates that the data were rejected as unusable during data validation.

g. NA = not applicable.

Table G-2. ICPP percolation pond groundwater quality data[a] for October 1977.

	USGS-121	USGS-121[b]	USGS-48	USGS-112	USGS-113	MAC/SMCL[c]
Depth to Water Table (ft)	456.7	456.7	461.8	477.6	477.6	
Sample Date	10/28/97 (mg/L)	10/28/97 (mg/L)	10/28/97 (mg/L)	10/28/97 (mg/L)	10/28/97 (mg/L)	(mg/L)
Chloride	15.8	20.3	34.2	217	207	250(350)[d]
TDS	233	229	300	589	712	500(800)[d]
Sodium	7.34	7.39	15.80	80.50	93.10	20[e]
NO_3-N	0.677	0.677	3.613	2.371	1.942	10
NO_2-N + NO_3-N	0.7	0.7	4.7	2.8	2.0	NA[f]
Chromium	0.0038	0.0043	0.0070	0.0060	0.0065	0.05
Fluoride	0.2	0.2	0.2	0.2	0.2	2
Iron	0.0422	0.0691	0.0656	0.0412	0.0121	0.3
Copper	0.0033	0.0028	0.0051	0.0058	0.0063	NA
pH	8.21	8.21	8.33	8.23	8.24	6.5–8.5

a. All results are from unfiltered samples, which reflect both suspended and dissolved contaminants in the groundwater.

b. Duplicate sample.

c. Maximum allowable concentrations in groundwater and secondary maximum contaminant levels referenced in IDAPA 16.02.299.05.

d. The permit specifies exceptions for chloride and TDS limits of 350 mg/L and 800 mg/L, respectively, and as shown in parenthesis.

e. No maximum established; 20 suggested as optimum.

f. NA = not applicable.

Table G-3. ICPP Sewage Treatment Plant groundwater quality data[a] for April 1997.

	USGS-121	USGS-121[b]	USGS-52	ICPP-MON-PW-024	MAC/SMCL[c]
Depth to Water Table (ft)	457.4	457.4	456.2	61.8	
Sample Date	4/9/97 (mg/L)	4/9/97 (mg/L)	4/16/97 (mg/L)	4/14/97 (mg/L)	(mg/L)
Chloride	13.9	13.0	31.9	118	250
TDS	233	189	278	444	500
NO_3-N	0.655	0.677	3.048	11.967	10
NO_2-N + NO_3-N	0.7 R[d]	0.7 R	3.5	16.8	NA[e]
Total Coliform	Absent	Absent	Absent	Absent	2 col/100 mL
Fecal Coliform	Absent	Absent	Absent	Absent	NA

a. All results are from unfiltered samples, which reflect both suspended and dissolved contaminants in the groundwater.

b. Duplicate sample.

c. Maximum allowable concentrations in groundwater and secondary maximum contaminant levels referenced in IDAPA 16.02.299.05.

d. R flag indicates that the data were rejected as unusable during data validation.

e. NA = not applicable.

Table G-4. ICPP Sewage Treatment Plant groundwater quality data[a] for October1997.

	USGS-121	USGS-121[b]	USGS-52	ICPP-MON-PW-024	MAC/SMCL[c]
Depth to Water Table (ft)	456.7	456.7	454.6	61.4	
Sample Date	10/28/97 (mg/L)	10/28/97 (mg/L)	10/28/97 (mg/L)	10/29/97 (mg/L)	(mg/L)
Chloride	15.8	20.3	31.9	110	250
TDS	233	229	271	518	500
NO_3-N	0.677	0.677	NS[c]	NS	10
NO_2-N + NO_3-N	0.7	0.7	4.0	8.5	NA[d]
Total Coliform	Absent	Absent	Absent	96 col/100 mL	2 col/100 mL
Fecal Coliform	Absent	Absent	Absent	Absent	NA

a. All results are from unfiltered samples, which reflect both suspended and dissolved contaminants in the groundwater.

b. Duplicate sample.

c. Maximum allowable concentrations in groundwater and secondary maximum contaminant levels referenced in IDAPA 16.02.299.05.

d. NA = not applicable.

Table G-5. TAN/TSF STP groundwater quality data[a] for January 1997.

	TANT-MON-A-001	TANT-MON-A-001[b]	TAN-10A	TAN-13A	TANT-MON-A-002	MAC/SMCL[c]
Depth to Water Table (ft)	206.4	206.4	206.8	209.2	210.9	
Sample Date	1/22/97 (mg/L)	1/21/97 (mg/L)	1/21/97 (mg/L)	1/21/97 (mg/L)	1/22/97 (mg/L)	(mg/L)
Chloride	13.1	12.5	111	3.8	4.4	250
TDS	198	201	404	200	208	500
Sodium	7.10	6.98	28.90	5.33	6.77	20[d]
NO_3-N	1.129	1.038	1.083	0.542	0.903	10
NO_2-N + NO_3-N	0.80	0.80	0.80	0.40	0.50	NA[e]
Arsenic	0.0027	0.0025	0.0014	0.0017	0.0020	0.05
Barium	0.0624	0.0628	0.153	0.0659	0.0902	2
Chromium	0.0065	0.0069	0.0013	0.0035	0.0053	0.05
Fluoride	0.30	0.30	0.20	0.20	0.20	2
Iron	0.169	0.163	0.342	0.0463 U[f]	0.143	0.3
Lead	0.0008	0.0022	0.0009	0.0035	0.0024	0.015
Manganese	0.0026	0.0025	0.008	0.0066	0.0263	0.05
Sulfate	30.0	30.3	35.1	14.1	13.6	250
Zinc	0.384	0.380	2.520	0.748	0.738	5
Total Coliform	Absent	Absent	Absent	Absent	8 col/100 mL	2 col/100 mL
Fecal Coliform	Absent	Absent	Absent	Absent	Absent	NA

a. All results are from unfiltered samples, which reflect both suspended and dissolved contaminants in the groundwater.

b. Duplicate sample.

c. Maximum allowable concentrations in groundwater and secondary maximum contaminant levels referenced in IDAPA 16.02.299.05.

d. No maximum established; 20 suggested as optimum.

e. NA = not applicable.

f. U flag indicates that the result was reported as below the detection limit.

Table G-6. TAN/TSF STP groundwater quality data[a] for April 1997.

	TANT-MON-A-001	TANT-MON-A-001[b]	TAN-10A	TAN-13A	TANT-MON-A-002	MAC/SMCL[c]
Depth to Water Table (ft)	205.2	205.2	205.3	208.0	212.3	
Sample Date	4/21/97 (mg/L)	4/21/97 (mg/L)	4/28/97 (mg/L)	4/23/97 (mg/L)	4/21/97 (mg/L)	(mg/L)
Chloride	15.2	16.5	110	3.7	4.1	250
TDS	192	190	359	191	212	500
Sodium	8.16	7.63	34.60	5.74	6.28	20[d]
NO_3-N	0.835	0.790	1.016	0.384	0.587	10
NO_2-N + NO_3-N	0.9	0.9	1.8	0.4	0.5	NA[e]
Arsenic	0.0027	0.0024	0.0023	0.0014 U[f]	0.0018	0.05
Barium	0.0734	0.0719	0.1810	0.0713	0.0827	2
Chromium	0.0070	0.0068	0.0007	0.0035	0.0054	0.05
Fluoride	0.3	0.3	0.2	0.2	0.2	2
Iron	0.173	0.165	0.407	0.0126 U	0.119	0.3
Lead	0.0027	0.0018	0.0117	0.0124	0.001	0.015
Manganese	0.0028	0.0027	0.0086	0.0035	0.0166	0.05
Sulfate	35.7	32.3	35.9	17.0	13.8	250
Zinc	0.328	0.327	2.380	1.120	0.529	5
Total Coliform	Absent	Absent	Absent	Absent	Absent	2 col/100 mL
Fecal Coliform	Absent	Absent	Absent	Absent	Absent	NA

a. All results are from unfiltered samples, which reflect both suspended and dissolved contaminants in the groundwater.

b. Duplicate sample.

c. Maximum allowable concentrations in groundwater and secondary maximum contaminant levels referenced in IDAPA 16.02.299.05.

d. No maximum established; 20 suggested as optimum.

e. NA = not applicable.

f. U flag indicates that the result was reported as below the detection limit.

Table G-7. TAN/TSF STP groundwater quality data[a] for July 1997.

	TANT-MON-A-001	TANT-MON-A-001[b]	TAN-10A	TAN-13A	TANT-MON-A-002	MAC/SMCL[c]
Depth to Water Table (ft)	206.7	206.7	206.9	208.0	210.9	
Sample Date	7/22/97 (mg/L)	7/22/97 (mg/L)	7/21/97 (mg/L)	7/22/97 (mg/L)	7/22/97 (mg/L)	(mg/L)
Chloride	15.7	13.5	74.5	3.4	3.9	250
TDS	210	207	398	202	202	500
Sodium	7.88	7.71	34.60	6.03	6.47	20[d]
NO_3-N	0.835	0.835	1.016	0.406	0.497	10
NO_2-N + NO_3-N	0.9	0.9	1.2	0.4	0.5	NA[e]
Arsenic	0.0024	0.0016 U	0.0024	0.0016 U[f]	0.0016 U	0.05
Barium	0.0714	0.0705	0.1800	0.0733	0.0850	2
Chromium	0.0057	0.0055	0.0006	0.0031	0.0046	0.05
Fluoride	0.3	0.3	0.2	0.2	0.1	2
Iron	0.1470	0.1170	0.3090	0.0133	0.0576	0.3
Lead	0.0018	0.0020	0.0131	0.0110	0.0031	0.015
Manganese	0.0022	0.0020	0.0073	0.0047	0.0170	0.05
Sulfate	30.1	33.6	35.9	14.3	13.8	250
Zinc	0.361	0.323	1.770	0.947	0.488	5
Total Coliform	Absent	Absent	10 col/100 mL	Absent	210 col/100 mL	2 col/100 mL
Fecal Coliform	Absent	Absent	Absent	Absent	Absent	NA

a. All results are from unfiltered samples, which reflect both suspended and dissolved contaminants in the groundwater.

b. Duplicate sample.

c. Maximum allowable concentrations in groundwater and secondary maximum contaminant levels referenced in IDAPA 16.02.299.05.

d. No maximum established; 20 suggested as optimum.

e. NA = not applicable.

f. U flag indicates that the result was reported as below the detection limit.