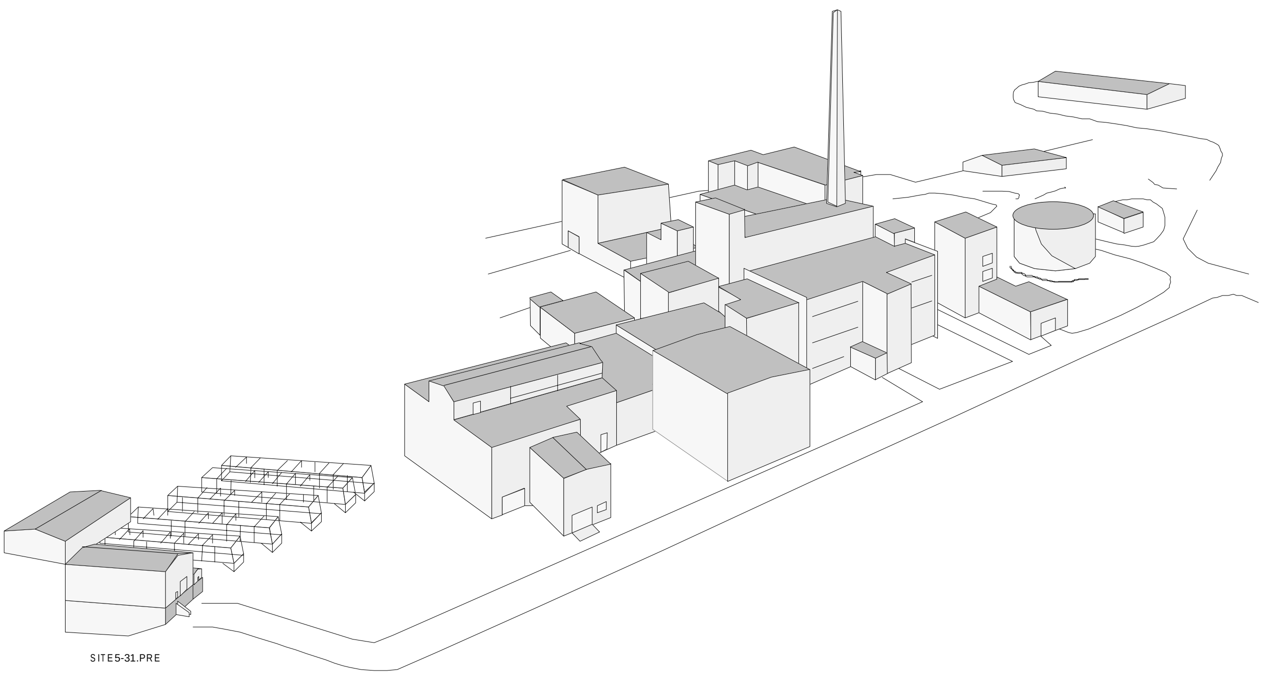
WEST VALLEY DEMONSTRATION PROJECT
SITE ENVIRONMENTAL REPORT
CALENDAR YEAR 1996



West Valley Nuclear Services Company, Inc.
and
Dames & Moore

Prepared for:
U.S. Department of Energy
Ohio Field Office
West Valley Area Office
Under Contract DE-AC24-81NE44139

June 1997
P.O. Box 191
10282 Rock Springs Road
West Valley, New York 14171-0191

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Preface

Environmental monitoring at the West Valley Demonstration Project (WVDP) is conducted by the West Valley Nuclear Services Company, Inc. (WVNS), under contract to the U.S. Department of Energy (DOE). The data collected provide an historical record of radionuclide and radiation levels from natural and manmade sources in the survey area. The data also document the quality of the groundwater on and around the WVDP and the quality of the air and water discharged by the WVDP.

This report represents a single, comprehensive source of off-site and on-site environmental monitoring data collected during 1996 by environmental monitoring personnel. The environmental monitoring program and results are discussed in the body of this report. The monitoring data are presented in the appendices. Appendix A is a summary of the site environmental monitoring schedule. Appendix B lists the environmental permits and regulations pertaining to the WVDP. Appendices C through F contain summaries of data obtained during 1996 and are intended for those interested in more detail than is provided in the main body of the report.

Requests for additional copies of the 1996 Site Environmental Report and questions regarding the report should be referred to the WVDP Community Relations Department, P.O. Box 191, 10282 Rock Springs Road, West Valley , New York 14171-0191 (phone: 716-942-4610).

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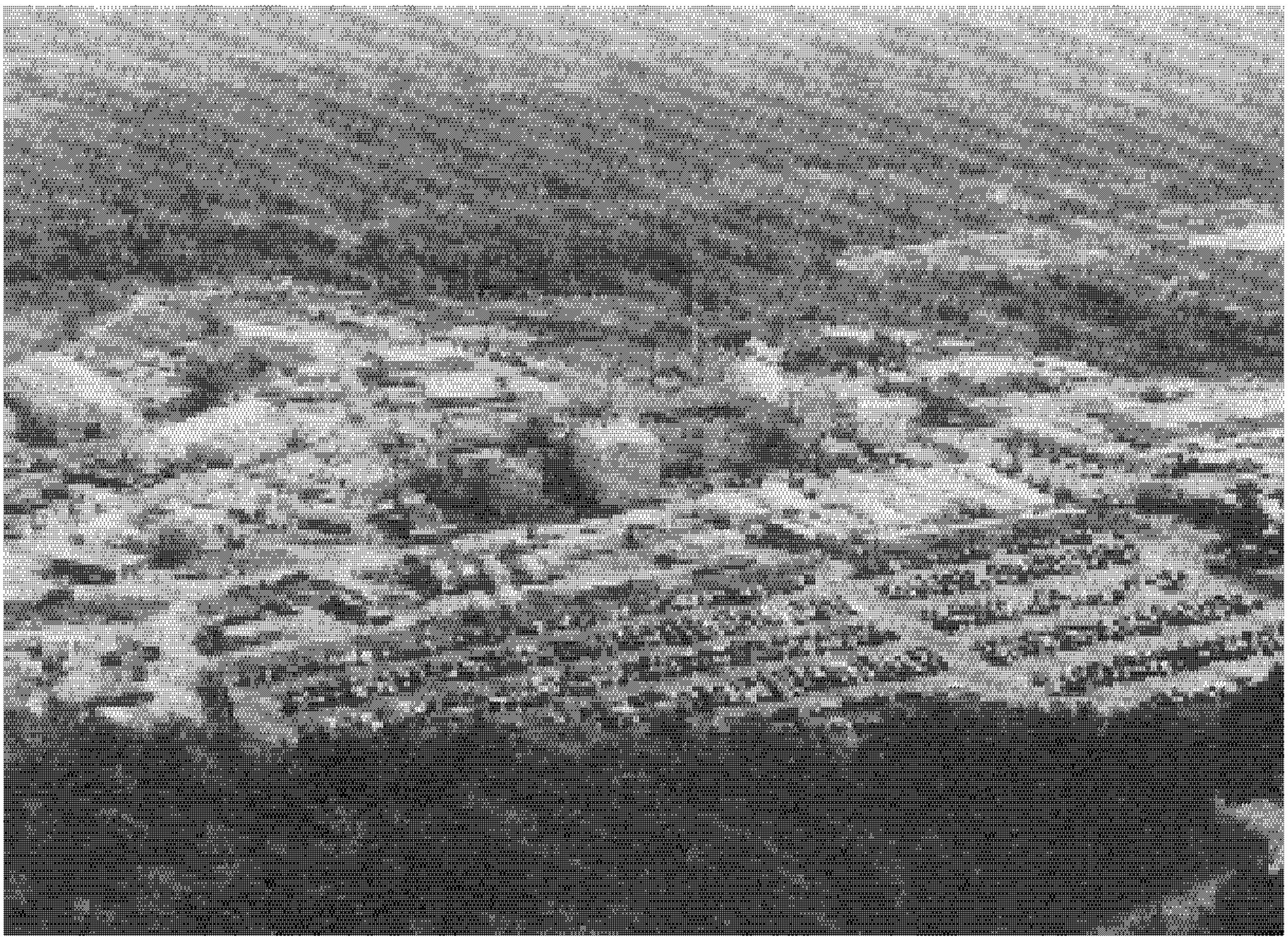

The West Valley Demonstration Project

EXECUTIVE SUMMARY

Project Description

The West Valley Demonstration Project (WVDP), the site of a U.S. Department of Energy environmental cleanup activity operated by West Valley Nuclear Services Co., Inc. (WVNS), is in the process of solidifying liquid high-level radioactive waste remaining at the site after commercial nuclear fuel reprocessing was discontinued. The Project is located in Western New York State, about 30 miles south of Buffalo, within the New York State-owned Western New York Nuclear Service Center (WNYNSC). The WVDP's central mission is to solidify the liquid high-level waste, now stored in underground tanks, in containers suitable for temporary storage on-site and for eventual transport to a federal repository. A major achievement in 1996 was the initiation of vitrification, a process in which the high-level waste is solidified in a durable, solid glass form.

Compliance

Management at the WVDP continued to provide strong support for environmental compliance issues in 1996. DOE Orders and applicable state and federal statutes and regulations are integrated into the Project's compliance program.

• Inspections by the U.S. Environmental Protection Agency (EPA) and the New York State Department of Environmental Conservation (NYSDEC) of hazardous waste activities verified Project compliance with the regulations.

• The Project continued to identify and evaluate specific waste management areas at the site to comply with the Resource Conservation and Recovery Act (RCRA) 3008(h) Administrative Order on Consent.

• The Project also met the requirements of the Emergency Planning and Community Right to Know Act (EPCRA) by identifying and making available to the local community information about hazardous materials used at the Project. All EPCRA reporting deadlines were met in 1996.

• The State Pollutant Discharge Elimination System (SPDES) permit currently identifies four per-

A reader opinion survey has been inserted in this report. If it is missing, please contact Community Relations at (716) 942-4610. Additional Project information is available on the Internet at http://www.wvdp.com.

mitted liquid outfalls at the Project. Permit applications to identify up to thirty-two storm water outfalls and to increase flow due to groundwater treatment activities were submitted in 1996.

• Although SPDES permit limits were exceeded twice in 1996 during temporary process upsets, this was an improvement over the seven exceedances recorded in 1995.

• No notices of violation from any environmental regulatory agencies were received in 1996.

• Among other pollution prevention accomplishments, waste minimization goals for 1996 were exceeded in all of the waste categories set in the goals statement.

• Although two unplanned on-site radiological liquid releases (minor spills inside previously contaminated facility areas) occurred during the year, there were no accidental off-site releases of radiological material in 1996.

Environmental Monitoring Program

Throughout the preparations and especially during the actual start-up of the vitrification process, specific, additional attention was given to environmental monitoring and assessment of effluents from site facilities. During 1996 Project environmental scientists continued to sample and measure effluent air and water, groundwater, surface streams, soil, sediment, vegetation, meat, milk, and game animals, and to record environmental radiation measurements. More than 11,000 samples were collected in order to assess the effect of site activities on public health, safety, and the environment.

The Project environmental monitoring network is continually being evaluated and updated to ensure that all locations and sample types that would be sensitive to process-related changes are monitored. Once samples are collected, they are tested for radioactivity or nonradioactive substances using approved laboratory procedures. Both the laboratory test results and direct measurement data are reviewed at several stages for quality and for comparison with similar data. Environmental monitoring results are kept up-to-date in a controlled computer database available to WVDP scientists, who assess the data and evaluate trends at key locations.

Air Monitoring

WVDP airborne radiological emissions include six routinely operated permitted exhaust stacks and five exhausts excluded from permitting because of their low emission potential. As anticipated, radioactive releases from the Project in 1996 were far below the most restrictive limits that ensure public health and safety. Start-up of the vitrification process in June added to the ventilation exhaust and slightly increased the total radiological air releases. The dose from 1996 air emissions was about 0.09% of the most restrictive limit. In 1995 the dose from these emissions was about 0.004%.

Although several fission products contribute to the radioactivity, the most significant increase was in airborne iodine-129, a long-lived isotope that exists in gaseous form at the high temperatures of the vitrification process. However, the amount of gaseous iodine-129 released during vitrification was far below regulatory limits. The main stack iodine-129 release from the vitrification process accounted for more than 99% of the 1996 calculated airborne dose from WVDP air emissions.

Six air samplers on the perimeter of the WNYNSC and four in more distant locations continuously collect samples of air at the average human breathing height. The samples are tested for radioactivity carried by airborne particles. At two of the ten locations test samples are collected for analysis of tritium and iodine-129. Gross radioactivity in air samples from around the perimeter was not different than radioactivity measured in remote background locations or nearby communities. A ten-year trend of gross (airborne particulate) radioactivity at the nearest perimeter sampler did not show any increases in 1996. Concentrations in samples from two on-site ambient air samplers located near waste storage facilities operated during 1996 also were indistinguishable from background levels.

Nonradiological air emission monitoring of nitrogen oxides, a byproduct of the vitrification process, is conducted as part of the emission-control process. Although there are a number of other permitted air emissions sources at the Project, none release a sufficient quantity of nonradiological material to warrant monitoring as a condition of a regulatory permit.

Surface Water Monitoring

The largest single source of radioactivity released to surface waters from the Project is the discharge from the low-level waste treatment facility through the lagoon 3 release outfall. The treated effluent water flows into Erdman Brook, which joins Frank's Creek just before exiting the Project's fenced area. Seven treated batches totaling 13.4 million gallons were released over a combined fifty-five day period in 1996. In 1995, 10.3 million gallons had been released. A large portion of the increase was due to treatment of groundwater pumped from the area north of the main facility.

The combined average concentrations of all radioactive isotopes in these releases in 1996 totaled approximately 35% of the DOE derived concentration guide (DCG) used to evaluate liquid process discharges. This is a decrease from the 43% average concentration in 1995.

Surface water is continually sampled on the Project premises by four automatic samplers. Time-composite samples are collected at Frank's Creek where it exits the Project and at two other on-site points where drainage flows off-site. Another automatic sampler is located at a drainage point near the former radioactive waste disposal areas. Samples also are collected periodically at nine other points of drainage from facility areas. The data from these samples are used to determine the type, amount, and probable origin of both radiological and nonradiological contaminants.

Again in 1996, the most notable source of gross beta and strontium-90 radioactivity in surface water was from groundwater flowing beneath the north plateau and emerging to join the surface water drainage from the north plateau into Frank's Creek and thence off-site. In 1996 the strontium-90 concentration, which originates from pre-Project operations, was about 1.3 times the derived concentration guide (DCG) for liquid discharges. This drainage point has been carefully monitored since the contaminated seep was identified in 1993. Currently, water contaminated with strontium-90 in the north plateau drainage area is being collected and treated by a groundwater recovery system.

Soil and Stream Sediments

Surface soil is collected annually at the ten air sampler locations to track long-term deposition. Sediments from off-site creeks are collected from three downstream and two upstream locations. Three on-site drainage areas are also sampled to track waterborne movement of contaminants.

Surface soil samples in 1996 showed little change from previous years. For the most part, except for one area that historically shows average cesium-137 concentrations above background values, the concentrations of radionuclides normally present both in worldwide fallout and in Project air emissions are no different at near-site locations than at background locations. The above-background detection of strontium-90 in two near-site soil samples in 1996 was not accompanied by air effluent releases on-site of sufficient magnitude to explain them and may be the result of analytical uncertainties. Due to pre-Project releases from nuclear fuel reprocessing activities, the concentrations of radioactivity in downstream creek sediments historically are above concentrations in the upstream sediments. However, the eleven-year graphs show no upward trends at either upstream or downstream points. No changes were noted in on-site soil/sediment samples between 1996 and previous years.

Groundwater Monitoring

Scheduled groundwater samples were collected from sixty-five on-site locations in 1996. Based on an evaluation of results from the 1995 program, the location, frequency of sampling, types of testing, and method of sample collection were adjusted for the 1996 monitoring program. Computerized screening of 1996 data speeded identification and evaluation of changes. Monitoring activities in 1996 included gathering more detailed information about the north plateau strontium-90 contamination. The 1996 groundwater program confirmed that strontium-90 is still the major contributor to elevated gross beta contamination in the plume on the north plateau. The concentrations of other isotopes were below the DCG levels generally applied to surface water. In addition to sampling wells, groundwater was collected from seeps on the side of the bank above Frank's Creek.

As in previous years, near-site residential water supply wells sampled during 1996 indicated no radioactive contamination.

Vegetation, Meat, and Milk

Test results from beans and sweet corn showed no difference between annual samples collected near the site and samples taken from remote locations. A single hay sample showed a strontium-90 result three times higher than its control location, but this increase was not corroborated by other sample types collected nearby. Apples collected from an on-site tree (not used for human consumption) had strontium-90 at levels about three times the background values, but not much higher than observed in 1995. In 1996, as in previous years, very little difference in radioactivity concentration was observed between samples of beef and milk from near-site and remote locations.

Game Animals

Fifty fish specimens from Cattaraugus Creek were collected in 1996 for testing. Ten of these were from below the Springville dam, including species that migrate up from Lake Erie. Two semiannual sample sets of ten fish each were collected downstream of Buttermilk Creek, which receives Project liquid effluents, and two sets were collected upstream. These samples represent sportfishing species and bottom-feeding indicator species. Testing for gamma-emitting isotopes and strontium-90 showed levels very similar to those in 1995 samples. Concentrations in downstream and upstream specimens of the same species were similar.

Three samples of whitetail deer venison from an on-site (WNYNSC) herd were tested for gamma-emitting isotopes and strontium-90. Two of three on-site venison samples were at background strontium-90 values. One sample, however, contained strontium-90 concentrations that were four times above the average 1993 to 1996 background concentration. One person eating 100 pounds of meat from this deer would receive 0.03 millirem, which is 3,300 times less than the DOE 100 mrem dose standard applicable to a member of the public. In comparison to an equal number of samples from deer taken in areas remote from the Project, the values for gamma-emitting isotopes were similar.

In 1996, the third year of public access to portions of the WNYNSC for deer hunting, 149 deer were taken by hunters during the hunting season.

Program Quality

The WVDP environmental program is designed to produce high quality, reliable results. To maintain this standard, each scientist must give continuous attention to the details of sample handling, following approved collection and analysis procedures and data review. In addition to a formal self-assessment review just before vitrification start-up, the WVDP environmental laboratory also continued the practice of analyzing radiological crosscheck samples sent from a national laboratory. Of 139 radiological analyses performed at both the on-site Project laboratory and off-site commercial service laboratories, 93% were within the control limits. Of the forty-six samples tested on-site at the Project environmental laboratory, 100% were within acceptable values, and 100% of the twenty-three nonradiological check samples tested at an off-site laboratory were within acceptable values.

Although no formal external audits of the environmental program were conducted in 1996, test results from the crosscheck program and from co-located sample measurements taken by independent agencies such as the Nuclear Regulatory Commission (NRC) and the New York State Department of Health (NYSDOH) indicate that high quality standards are being met. The WVNS Environmental Affairs and the WVNS Quality Assurance departments periodically conducted and documented informal reviews of program activities in 1996.

Notable 1996 Events

The central event during 1996 was start-up of the WVDP vitrification facility. Preoperational testing and readiness reviews occupied the first part of the year. After June the focus shifted to keeping close watch on the new process. Changes in air emissions were noted. The release rate of radon-220 increased, as did the release rate of radioactive iodine isotopes. Although the actual levels are small compared to public health standards, identifying these changes was important in assessing the environmental characteristics of the new vitrification process.

Dose Assessment

There were no events affecting public health and safety or the environment associated with Project operations in 1996. The small amounts of radioactive materials that were released were assessed and doses were calculated using approved computer modeling codes. These evaluations include calculations of doses received from the consumption of game animals and locally grown food. Airborne doses were calculated using CAP88-PC, an EPA-approved computer code. The result was a maximum dose to an off-site individual of 0.009 millirem (mrem). The limit is 10 mrem. Doses from the liquid pathway to the maximally exposed person were estimated to be 0.04 mrem from Project effluents. The north plateau drainage contribution to the total liquid dose was estimated to be 0.02 mrem. The predicted dose from all pathways was less than 0.08 mrem, or 0.08% of the 100 mrem DOE limit.

Conclusion

The West Valley Demonstration Project conducts extensive monitoring of on-site facilities and the surrounding environment. This program fulfills federal and state requirements to assess the impact of Project activities on public health and safety and the environment. In addition to demonstrating compliance with environmental regulations and directives, evaluation of data collected in 1996 indicates that Project activities pose no threat to public health, safety, or the environment.

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INTRODUCTION

History of the West Valley Demonstration Project

In the early 1950s interest in promoting peaceful uses of atomic energy led to the passage of an amendment to the Atomic Energy Act that allowed the Atomic Energy Commission to encourage commercialization of nuclear fuel reprocessing as a way of developing a civilian nuclear industry. The Atomic Energy Commission made its technology available to private industry and invited proposals for the design, construction, and operation of reprocessing plants.

In 1961 the New York Office of Atomic Development acquired 1,332 hectares (3,340 acres) near West Valley, New York and established the Western New York Nuclear Service Center (WNYNSC). Davison Chemical Co., together with the New York State Atomic Research and Development Authority, which later became the New York State Energy Research and Development Authority (NYSERDA), undertook construction and operation of a nuclear fuel reprocessing plant under a co-license issued by the Atomic Energy Commission. Nuclear Fuel Services, Inc. (NFS) was formed by Davison Chemical Co. to operate the plant as a commercial facility. NFS leased the property at the Western New York Nuclear Service Center and in 1966 began operations to recycle fuel from both commercial and federally owned reactors.

In 1972, while the plant was closed for modifications and expansion, federal and state safety regulations, which were more rigorous than those previously in existence, were imposed. Most of the changes concerned the disposal of high-level radioactive liquid waste and the prevention of earthquake damage to the facilities. NFS decided that compliance with the new regulations was not economically feasible, and in 1976 NFS notified NYSERDA that it would not continue in the fuel reprocessing business.

Following this decision, the reprocessing plant was shut down. Under the original agreement between NFS and New York State, the state was ultimately responsible for both the radioactive wastes and the facility. Numerous studies followed the closing, leading eventually in 1980 to the passage of Public Law 96-368, the West Valley Demonstration Project Act, which authorized the U.S. Department of Energy (DOE) to demonstrate a method for solidifying the 2.3 million liters (600,000 gal) of liquid high-level waste that remained at the West Valley site. Congress anticipated that the technologies developed at West Valley would be used at other facilities in the United States.

West Valley Nuclear Services Co., Inc. (WVNS), a subsidiary of Westinghouse Electric Corporation, was chosen by the DOE to be the management and operating contractor for the West Valley Demonstration Project (WVDP). The WVDP Act specifically states that the facilities and the high-level radioactive waste on-site shall be made available (by the state of New York to the DOE) without the transfer of title for such a period as may be required for the completion of the Project.

The purpose of the WVDP is to solidify the high-level radioactive waste left at the site from the original nuclear fuel reprocessing activities, develop suitable containers for holding and transporting the solidified waste, arrange transportation of the solidified waste to a federal repository, dispose of any Project low-level and transuranic waste resulting from the solidification of high-level waste, and decontaminate and decommission the Project facilities.

The high-level waste was contained in underground storage tanks and had settled into two layers, a liquid supernatant and a precipitate sludge. Various subsystems were constructed that permitted the successful start-up in May 1988 of the integrated radwaste treatment system (IRTS). The system stripped radioactivity from the liquid supernatant, allowing the major portion of the liquid to be treated as low-level waste. Treatment of the supernatant liquid from the high-level waste tanks through the IRTS was completed in 1990.

The next step in the process, washing the sludge with water to remove soluble constituents, began in late 1991 and was completed in 1994. (See *Chapter 1, Environmental Monitoring Program Information* [p. 1-7], for a more detailed description.) In 1995, the contents of the high-level waste tanks were combined and the subsequent mixture washed a final time. The last step, vitrification of the remaining high-level waste residues, began in July 1996.

This annual environmental monitoring report is published to inform WVDP stakeholders about environmental monitoring conditions. The report presents a summary of the environmental monitoring data gathered during the year in order to characterize the performance of the WVDP's environmental management, confirm compliance with standards and regulations, and highlight significant programs.

The geography, economy, climate, ecology, and geology of the region are principal factors in assessing possible effects of site activities on the surrounding population and environment and are an integral consideration in the design and structure of the environmental monitoring program.

Location

The WVDP is located about 50 kilometers (30 mi) south of Buffalo, New York (Fig. 1). The WVDP facilities occupy a security-fenced area of about 80 hectares (200 acres) within the 1,332-hectare (3,340-acre) Western New York Nuclear Service Center. This fenced area is referred to as the Project premises, or the restricted area.

The WVDP is situated on New York State's Allegheny plateau at an average elevation of 400 meters (1,300 ft). The communities of West Valley, Riceville, Ashford Hollow, and the village of Springville are located within 8 kilometers (5 mi) of the plant. Several roads and a railway pass through the WNYNSC, but the public does not have access to the WNYNSC. Generally, hunting, fishing, and human habitation on the WNYNSC are prohibited. (For purposes of defining environmental monitoring sample collection locations, the land within the WNYNSC is considered to be "on-site.") A NYSERDA-sponsored pilot program to control the deer population was initiated in 1994 and continued in 1995 and 1996. Limited hunting permits were issued to local residents, and community response was favorable.

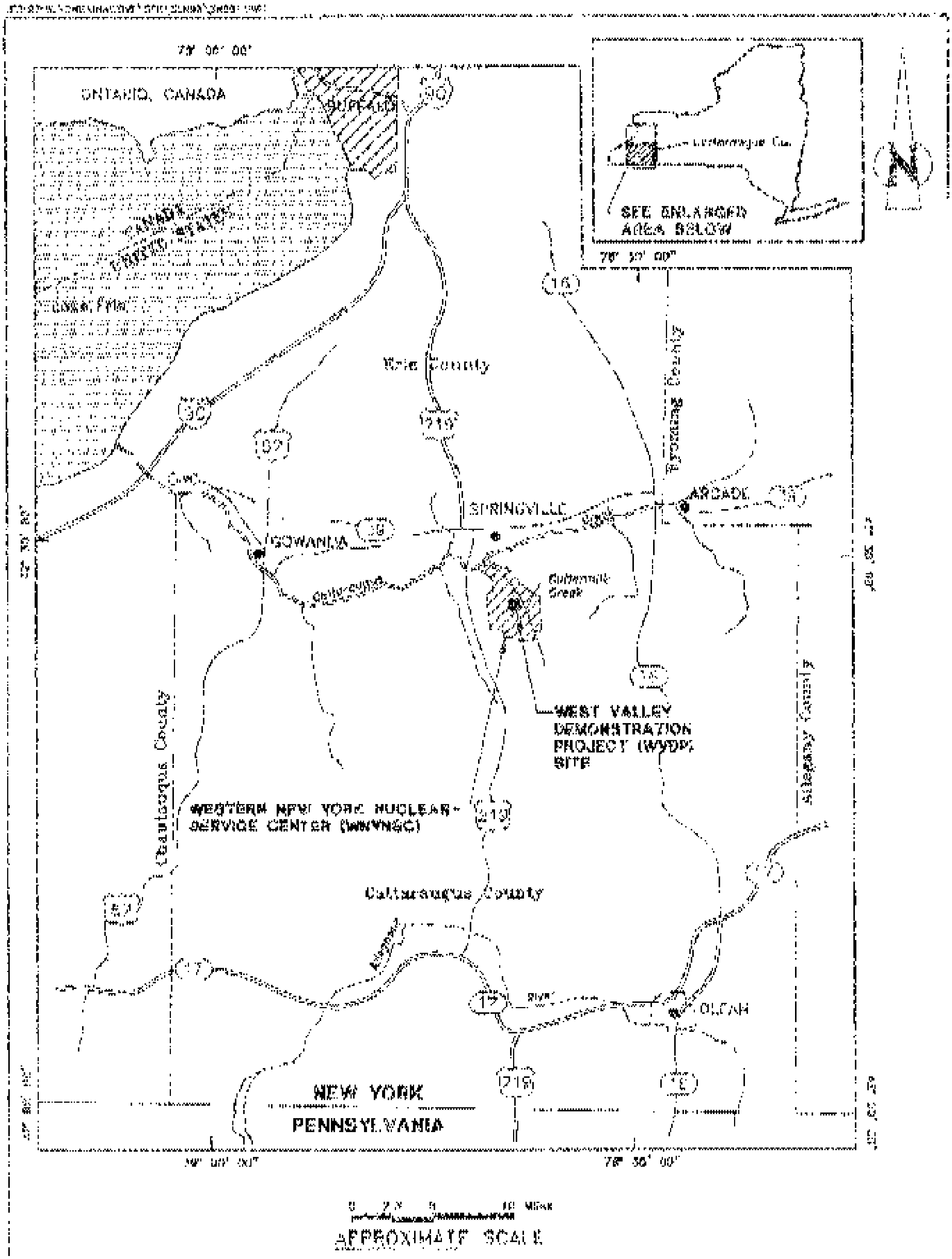

Figure 1. Location of the Western New York Nuclear Service Center.

A Young White-tailed Resident

Socioeconomics

The WNYNSC lies within the town of Ashford in Cattaraugus County. The nearby population, approximately 9,200 residents within 10 kilometers (6.2 mi) of the Project, relies primarily on an agricultural economy. No major industries are located within this area.

The land immediately adjacent to the WNYNSC is used primarily for agriculture and arboriculture. Cattaraugus Creek is used locally for swimming, canoeing, and fishing. Although some water to irrigate nearby golf course greens and tree farms is taken from Cattaraugus Creek, no public water supply is drawn from the creek downstream of the WNYNSC before the creek flows into Lake Erie near Buffalo, New York. Waters from Lake Erie are used as a public water supply.

Climate

Although there are recorded extremes of 37°C (98.6°F) and -42°C (-43.6°F) in Western New York, the climate is moderate, with an average annual temperature of 7.2°C (45.0°F). Rainfall is relatively high, averaging about 104 centimeters (41 in) per year. Precipitation in 1996 totaled 114 centimeters (45 in). Precipitation is evenly distributed throughout the year and is markedly influenced by Lake Erie to the west and, to a lesser extent, by Lake Ontario to the north. Regional winds are generally from the west and south at about 4 m/sec (9 mph).

Biology

The WNYNSC lies within the northern deciduous forest biome, and the diversity of its vegetation is typical of the region. Equally divided between forest and open land, the site provides a habitat especially attractive to white-tailed deer and various indigenous birds, reptiles, and small mammals. No species on the federal endangered-species list are known to be present on the WNYNSC.

Geology and Groundwater Hydrology

The WVDP site is located on the west shoulder of a steep-sided glacially scoured bedrock valley that is filled with a thick sequence of glacial sediments. (See Figs. 3-2 and 3-3 [pp. 3-4 and 3-5] in *Chapter 3, Groundwater Monitoring*.) The WVDP site is bordered by two stream valleys (Frank's

Creek and Quarry Creek) and divided by a third stream valley (Erdman Brook) into two portions, the north and south plateaus. (See Fig. 3-1 [p. 3-3] in *Chapter 3, Groundwater Monitoring*.)

The uppermost layer of glacial sediments on the south plateau consists of a silty clay till, the Lavery till. The Lavery till does not transmit significant quantities of water except where it is exposed at ground surface, where weathering has fractured the near-surface soils. Groundwater flow in the weathered till has both a vertically downward component and a horizontal component to the northeast. Groundwater flow in the unweathered portion of the till, beneath the exposed weathered till, is predominantly vertically downward.

On the north plateau a relatively permeable alluvial sand and gravel layer overlies the glacial sequence of sediments (i.e., the Lavery till, the Kent recessional sequence, and the Kent till). Groundwater flow in the sand and gravel unit of the north plateau is predominantly horizontal, towards the northeast, discharging to seeps and streams along the plateau's edge and via evapotranspiration.

Within the Lavery till on the north plateau is a silty, sandy unit of limited areal extent, the Lavery till-sand. The flow of groundwater within the till-sand appears to be very limited. Surface discharge points have not been observed, but gradients indicate flow to the southeast.

The Kent recessional sequence that underlies the Lavery till beneath both north and south plateaus is composed of silt and silty sand with localized pockets of gravel. Groundwater flow in the Kent recessional sequence is also towards the northeast and discharges ultimately to Buttermilk Creek.

The uppermost few feet of shale bedrock in the Lavery till have demonstrated the ability to transmit groundwater flow via fractures.

Information in this Report

Format and Content

Individual chapters in this report include information on compliance with regulations, general information about the monitoring program and significant activities in 1996, summaries of the results of radiological and nonradiological monitoring, and calculations of radiation doses to the population within 80 kilometers of the site. Where appropriate, graphs and tables are included to illustrate important trends and concepts. The bulk of the supporting data is furnished separately in the appendices following the text.

Appendix A (pp. A-i through A-53) summarizes the 1996 environmental monitoring program at both on-site and off-site locations. Samples are designated by a coded abbreviation indicating sample type and location. (A complete listing of the codes is found in the index to *Appendix A* [pp. A-v through A-vii].) *Appendix A* lists the kinds of samples taken, the frequency of collection, the parameters analyzed, the location of the sample points, and a brief rationale for the monitoring activities conducted at each location.

Appendix B (pp. B-1 through B-9) provides a list of those radiation protection standards most relevant to the operation of the WVDP as set by the DOE. It also lists federal and state laws and regulations that affect the WVDP and environmental permits held by the site.

Appendix C (pp. C1-1 through C6-9) summarizes analytical data from air, surface water, off-site groundwater, sediment, soils, and biological samples (meat, milk, food crops, and fish) as well as direct radiation measurements and meteorological monitoring.

Appendix D (pp. D-1 through D-10) provides data from the comparison of results of analyses of identically prepared samples (crosscheck analyses) by both the WVDP and independent laboratories.

Radiological concentrations in crosscheck samples of air, water, soil, milk, and vegetation are reported here. *Appendix D* also lists the comparisons of direct radiation measurements from thermoluminescent dosimeters (TLDs) monitored by the WVDP and measurements from dosimeters placed in the same locations by the U.S. Nuclear Regulatory Commission (NRC).

Appendix E (pp. E-1 through E-28) summarizes the data collected from on-site groundwater monitoring. The tables in *Appendix E* report concentrations at various locations for parameters such as gross alpha and gross beta, tritium, gamma-emitting radionuclides, organic compounds, and dissolved metals.

Appendix F (pp. F-1 through F-6) contains groundwater monitoring data for the New York State-licensed disposal area (SDA), provided by NYSERDA.

Acronyms

Acronyms often are used in technical reports to speed up the reading process. Although using acronyms can be a practical way of referring to agencies or systems with long, unwieldy names, having to look up rarely used acronyms can defeat the purpose of using them. Accordingly, full names of agencies and systems have been used in this report where it will help the reader. However, common acronyms that the reader is apt to be familiar with (e.g., DOE, EPA, NRC, NYSDEC) or that are used often in this report (e.g., WVDP, WNYNSC) are spelled out only at the beginning of sections. A list of acronyms is found at the end of this report.

Environmental Monitoring Program

The environmental monitoring program for the WVDP began in February 1982. The primary program goal is to detect changes in the environment resulting from Project activities and to assess the effect of any such changes on the human population and the environment surrounding the site.

The monitoring network and sample collection schedule have been structured to accommodate specific biological and physical characteristics of the area. Among the several factors considered in designing the environmental monitoring program were the kinds of wastes and other byproducts resulting from the processing of high-level waste; possible routes that radiological and nonradiological contaminants could follow into the environment; geologic, hydrologic, and meteorologic site conditions; quality assurance standards for monitoring and sampling procedures and analyses; and the limits and standards set by federal and state governments and agencies. As new processes and systems become part of the Project, appropriate additional monitoring will be provided.

Monitoring and Sampling

The environmental monitoring program consists of on-site effluent monitoring and on-site and off-site environmental surveillance in which samples are measured for both radiological and nonradiological constituents. (See the *Glossary* for more detailed definitions of effluent monitoring and environmental surveillance.) Monitoring and surveillance include both the continuous recording of data and the collecting of soil, sediment, water, air, and other samples at specific times.

Monitoring and sampling of environmental media provide two ways of assessing the effects of on-site radioactive waste processing. Monitoring generally is a continuous process of measurement that allows rapid detection of any potential effects on the environment from site activities. Sampling is the collection of media at scheduled times; sampling is slower than direct monitoring in indicating results because the samples collected must be analyzed in a laboratory to obtain data, but it allows much smaller quantities of radioactivity to be detected through the analysis.

Permits and Regulations

Data gathering, analysis, and reporting to meet stringent federal and state requirements and standards are an integral part of the monitoring program. The current program meets the requirements of DOE Orders 5400.1 and 5400.5 and DOE Regulatory Guide DOE/EH-0173T.

The West Valley Demonstration Project also holds a State Pollutant Discharge Elimination System (SPDES) permit as required by the New York State Department of Environmental Conservation (NYSDEC), which regulates liquid effluent discharges containing nonradiological pollutants. The SPDES permit identifies the outfalls where liquid effluents are released to surface water drainage systems and specifies the sampling and analytical requirements for each outfall.

In addition, the site operates under state-issued air discharge permits for nonradiological plant emissions. Radiological air emissions must comply with the National Emissions Standards for Hazardous Air Pollutants (NESHAP) regulations. Depending upon the potential to emit radionuclides, some radiological emission points must be permitted by the Environmental Protection Agency (EPA).

For more information about air and SPDES permits see the *Environmental Compliance Summary: Calendar Year 1996* (pp. li and liii). Environmental permits are listed in *Appendix B* (pp. B-5 through B-9).

Exposure Pathways Monitored at the West Valley Demonstration Project

The major near-term pathways for potential movement of possible contaminants away from the site are by surface water drainage and airborne transport. For this reason the environmental monitoring program emphasizes the collection of air and surface water samples. Samples are collected on-site from locations such as plant ventilation stacks as well as various water effluent points and surface water drainage locations. Samples of air, water, soils, and biota from the environment surrounding the site would indicate any radioactivity that might reach the public from site releases. Extensive groundwater monitoring addresses many long-term pathway concerns.

Water and Sediment Pathways

Process waters are collected in a series of on-site lagoons for treatment before being discharged. (The location of the lagoons is noted on Fig. 2-3 [p. 2-6] in *Chapter 2, Environmental Monitoring*.) Samples of this effluent and the effluent at two other permitted discharge points are collected regularly or, in the case of lagoon 3, when the lagoon water is released. The samples are analyzed for radiological parameters, including gross alpha and gross beta, tritium, strontium-90, and gamma radionuclides, and for nonradiological parameters, including pH. Additional analyses of composite samples determine metals content, solids, biochemical oxygen demand, nitrates, nitrites, ammonia, sulfate, organic chemicals, and specific isotopic radioactivity.

In general, on-site groundwater and surface water samples are collected regularly and analyzed, at a minimum, for gross alpha and gross beta radioactivity, tritium, and pH. Selected samples are analyzed for conductivity, chlorides, metals, volatile organic compounds, and other parameters. Potable water on the site is analyzed monthly for radioactivity and annually for chemical constituents. Residential drinking water wells located near the site are sampled annually and analyzed for gross alpha and gross beta radioactivity, tritium, gamma radionuclides, pH, and conductivity.

Off-site surface waters, primarily from Cattaraugus Creek and Buttermilk Creek, are sampled both upstream of the Project for background radioactivity and downstream to measure possible Project contributions. Sediments deposited downstream of the facility and at upstream background locations are collected annually and analyzed for gross alpha, gross beta, and specific radionuclides. (See *Appendix C-1* [pp. C1-1 through C1-24] for water and sediment data summaries.)

Groundwater Pathways

Groundwater discharge at the WVDP site occurs as springs, seeps along stream channels, direct discharge to streams, evapotranspiration, vertical groundwater outflow, and discharge to artificial draining systems and lagoons. All of these discharges vary with the seasons. Discharge from springs and seeps is highest during the spring. Evapotranspiration is at a maximum during the summer. Groundwater discharge is, in general, lowest during the winter because the ground surface is frozen, which minimizes recharge.

Routine monitoring of groundwater includes sampling for contamination and radiological indicator and groundwater quality parameters and for nonradiological parameters such as volatiles, semivolatiles, and metals, as well as specific analytes of interest at particular monitoring locations. (See Table 3-2 [pp. 3-22 through 3-27] in *Chapter 3, Groundwater Monitoring*.)

Air Pathways

Permitted effluent air emissions are continuously monitored for alpha and beta activity. Alarms indicate any unusual rise in radioactivity. Air particulate sampling filters, which are retrieved and analyzed weekly for gross radioactivity, are also composited quarterly and analyzed for strontium-90 and specific gamma- and alpha-emitting radionuclides.

Iodine-129 and tritium also are measured in effluent ventilation air at some locations. At two locations silica gel-filled columns are used to extract water vapor that is then distilled from the desiccant and analyzed for tritium. Six permanent samplers contain activated charcoal adsorbent that is analyzed for iodine-129. The silica gel column distillates are analyzed weekly; the charcoal is collected weekly and composited for quarterly analysis.

Off-site sampling locations include those considered most representative of background conditions and those most likely to be downwind of airborne releases. Among the criteria used to position off-site air samplers are prevailing wind direction, land usage, and the location of population centers.

Off-site air is continuously sampled at ten locations. Background samplers are located far from the site in Great Valley and Nashville, New York. Nearby-community samplers are in Springville and West Valley, New York. (See Fig. A-9 [p. A-53] in *Appendix A* for these four off-site air sampling locations.) Six samplers are located on the perimeter of the WNYNSC. (See Fig. 2-2 [p. 2-5] in *Chapter 2, Environmental Monitoring*.) These samples are analyzed for parameters similar to the effluent air samples. (See *Appendix C-2* [pp. C2-1 through C2-25] for air monitoring data summaries.)

Atmospheric Fallout

An important contributor to environmental radioactivity is atmospheric fallout. Sources of fallout include earlier atmospheric testing of atomic explosives and residual radioactivity from accidents such as occurred at Chernobyl. Four site perimeter locations and one on-site location currently are sampled for fallout using pot-type samplers that are collected every month. Long-term fallout is determined by analyzing soil collected annually at each of the six perimeter and four off-site air samplers. Three additional on-site soil samples are taken annually. (See *Appendix C-2* [p. C2-24] for fallout data summaries and *Appendix C-1* [pp. C1-22 and C1-23 for soil data summaries.)

Food Pathways

A potentially significant pathway of radioactivity to humans is through eating produce and domesticated farm animals raised near the WVDP and through game animals and fish that include the WVDP in their range. Animal and fish samples from potentially affected areas are gathered and analyzed for radionuclide content in order to reveal any long-term trends. Fish are collected at several locations along Cattaraugus Creek and its tributaries at various distances downstream from the WVDP. Venison is sampled from the deer herd ranging within the WNYNSC. Beef, milk, hay, and produce are collected at nearby farms and at selected locations well away from any possible WVDP influence. (See *Appendix C-3* [pp. C3-1 through C3-8] for biological data summaries.)

Direct Radiation Measurement

Direct penetrating radiation is measured using thermoluminescent dosimeters (TLDs) located on- and off-site. Measurement points within the site are placed near selected waste management units and around the inner security fence. Other measurement locations are situated around the site perimeter and access road and at background locations remote from the WVDP. The TLDs are retrieved quarterly and are processed by an off-site service to obtain the integrated gamma exposure.

Forty-three measurement points were used in 1996. (See *Appendix C-4* [pp. C4-1 through C4-6] for a summary of the direct radiation data. See also *Appendix D* [p. D-9] for a comparison of WVDP subcontractor and independent co-located NRC results.)

Meteorological Monitoring

Meteorological data are continuously gathered and recorded on-site. Wind speed and direction, barometric changes, temperature, dewpoint, and rainfall are all measured. Such data are valuable in evaluating long-term geohydrological trends and for use in airborne dispersion models. In the event of an emergency, immediate access to the most recent meteorological data is indispensable for predicting the path and concentration of any materials that become airborne. (See *Appendix C-6* [pp. C6-1 through C6-9] for meteorological data summaries.)

Quality Assurance and Control

The work performed by and through the on-site Environmental Laboratory is regularly reviewed by several agencies for accuracy and compliance with applicable regulations. Audits of the laboratory routinely focus on proper record keeping and reporting, timely calibration of equipment, training of personnel, adherence to accepted procedures, and general laboratory safety.

The Environmental Laboratory also participates in quality assurance crosscheck programs administered by federal agencies. (See *Appendix D* [pp. D-1 through D-10] for a summary of crosscheck performance.) Outside laboratories contracted to perform analyses for the WVDP also are regularly subjected to performance audits.

Environmental monitoring management continues to strengthen its formal self-assessment program, developing and implementing new strategies and procedures for ensuring high quality data. Experienced senior scientists and specialists in varying disciplines follow an annual schedule of self-assessments, produce formal reports with recommended corrective actions, and track the actions planned for implementation.

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ENVIRONMENTAL COMPLIANCE SUMMARY

CALENDAR YEAR 1996

Introduction: Compliance Program

The primary mission of the West Valley Demonstration Project (WVDP) is to develop and demonstrate a safe method of solidifying high-level radioactive mixed waste. Vitrification, the selected method, converts radioactive and hazardous materials into a glass-like substance by incorporating these materials into a glass structure. The treatment process is regulated by various federal and state laws in order to protect the public, workers, and the environment.

The U.S. Department of Energy (DOE), the federal agency that oversees the WVDP, established its policy concerning environmental protection in DOE Order 5400.1, General Environmental Protection Program. This Order lists the regulations, laws, and required reports that are applicable to DOE-operated facilities. DOE Order 5400.1 requires the preparation of this annual Site Environmental Report, which is intended to summarize environmental data gathered during the calendar year, describe significant programs, and confirm compliance with environmental regulations.

The major federal environmental laws and regulations that apply to the West Valley Demonstration Project are the Resource Conservation and Recovery Act, the Clean Air Act, the Emergency Planning and Community Right-to-Know Act, the Clean Water Act, the Safe Drinking Water Act, the Toxic Substances Control Act, and the National Environmental Policy Act. These laws are administered primarily by the U.S. Environmental Protection Agency (EPA) and the New York State Department of Environmental Conservation (NYSDEC) through state programs and regulatory requirements such as permitting, reporting, inspecting, and performing audits.

In addition, because the emission of radiological and nonradiological materials from an active facility cannot be completely prevented, the EPA, NYSDEC, and the DOE have established standards for such emissions to protect human health and the environment. The WVDP applies to NYSDEC and the EPA for permits that allow the site to release limited amounts of radiological and nonradiological constituents through controlled and monitored discharges of water and air. These concentrations have been determined to be safe for humans and the environment. In general, the permits describe the discharge points, list the limits on those pollutants likely to be present, and define the sampling and analysis schedule.

Environmental inspections and audits are conducted routinely by the EPA, NYSDEC, the New York State Department of Health (NYSDOH), and the Cattaraugus County Health Department. On-site and off-site radiological monitoring in 1996 confirmed that site activities were conducted well within state and federal regulatory limits. However, some nonradiological State Pollutant Discharge Elimination System (SPDES) permit limits were exceeded. (These exceptions, also commonly called exceedances, are described in more detail under the **Clean Water Act** section [p.liv]). Efforts have been made to eliminate the potential for these exceedances to recur.

Management at the WVDP continued to provide strong support for environmental compliance issues in 1996. DOE Orders and applicable state and federal statutes and regulations are integrated into the compliance program at the Project, demonstrating a commitment to protecting the public and the environment while working towards the WVDP goal of high-level radioactive mixed waste vitrification.

The following environmental compliance summary describes the federal and state laws and regulations that are applicable to the WVDP and the relevant environmental compliance activities that occurred at the WVDP in 1996.

Compliance Status

Resource Conservation and Recovery Act (RCRA)

The Resource Conservation and Recovery Act (RCRA) was enacted to ensure that hazardous wastes are managed in a manner that protects human health and the environment. RCRA and its implementing regulations govern hazardous waste generation, treatment, storage, and disposal. Under RCRA, generators are responsible for ensuring the proper treatment, storage, and disposal of their wastes.

Various federal agencies have specific responsibilities under RCRA. The EPA is responsible for issuing guidelines and regulations for the proper management of solid and hazardous waste. In New York, the EPA has delegated the authority to enforce these regulations to NYSDEC. In May 1990 the state of New York was authorized by the EPA to administer a radioactive mixed waste program. The U.S. Department of Transportation (DOT) is responsible for issuing guidelines and regulations for the labeling, packaging, and spill-reporting provisions for hazardous wastes in transit.

Each facility that treats, stores (for more than 90 days) or disposes of hazardous waste at that facility must apply for a permit from the EPA (or state, if so authorized). The permit defines the treatment processes to be used, the design capacity of these processes, the location of hazardous waste storage units, and the hazardous wastes to be handled. In 1984 the DOE notified the EPA of hazardous waste activities at the WVDP, identifying the WVDP as a generator of hazardous waste. In June 1990 the WVDP filed a Part A Permit Application with NYSDEC. Based on that submittal, the WVDP was granted interim status. The WVDP continues to update the RCRA Part A Permit Application as changes to the site's interim-status waste-management operations occur; however, no updates were needed in 1996.

Hazardous Waste Management Program

In order to dispose of hazardous wastes generated from on-site activities, the WVDP uses permitted transportation services to ship RCRA-regulated wastes to permitted treatment, storage, or disposal facilities (TSDFs). Using these services, the WVDP shipped approximately 69.8 metric tons (76.9 tons) of nonradioactive, hazardous waste off-site in 1996. Of this amount, 0.8 metric tons (0.9 tons) were recycled by the TSDFs.

Hazardous waste shipments and their receipt at designated TSDFs are documented by signed manifests that accompany the shipment. If the signed manifest is not returned to the generator of the waste within the NYSDEC statutory limit of forty-five days from shipment, an exception report must be filed and receipt of the waste confirmed with the TSDF. No exception reports were required to be filed in 1996.

Hazardous waste activities must be reported to NYSDEC every year through the submittal of a hazardous waste report. This report summarizes the hazardous waste activities for the previous year, specifies the quantities of hazardous waste generated, and identifies the TSDFs used. In addition, a hazardous waste reduction plan must be filed every two years and updated annually. This plan, which documents the efforts to minimize the generation of hazardous waste, was first submitted to NYSDEC in 1990. The most recent hazardous waste-reduction plan was submitted in 1996.

Annual inspections to assess compliance with hazardous waste regulations were conducted by NYSDEC (March 14, 1996) and the EPA (July 24, 1996). No deficiencies were noted during the inspections.

Nonhazardous, Regulated Waste Management Program

The WVDP transported approximately 27.4 metric tons (30.2 tons) of nonradioactive, nonhazardous material off-site to solid waste management facilities in 1996. Of this amount, 3.1 metric tons (3.4 tons) were recycled or reclaimed. The industrial waste materials included items such as concrete, asbestos debris, monitoring-well purge water, and neutralized acids and bases from laboratory and chemical mixing operations. Some of the regulated materials recycled or reclaimed included lead acid batteries and nonhazardous oils. In 1996, the WVDP also shipped approximately 2,000 metric tons (2,200 tons) of digested sludge and untreated wastewater from the site sanitary and industrial wastewater treatment facility to the Buffalo Sewer Authority for treatment.

Radioactive Mixed Waste (RMW) Management Program

Radioactive mixed waste (RMW) contains both a radioactive component, regulated under the Atomic Energy Act (AEA), and a hazardous component, regulated under RCRA. Both the EPA and NYSDEC oversee RMW management at the WVDP. To address the management of the hazardous component of RMW, in March 1993 the DOE entered into a Federal and State Facility Compliance Agreement (FSFCA) with the EPA, NYSDEC, the New York State Energy Research and Development Authority (NYSERDA), and West Valley Nuclear Services Company, Inc. (WVNS), the primary contractor for the DOE at the WVDP. The FSFCA addresses requirements for managing the hazardous component of the RMW, e.g., regulatory compliance with the Land Disposal Restrictions (LDR) of RCRA for RMW, specifies particular storage requirements for RMW, and requires the characterization of historical wastes in storage at the WVDP. Characterization of historical wastes continued during 1996.

The Federal Facility Compliance Act (FFCAct) of 1992, an amendment to RCRA, was signed into law on October 6, 1992. The FFCAct requires DOE facilities to develop treatment plans for RMW inventories and to enter into agreements with regulatory agencies that require the treatment of the inventories according to the approved plans.

DOE facilities developed site treatment plans in three steps: conceptual, draft, and proposed. The WVDP's conceptual plan was submitted to NYSDEC in October 1993 and the draft plan in August 1994. The WVDP submitted the proposed site treatment plan to NYSDEC in March 1995. The proposed plan is comprised of two volumes: the Background Volume and the Plan Volume. The Background Volume provides information on each RMW stream as well as information on the preferred treatment method for the waste. The Plan Volume contains proposed schedules for treating the RMW to meet the LDR requirements of RCRA. Each submittal to NYSDEC underwent a public comment period during which input was solicited from WVDP stakeholders.

The DOE and NYSDEC entered into a consent order on September 3, 1996, that requires the completion of the milestones identified in the Plan Volume. The WVDP began implementing the site treatment plan immediately. All milestones for calendar year 1996 were met.

RCRA Facility Investigation (RFI) Program

The DOE and NYSERDA entered into a RCRA 3008(h) Administrative Order on Consent with NYSDEC and the EPA in March 1992. The Consent Order requires NYSERDA and the DOE's West Valley Demonstration Project Office (DOE-WV) to conduct RCRA facility investigations at solid waste management units (SWMUs) in order to determine if there has been a release or if there is a potential for release of RCRA-regulated hazardous waste or hazardous constituents from SWMUs.

Because of the proximity of some of the units to each other, twenty-five SWMUs were grouped into twelve super solid waste management units (SSWMUs) to facilitate investigative efforts under the RCRA facility investigation (RFI) program.

In general, the purpose of a RCRA facility investigation is to collect and evaluate information to determine which of the following actions are appropriate for each SWMU or SSWMU in accordance with the Consent Order: no further action; a corrective measures study; or additional investigations to support one of the other actions. The RFI addresses RCRA-regulated hazardous wastes or hazardous constituents. To define and assess the environmental settings, unit and waste characteristics, and the potential sources and extent of nonradiological contamination, the WVDP has reviewed existing information and collected and analyzed samples of surface soil, subsurface soil, sediment, and groundwater.

In 1996 the WVDP continued to identify and evaluate SWMUs to ensure compliance with the requirements of the RCRA 3008(h) Administrative Order on Consent. (See **Current Issues and Actions** [p.lviii]). Of the twelve SSWMUs, five have been identified to date as requiring no further action: #2, miscellaneous small units; #6, the low-level waste storage area; #7, the chemical process cell waste storage area; #10, the radwaste treatment system drum cell; and #12, the hazardous waste storage lockers.

Similarly, four SSWMUs have been identified as requiring no immediate action other than continued groundwater monitoring: #1, the low-level waste treatment facility; #8, the construction and demolition debris landfill; #9, the Nuclear Regulatory Commission (NRC)-licensed disposal area; and #11, the New York State-licensed disposal area. Determinations for the three remaining SSWMUs will be made in 1997 following EPA and NYSDEC review of the associated draft RFI reports.

In May 1994, sixteen rooms previously used during nuclear fuel reprocessing operations were evaluated under the RFI program, as required by the Consent Order. In December 1994 the EPA and NYSDEC reviewed the evaluation and issued a determination of "no further action" for eight of the rooms. At the same time, NYSDEC and the EPA requested additional information on the remaining eight rooms. In February 1995 the WVDP provided NYSDEC and the EPA with the information requested. A determination concerning these rooms will be made following review of the three remaining SSWMU draft RFI reports that the WVDP previously submitted to the EPA and NYSDEC.

Waste Minimization and Pollution Prevention

The WVDP has initiated a long-term program to minimize the generation of low-level radioactive waste, radioactive mixed waste, hazardous waste, industrial waste, and sanitary waste as directed by Executive Order 12856, Federal Compliance with Right-to-Know and Pollution Prevention Requirements.

Using 1993 waste-generation rates as a baseline for comparison, the WVDP plans to reduce the generation of low-level radioactive waste, radioactive mixed waste, and hazardous waste by 50% by December 31, 1999. Similarly, the generation of industrial and sanitary waste will be reduced by 30% by the same date.

Toward that end, the WVDP set the following cumulative waste-reduction goals for 1996: a 26% reduction in the generation of low-level radioactive waste, radioactive mixed waste, and hazardous waste; an 18% reduction in industrial waste; and a 10% reduction in sanitary waste.

The WVDP greatly exceeded the 1996 reduction goals for all six waste categories. Low-level radioactive waste generation was reduced by 91%, radioactive mixed waste generation by 68%, and hazardous waste generation by 66%. In a similar manner, industrial waste generation was reduced by 50% and sanitary waste generation by 44%.

Specific accomplishments in waste minimization and pollution prevention during 1996 included the following:

- 203.0 metric tons (224.0 tons) of paper were recycled
- 152.9 metric tons (168.5 tons) of galvanized steel, carbon steel, stainless steel, and aluminum were recycled
- 0.8 metric tons (0.9 tons) of hazardous waste were recycled
- 3.1 metric tons (3.4 tons) of nonhazardous, regulated waste were recycled.

Underground Storage Tanks Program

RCRA regulations also cover the use and management of underground storage tanks and establish minimum design requirements in order to protect groundwater resources from releases. The regulations, codified at Title 40, Code of Federal Regulations (CFR), Part 280, require underground storage tanks to be equipped with overfill protection, spill prevention, corrosion protection, and leak detection systems. New tanks must comply with regulations at the time of installation. Facilities with tanks in service on December 22, 1988, were allowed a ten-year grace period for installing the upgrades.

New York State also regulates underground storage tanks through two programs, petroleum bulk storage (Title 6, New York Official Compilation of Rules and Regulations [NYCRR], Parts 612 - 614) and chemical bulk storage (6 NYCRR Parts 595 - 599). The registration and minimum design requirements are similar to those of the federal program except that petroleum tank fill ports must be color-coded using American Petroleum Institute standards to indicate the product being stored. The WVDP does not use underground chemical bulk storage tanks.

The WVDP does store petroleum products in three regulated, 2,000-gallon underground tanks. Two of the tanks contain unleaded gasoline. The third tank contains low-sulfur diesel fuel. Procedural controls in conjunction with metered delivery provide overfill protection and spill prevention. The tank fill ports are color-coded as required. Leak detection requirements are met through daily tank-gauging, inventory records, and monthly reconciliations of the product added, product removed, and the current contents. A fourth tank, a 550-gallon underground storage tank, is used to store diesel fuel for the standby power plant for the supernatant treatment ventilation blower system. This tank, a double-walled tank with an interstitial leak detection system, is filled by a metered delivery system and is monitored through daily gauging and monthly reconciliations. The tank's fill port is also color-coded in accordance with American Petroleum Institute standards. An annual test for tightness and integrity of the 2,000-gallon underground storage tanks took place on October 3, 1996. The 550-gallon underground storage tank does not require tightness or integrity testing because of its integral leak detection system.

In accordance with EPA underground storage tank regulations, these underground tanks must be upgraded to meet the requirements for new or substantially modified underground storage tanks (e.g., corrosion protection, interior lining, overfill protection) by December 22, 1998 or be permanently closed. The three 2,000-gallon underground tanks will be removed and the 550-gallon underground tank upgraded prior to that date.

New York State-regulated Aboveground Storage Tanks

The state of New York regulates aboveground petroleum bulk storage under 6 NYCRR Parts 612, 613, and 614. Aboveground hazardous bulk chemical storage is regulated by New York State under 6 NYCRR Part 595 et seq. These regulations require secondary containment, external gauges to measure the current reserves, monthly visual inspections of petroleum tanks, and documented daily, annual, and five-year inspections of chemical tanks. Furthermore, petroleum tank fill ports must be color-coded, and chemical tanks labeled to indicate the product stored.

An aboveground chemical storage tank, used to store nitric acid, was permanently closed in 1996. At the end of 1996 the registration included nine aboveground petroleum tanks and fourteen aboveground chemical storage tanks. Three of the petroleum tanks contain No. 2 fuel oil, one contains unleaded gasoline, and the remainder contain diesel fuel. Eleven of the chemical storage tanks contain nitric acid or nitric acid mixtures. Sulfuric acid, sodium hydroxide, and anhydrous ammonia are stored in the remaining three tanks. All of the tanks are equipped with gauges and secondary containment systems.

The Quality Assurance department inspects the aboveground petroleum tanks every month. In December 1996, an inspection of all aboveground, hazardous substance storage tanks was conducted to fulfill the requirements for annual inspection (6 NYCRR Part 598.7(c)). No violations were noted during the inspection.

Medical Waste Tracking

Medical waste poses a potential for exposure to infectious diseases and pathogens from contact with human bodily fluids. Medical evaluations, inoculations, and laboratory work at the on-site nurse's office regularly generate potentially infectious medical wastes that must be tracked in accordance with NYSDEC requirements (6 NYCRR Part 364.9). The WVDP has retained the services of a permitted waste hauler and disposal firm to manage the medical wastes generated. Medical wastes are sterilized with an autoclave by the firm to remove the associated hazard and then disposed. Approximately 21.3 kilograms (47 lbs) of medical waste were generated and disposed in 1996.

Clean Air Act (CAA)

The Clean Air Act (CAA), as amended, establishes a framework for the EPA to regulate air emissions from both stationary and mobile sources. In 1996 NYSDEC adopted regulations to implement new EPA Clean Air Act requirements. In New York State either the EPA or NYSDEC issues permits for stationary sources emitting regulated pollutants, including hazardous air pollutants. Sources requiring permits are those that emit a regulated pollutant in quantities above a predetermined threshold that is from a particular source such as a stack, duct, vent, or other similar opening. Under the CAA, this type of air emission is considered a point source. Non-point sources of emissions such as lagoons and soil piles do not require specific permits from the EPA or NYSDEC. Emissions from these sources are, however, quantified for reporting purposes to both the EPA and NYSDEC.

Emissions of radionuclides from the WVDP are regulated by the EPA under 40 CFR Part 61, the National Emission Standards for Hazardous Air Pollutants (NESHAP). The WVDP currently has permits for six radionuclide sources. In addition, the WVDP has interim approval from the EPA to operate two additional sources, the slurry-fed ceramic melter and the vitrification heating, ventilation, and air conditioning (HVAC) system. Other less significant sources of radionuclide emissions, such as those from the on-site laundry, do not require permits. The WVDP reports the radionuclide emissions from its non-permitted and permitted sources to the EPA annually in accordance with NESHAP regulations. Calculations to demonstrate compliance with NESHAP radioactive dose limits showed 1996 doses to be less than 0.1% of the 10 millirem standard.

Nonradiological sources of air emissions are regulated by NYSDEC. The WVDP has twenty-nine certificates-to-operate (COs) for nonradiological point sources. On June 7, 1996, NYSDEC filed amendments to Title 6 NYCRR Part 201, Construction and Operating Permits. The amendments went into effect on July 7, 1996. On the effective date all valid COs for a given facility were extended indefinitely. As such, the WVDP's twenty-nine COs were extended without expiration.

The vitrification facility off-gas system permit-to-construct (PC) was extended in 1995 to allow for the completion of construction and start-up testing. A nitrogen oxides (NO_x) Relative Accuracy Test Audit (RATA) conducted on May 30, 1996 verified the level of NO_x emissions and the accuracy of the monitoring system for the stack. Representatives from NYSDEC Region 9, Division of Air Resources, visited the site to observe the NO_x RATA. On June 14, 1996 the WVDP submitted a letter to NYSDEC requesting that the PC be converted to a CO.

The air permits that were in effect at the WVDP in 1996 are listed in *Appendix B*, Table B-3 (pp. B-5 through B-9).

Emergency Planning and Community Right-to-Know Act (EPCRA)

The Emergency Planning and Community Right-to-Know Act (EPCRA) was enacted as Title III of the Superfund Amendments and Reauthorization Act (SARA). EPCRA was designed to create a working partnership between industry, business, state and local governments, public health and emergency response representatives, and interested citizens. EPCRA is intended to address concerns about the effects of chemicals used, stored, and released in communities.

Executive Order 12856, Federal Compliance with Right-to-Know Laws and Pollution Prevention Requirements, requires all federal agencies to comply with the following EPCRA provisions: planning notification (Sections 302 - 303), extremely hazardous substance (EHS) release notification (Section 304), material safety data sheet (MSDS)/chemical inventory (Sections 311 - 312), and toxic release inventory (TRI) reporting (Section 313).

The WVDP complied with these provisions in 1996 as follows and as summarized in the table below.

• In May and October 1996, WVDP representatives attended the semiannual meetings of the Cattaraugus County Local Emergency Planning Committee (EPCRA Section 302-303). At the meeting in May, the 1996 revision to the SARA Title III Hazardous Materials Response Plan was distributed. The October meeting was hosted by the WVDP. WVDP representatives also attended meetings held by Cattaraugus and Erie County Emergency Management Services.

• In 1996 the WVDP complied with all necessary EPCRA reporting requirements. There were no releases that triggered any release notifications (EPCRA Section 304).

• Under EPCRA Section 311 the WVDP reviews information about reportable chemicals every quarter. If a hazardous chemical, which has not been previously reported, becomes present on-site in an amount exceeding the threshold planning quantity, an MSDS and an updated hazardous chemical list is submitted to the state and local emergency response groups. This supplemental reporting ensures that the public and the emergency responders have current information about the chemicals on-site. In 1996, the WVDP made two Section 311 notifications, one for liquid nitrogen and the other for liquid carbon dioxide.

• Under EPCRA Section 312 the WVDP submits annual reports to state and local emergency response organizations and fire departments that specify the quantity, location, and hazards associated with chemicals stored on-site. Sixteen reportable chemicals above threshold planning quantities were stored on-site in 1996.

• Under EPCRA Section 313, the WVDP submitted a toxic release inventory (TRI) report to the EPA in 1996 for nitric acid during calendar year 1995.

EPCRA 302-303:			
Planning Notification	[√] Yes	[ ] No	[ ] Not Req.
EPCRA 304:			
EHS Release Notification	[ ] Yes	[ ] No	[√] Not Req.
EPCRA 311-312:			
MSDS/Chemical Inventory	[√] Yes	[ ] No	[ ] Not Req.
EPCRA 313:			
TRI Reporting	[√] Yes	[ ] No	[ ] Not Req.

All the SARA notifications were submitted within the required time frames.

Clean Water Act (CWA)

Section 402 of the Clean Water Act (CWA) of 1972, as amended, authorizes the EPA to regulate discharges of pollutants to surface water and groundwater through a National Pollutant Discharge

Elimination System (NPDES) permit program. The EPA has delegated this authority to the state of New York, which issues State Pollutant Discharge Elimination System (SPDES) permits.

Section 404 of the CWA contains regulations for the development of areas in and adjacent to the waters of the United States. Supreme Court interpretations of Section 404 have resulted in the inclusion of wetlands in the regulatory definition of waters of the United States. (New York State also has promulgated regulations at 6 NYCRR Parts 662 through 665 for the protection of freshwater wetlands.) Section 404 provides regulatory controls for the disposal of dredged or fill material into these areas by granting the U.S. Army Corps of Engineers the authority to designate disposal areas and issue permits for these activities.

In addition, Section 401 of the CWA requires applicants for a federal license or permit pursuant to Section 404 to obtain certification from the state that the proposed discharge complies with effluent and water quality-related limitations, guidelines, and national standards of performance identified under the CWA such as Sections 301, 302, 303, 306, 307, and 511(c).

SPDES-permitted Outfalls

Point source liquid effluent discharges to surface waters of New York State are permitted through the New York SPDES program. The WVDP has four SPDES-permitted outfalls, which discharge to Erdman Brook and Frank's Creek.

• Outfall 001 (WNSP001) discharges treated wastewater from the low-level waste treatment facility (LLWTF) and the groundwater pump-and-treat system (i.e., the north plateau groundwater recovery system. See **Current Issues and Actions,** *Groundwater Treatment* [p.lviii] and *Chapter 3, Groundwater Monitoring*). The treated wastewater is held in lagoon 3, sampled and analyzed, and periodically released upon notification of NYSDEC.

In 1996 the treated wastewater from the LLWTF was discharged at WNSP001 in seven batches that totaled 50.6 million liters (13.4 million gal) for the year. The annual average concentration of radioactivity at the point of release was 35% of the DOE derived concentration guides (DCGs). None of the individual releases exceeded the DCGs.

• Outfall 007 (WNSP007) discharges the effluent from the site sanitary and industrial wastewater treatment facility, which treats sewage and various nonradioactive wastewaters from physical plant systems (e.g., water plant production residuals and boiler blowdown). The average daily flow at WNSP007 in 1996 was 76,100 liters (20,100 gal).

• Outfall 008 (WNSP008) discharges groundwater and storm water flow directed from the northeast side of the site's LLWTF lagoon system through a french drain. The average daily flow at WNSP008 in 1996 was 8,300 liters (2,200 gal).

• Outfall 116 represents the confluence of outfalls 001, 007, and 008 as well as wet weather flows (e.g., storm water run-off), groundwater surface seepage, and augmentation water (i.e., untreated water from the site reservoirs). The outfall is not a physical monitoring location but the point where compliance with the SPDES permit limit for total dissolved solids (TDS) is maintained through calculation using monitoring data from these upstream sources.

The WVDP obtained storm water characterization data through sampling and analysis in 1991 and submitted a storm water discharge permit application to NYSDEC on September 30, 1992. In early 1994, NYSDEC indicated that any future storm water discharge requirements would be incorporated into the WVDP's existing SPDES permit. In response to NYSDEC comments on the permit application, the WVDP monitored the discharge at eleven storm water outfalls in 1995. In April 1996 the WVDP submitted a new SPDES permit application that identified these outfalls. In March 1996 the WVDP submitted to NYSDEC an application for a SPDES permit modification to increase the average flow of effluent from the pump-and-treat system from approximately 9.8 million liters (2.6 million gal) a year to approximately 39.7 million liters (10.5 million gal) a year. (See **Current Issues and Actions** [p.lviii].)

The SPDES permit limits were exceeded twice at outfall 001 in 1996. Although these exceedances did not have any significant adverse effect on the environment, the WVDP is continuing to work with NYSDEC to prevent the recurrence of these events. These exceedances are summarized in the table below.

- On August 22, nitrite was measured at 0.24 mg/L, which exceeded the permit limit of 0.1 mg/L. A malfunction in the chemical addition system resulted in the addition of excess acid to the effluent holding lagoon, lagoon 3. The low pH from this addition upset the chemical oxidation and natural biological nitrification processes that convert ammonia to nitrite and nitrite to nitrate. As a result, the nitrite intermediate became elevated. The conversion processes returned to normal conditions as the pH naturally rose. A chemical metering pump has been installed to provide better pH control.

- On August 27, a pH of 5.21 standard units (s.u.) was recorded, which was below the allowable lower limit of 6.5 s.u. The exceedance resulted from a failure to close the discharge valve during pH adjustment to allow for sufficient mixing of the treated water held in lagoon 3. During subsequent discharges the discharge valve will be closed during pH adjustments.

The permit exceedances reported for these parameters did not result in NYSDEC issuing any notices of violation.

On March 29, 1996 NYSDEC conducted its annual facility inspection. At the request of the inspector, the SPDES outfalls, the sanitary and industrial wastewater treatment facility, and the LLWTF were toured. No violations were noted during the inspection.

Wetlands

In 1993 a wetlands investigation was conducted under Section 404 of the CWA, which identified fifty-one wetland units on a 550-acre area that includes the 200-acre WVDP site and adjacent parcels north, south, and east of the site. A report documenting the wetlands investigation and

Permit Type	***Outfall No.***	***Parameter***	***Date(s) Exceeded***	***Description/Solution***
SPDES	SP001	Nitrite	August 22, 1996	Low pH inhibited nitrification process/A chemical metering pump has been installed to provide better pH control
SPDES	SP001	pH	August 27, 1996	Overcompensation for rising pH/ During subsequent discharges the discharge valve will be closed during pH adjustments

delineation was submitted to the U.S.Army Corps of Engineers and NYSDEC in June 1994.

NYSDEC reviewed the report and inspected the site, determining that a group of eight contiguous wetlands met the criteria for regulation as a single unit. The group of eight contiguous wetland units, delineated by NYSDEC as a linked unit, will be included on the next available proposed amendment to the official New York State Freshwater Wetlands Map for Cattaraugus County.

Any work conducted within a mapped wetland or within 100 feet of a mapped New York freshwater wetland requires NYSDEC approval. The WVDP notifies the U.S. Army Corps of Engineers and NYSDEC of those proposed actions that have the potential to affect any of the fifty-one wetland units and that are not specifically exempted from regulation or notification. No notifications were required in 1996.

Petroleum- and Chemical-Product Spill Reporting

The WVDP has a Spill Notification and Reporting Policy to ensure that all spills are properly managed, documented, and remediated in accordance with applicable regulations. This policy identifies the departmental responsibilities for spill management and illustrates the proper spill control procedures. The policy stresses the responsibility of each employee to notify the main plant operations shift supervisor upon discovery of a spill. This first-line reporting requirement helps to ensure that spills are properly evaluated and managed.

Under a June 1996 agreement with NYSDEC regarding the agency's petroleum spill-reporting protocol, the WVDP is not required to report spills of petroleum products of 5 gallons or less onto an impervious surface (e.g., asphalt or concrete) that are cleaned up within two hours of discovery. Spills of petroleum products of 5 gallons or less onto the ground are entered in a monthly petroleum spill log. Spills of any amount that travel to waters of the state (i.e., surface water, drainage systems, or groundwater) must be reported immediately to the NYSDEC spill hotline and entered in the monthly log. Spills of petroleum products that enter any navigable water of New York State are reported to the National Response Center within two hours of discovery. Each monthly petroleum spill log is submitted to NYSDEC on the fifteenth day of the following month. In addition to the NYSDEC spill- and release-reporting regulations, the WVDP also reports spills of hazardous substances in accordance with reporting requirements under RCRA, the CAA, EPCRA, the CWA, and the Toxic Substances Control Act (TSCA).

Petroleum- and chemical-product spills were logged and evaluated throughout the year. Two petroleum spills required immediate notification of NYSDEC. No chemical spills exceeded the reportable quantities and, therefore, required no reporting. All the spills were cleaned up in a timely fashion in accordance with the WVDP Spill Notification and Reporting Policy, and the clean-up debris was characterized and dispositioned appropriately. None of the spills resulted in any adverse environmental impact.

Safe Drinking Water Act (SDWA)

The Safe Drinking Water Act (SDWA) requires that each federal agency having jurisdiction over a federally owned or maintained public water system must comply with all federal, state, and local requirements regarding safe drinking water. The drinking water quality program in the state of New York is administered by NYSDOH through county health departments.

The WVDP obtains its drinking water from surface water reservoirs on the Western New York Nuclear Service Center (WNYNSC) site and is considered a non-transient, non-community public water supplier. The Project's drinking water treatment facility purifies the water by clarification, filtration, and chlorination before it is distributed on-site.

As an operator of a drinking water supply system, the WVDP collects routine drinking water samples to monitor organic and inorganic water quality. The results of these analyses are reported to the Cattaraugus County Health Department. The Cattaraugus County Health Department also independently collects a sample of WVDP drinking water every month to determine bacterial and residual chlorine content. Analysis of the microbiological samples collected in 1996 produced satisfactory results and the free chlorine residual measurements in the distribution system were positive on all occasions, indicating proper disinfection.

From 1993 to 1996 the WVDP conducted annual sampling and testing for lead and copper in the site's drinking water in accordance with EPA and NYSDOH regulations. Previous analytical results showed lead levels to be above the action level of 15μg/L at several locations in the distribution system. In 1996, the WVDP replaced existing water faucets with lead-free faucets in an effort to lower the lead levels. NYSDOH regulations require an evaluation of potential water treatment actions and the preparation of a corrosion control plan for water systems that do not meet the lead and copper action levels. Because two consecutive lead and copper sample rounds were below the EPA action levels in 1996, the site was not required to implement the state-designated corrosion control program. In addition, the WVDP was allowed to reduce the sampling frequency and number of sampling sites.

Other than two maximum contaminant level violations for turbidity that occurred early in January and February, 1996 monitoring results indicated that the Project's drinking water met NYSDOH drinking water quality standards. The high turbidity was attributed to a storm event that flooded the site's water supply reservoirs and that subsequently overloaded the water treatment facility clarifier.

The Cattaraugus County Health Department conducted its annual inspection of the WVDP water supply system on November 4, 1996. No detrimental findings or notices of violation were issued.

Other 1996 site drinking water program activities included the inspection in July 1996 of the new water clarifier, which had been installed in 1995, and the construction of the new potable water storage tank in December 1996.

Toxic Substances Control Act (TSCA)

The Toxic Substances Control Act (TSCA) of 1976 regulates the manufacture, processing, distribution, and use of chemicals, including polychlorinated biphenyls (PCBs) and asbestos-containing materials. In 1996 the WVDP continued to manage radioactively contaminated PCB wastes as radioactive mixed wastes because PCBs are a listed hazardous waste in New York State. These wastes originated from a dismantled hydraulic power unit inside the former reprocessing facility and from two radiologically contaminated capacitors that contained PCB fluids. To comply with TSCA, the WVDP maintains an annual document log that details PCB use and appropriate PCB waste storage on-site and any changes in storage or disposal status. In August 1996 the DOE and the EPA entered into a federal facility compliance agreement for the storage of radioactively contaminated PCB wastes. The agreement allows the WVDP to store radioactively contaminated PCB wastes for more than one year, the statutory limit for storage under TSCA. In 1996 the WVDP also continued to manage asbestos-containing materials in accordance with the WVDP Asbestos Management Plan. The plan includes requirements for limiting worker exposure to asbestos-containing materials and requirements for asbestos-abatement projects and maintenance activities, and it identifies the inventory of on-site asbestos-containing materials.

National Environmental Policy Act (NEPA)

The National Environmental Policy Act (NEPA) of 1969, as amended, establishes a national policy to ensure that protection of the environment is included in federal planning and decision making (Title I). Its goals are to prevent or eliminate potential damage to the environment that could arise from federal legislative actions or proposed federal projects. The President's Council on Environmental Quality (CEQ), established under Title II of NEPA, sets the policy for fulfilling these goals. The CEQ regulations for implementing NEPA are promulgated at 40 CFR Parts 1500 - 1508.

The DOE began revising its NEPA-compliance procedures and guidelines in 1990. On May 26, 1992 the President's Council on Environmental Quality approved the DOE's NEPA procedures, which are promulgated at 10 CFR Part 1021. In July 1996 the DOE amended the NEPA procedures.

NEPA requires that all federal agencies proposing actions that have the potential to significantly affect the quality of human health and the environment prepare detailed environmental statements. The DOE implements NEPA by requiring an environmental review of all proposed actions (10 CFR Part 1021). The DOE's NEPA procedures embody a hierarchical system of assessment for reviewing and documenting proposed actions commensurate with the action's potential for impacting the environment. Reflecting least to greatest significance, the levels of review and documentation are: no impact and categorical exclusion; potential impact and an environmental assessment; and significant impact and an environmental impact statement. (See pp. 1 and 3 in the *Glossary*.)

Eight proposed actions at the WVDP were reviewed in 1996 under the DOE's NEPA-implementing regulations. The proposed actions included activities such as routine maintenance, removal of Class A low-level radioactive waste (LLW) for commercial disposal, replacement of the lag storage area #3 enclosure, continuation of groundwater pump-and-treat system operations, repair of the site's water reservoir emergency spillway, mixed LLW sorting and packaging, construction of a vitrification fabrication support structure, and refurbishment of shield window oil. The first four proposed actions were categorically excluded. The other four were within the scope of existing NEPA documentation and, therefore, did not require further review under NEPA.

Preparation of the draft environmental impact statement for completion of the WVDP (by the DOE) and closure or long-term management of the facilities at the WNYNSC (by NYSERDA) continued in 1996. The draft was distributed for a six-month public review period. The review period began March 22, 1996 and officially closed September 22, 1996. The public comments that were received are currently available for review in the WVDP public reading rooms. The Project's efforts are now focused on resolution of the comments received on the draft environmental impact statement. In addition, a citizen task force has been formed to assist the DOE and NYSERDA in gaining a better understanding of the public's concerns and preferences and to assist in the development of a preferred alternative. Preparation of the final environmental impact statement will begin once a preferred alternative has been identified.

Summary of Permits

The environmental permits that were in effect at the WVDP in 1996 are listed in *Appendix B*, Table B-3 (pp. B-5 through B-9).

Current Issues and Actions

Resource Conservation and Recovery Act

RCRA Facility Investigation

In 1996 the WVDP continued to identify and evaluate SWMUs to ensure compliance with the requirements of the RCRA 3008(h) Administrative Order on Consent. The two remaining draft RFI reports were submitted to both the EPA and NYSDEC. Four of the previously submitted draft reports were finalized during 1996. The current focus of the RFI program is on finalizing the remaining draft RFI reports that have been reviewed by the EPA and NYSDEC.

Clean Water Act

Groundwater Treatment

In November 1995 the WVDP installed a groundwater pump-and-treat system to mitigate the movement of strontium-90 contamination in the groundwater northeast of the process building. Two 15-foot deep recovery wells, installed near the leading edge of the groundwater plume, are designed to collect contaminated groundwater from the underlying sand and gravel unit. The treatment system uses an ion-exchange column to remove strontium-90 from the groundwater and is operated in conjunction with the LLWTF. After the groundwater is treated, it is discharged to lagoons 2, 4, or 5 at the LLWTF. Approximately 16.1 million liters (4.3 million gal) were processed through the system in 1996.

In March 1996 the WVDP submitted to NYSDEC an application for a SPDES permit modification to increase the average flow of effluent from the groundwater pump-and-treat system from approximately 9.8 million liters (2.6 million gal) a year to approximately 39.7 million liters (10.5 million gal) a year. In September 1996 a third recovery well was installed to improve groundwater capture and system performance.

In addition, the Project also evaluated other technologies in 1996 to determine if there were more effective methods for treating the groundwater. From July 1996 to December 1996, laboratory benchscale tests were conducted to determine the effectiveness of using phosphate-based materials to immobilize strontium-90 contamination in samples of soil and groundwater. (Through chemical substitution, the phosphate material bonds in place with metal ions.) The results of these tests are being evaluated.

Storm Water Discharge Permit Application

Precipitation can become contaminated with pollutants from industrial process facilities, stored industrial materials, material handling areas, access roads, or vehicle parking areas. To protect the environment, aquatic resources, and public health, Section 402(p) of the CWA requires that a storm water discharge permit application containing facility-specific information be submitted to the permitting authority. NYSDEC, the permitting authority in New York State, uses this information to ascertain the significance of releases of pollutants from storm water collection and discharge systems and to determine appropriate permitting requirements.

In 1992 the WVDP submitted an application for an individual permit for storm water discharges associated with industrial activity. The application included characteristic analytical results from sampling conducted at three locations in 1991. These monitoring locations not only comprised all storm water discharged from the WVDP but also included base flow for the receiving water at the sample points. NYSDEC requested that the sampling points be moved to locations with no base flow to differentiate the quality of the storm water discharges from the receiving water. In response to the request, thirty-two on-site monitoring points were identified in 1994. CWA regulations allow petitioning to group identical discharges for monitoring and reporting. NYSDEC accepted the WVDP's petition to group several of the discharge points.

As such, eleven storm water outfalls were monitored in 1995. Two samples were collected from each outfall, a first-flush sample collected within roughly the first half-hour of the storm event and a flow-weighted composite collected during the first three hours of the storm event. The storm water samples were analyzed for parameters identified in the existing SPDES permit. In April 1996, the WVDP submitted a new SPDES discharge permit application that identified these outfalls.

Project Assessment Activities in 1996

As the primary contractor for the DOE at the WVDP, WVNS conducted more than sixty-seven reviews of environmentally related activities in 1996. These included one Project appraisal, one self-assessment, and sixty-five surveillances. In addition, five reviews were conducted by external organizations such as NYSDEC and the EPA. Overall results of the reviews reflect continuing, well-managed environmental programs at the WVDP.

Significant external environmental overview activities in 1996 included an inspection by NYSDEC for compliance with the CAA (i.e., to observe the NO_x RATA); inspections by the EPA and NYSDEC for compliance with RCRA; an inspection by NYSDEC for compliance with SPDES requirements; and an annual inspection of the WVDP potable water supply system by the Cattaraugus County Health Department. These inspections did not identify any environmental program findings and further demonstrated the WVDP's commitment to protection of the environment.

Follow-up to the 1994 U.S. Department of Energy Audit

In April 1994 the DOE Idaho Operations Office conducted a comprehensive environmental, safety, health, and quality assurance audit. The audit team evaluated environmental programs, construction safety, fire protection, nuclear safety, emergency preparedness, conduct of operations, radiological controls, industrial hygiene, firearms safety, and transportation programs. The audit identified eleven findings, twenty-three observations, and four concerns. No deficiencies were found that represented conditions or actions posing a threat to public health or the environment.

WVNS responded to the audit items in an action plan, which was submitted to the DOE on September 9, 1994. In 1995 one item relating to this audit remained open. As of May 1996 all of the identified action items were resolved and closed by the DOE.

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ENVIRONMENTAL MONITORING PROGRAM INFORMATION

Introduction

The high-level radioactive waste (HLW) presently stored at the West Valley Demonstration Project (the WVDP or Project) is the byproduct of the reprocessing of spent nuclear fuel conducted during the late 1960s and early 1970s by Nuclear Fuel Services, Inc. (NFS).

Since the Western New York Nuclear Service Center (WNYNSC) is no longer an active nuclear fuel reprocessing facility, the environmental monitoring program focuses on measuring radioactivity and chemicals associated with the residual effects of NFS operations and the Project's high-level waste treatment and low-level waste management operations. The following information about the operations at the WVDP and about radiation and radioactivity will be useful in understanding the activities of the Project and the terms used in reporting the results of environmental testing measurements.

Radiation and Radioactivity

Radioactivity is a process in which unstable atomic nuclei spontaneously disintegrate or "decay" into atomic nuclei of another isotope or element. (See p. 4 in the *Glossary*.) The nuclei continue to decay until only a stable, nonradioactive isotope remains. Depending on the isotope, this process can take anywhere from less than a second to hundreds of thousands of years.

Radiation is the energy released as atomic nuclei decay. By emitting energy the nucleus moves towards a less energetic, more stable state. The energy that is released takes three main forms: alpha particles, beta particles, and gamma rays.

Alpha Particles

An alpha particle, released by decay, is a fragment of a much larger nucleus. It consists of two protons and two neutrons (similar to a helium atom nucleus) and is positively charged. Compared to beta particles, alpha particles are relatively large and heavy and do not travel very far when ejected by a decaying nucleus. Alpha radiation, therefore, is easily stopped by a thin layer of material such as paper or skin. However, if radioactive material is ingested or inhaled, the alpha particles released inside the body can damage soft internal tissues because all of their energy is absorbed by tissue cells in the immediate vicinity of the decay. An example of an alpha-emitting radionuclide is the uranium isotope with an atomic weight of 232 (uranium-232). At the WVDP, uranium-232 is

Ionizing Radiation

Radiation can be damaging if, in colliding with other matter, the alpha or beta particles or gamma rays knock electrons loose from the absorber atoms. This process is called ionization, and the radiation that produces it is referred to as ionizing radiation because it changes a previously electrically neutral atom, in which the positively charged protons and the negatively charged electrons balance each other, into a charged atom called an ion. An ion can be either positively or negatively charged. Various kinds of ionizing radiation produce different degrees of damage.

in the high-level waste mixture and can be detected in liquid waste streams as a result of a thorium-based nuclear fuel reprocessing campaign conducted by NFS.

Beta Particles

A beta particle is an electron that results from the breakdown of a neutron in a radioactive nucleus. Beta particles are small compared to alpha particles, travel at a higher speed (close to the speed of light), and can be stopped by a material such as wood or aluminum less than an inch thick. If beta particles are released inside the body they do much less damage than an equal number of alpha particles. Because they are smaller and faster and have less of a charge, beta particles deposit energy in fewer tissue cells and over a larger volume than alpha particles. Strontium-90, a fission product, is an example of a beta-emitting radionuclide. Strontium-90 is found in the decontaminated supernatant.

Gamma Rays

Gamma rays are high-energy "packets" of electromagnetic radiation, called photons, that are emitted from the nucleus. They are similar to x-rays but generally have a shorter wavelength and therefore are more energetic than x-rays. If the alpha or beta particle released by the decaying nucleus does not carry off all the energy generated by the nuclear disintegration, the excess energy may be emitted as gamma rays. If the released energy is high, a very penetrating gamma ray is produced that can only be effectively reduced by shielding consisting of several inches of a heavy element, such as lead, or of water or concrete several feet thick. Although large amounts of gamma radiation are dangerous, gamma rays are also used in many lifesaving medical procedures. An example of a gamma-emitting radionuclide is barium-137m, a short-lived daughter product of cesium-137. Both barium-137m and cesium-137 are major constituents of the WVDP high-level radioactive waste.

Measurement of Radioactivity

The rate at which radiation is emitted from a disintegrating nucleus can be described by the number of decay events or nuclear transformations that occur in a radioactive material over a fixed period of time. This process of emitting energy, or radioactivity, is measured in curies (Ci) or becquerels (Bq).

The curie is based on the decay rate of the radionuclide radium-226 (Ra-226). One gram of radium-226 decays at the rate of 37 billion nuclear disintegrations per second (3.7×10^{10} d/s), so one curie equals 37 billion nuclear disintegrations per second. One becquerel equals one decay, or disintegration, per second.

Very small amounts of radioactivity are sometimes measured in picocuries. A picocurie is one-tril-

Potential Effects of Radiation

The biological effects of radiation can be either somatic or genetic. Somatic effects are restricted to the person exposed to radiation. For example, sufficiently high exposure to radiation can cause clouding of the lens of the eye or loss of white blood cells.

Radiation also can cause chromosomes to break or rearrange themselves or to join incorrectly with other chromosomes. These changes may produce genetic effects and may show up in future generations. Radiation-produced genetic defects and mutations in offspring of an exposed parent, while not positively identified in humans, have been observed in some animal studies.

The effect of radiation depends on the amount absorbed within a given exposure time. The only observable effect of an instantaneous whole-body dose of 50 rem (0.5 Sv) might be a temporary reduction in white blood cell count. An instantaneous dose of 100-200 rem (1-2 Sv) might cause additional temporary effects such as vomiting but usually would have no long-lasting side effects.

Assessing biological damage from low-level radiation is difficult because other factors can cause the same symptoms as radiation exposure. Moreover, the body apparently is able to repair damage caused by low-level radiation.

The effect most often associated with exposure to relatively high levels of radiation appears to be an increased risk of cancer. However, scientists have not been able to demonstrate with certainty that exposure to low-level radiation causes an increase in injurious biological effects, nor have they been able to determine if there is a level of radiation exposure below which there are no biological effects.

Background Radiation

Background radiation is always present, and everyone is constantly exposed to low levels of such radiation from both naturally occurring and manmade sources. In the United States the average total annual exposure to this low-level background radiation is estimated to be about 360 millirem (mrem) or 3.6 millisieverts (mSv). Most of this radiation, approximately 300 mrem (3 mSv), comes from natural sources. The rest comes from medical procedures, consumer products, and other manmade sources. *(See p. 4-3 in Chapter 4, Radiological Dose Assessment.)*

Background radiation includes cosmic rays, the decay of natural elements such as potassium, uranium, thorium, and radon, and radiation from sources such as chemical fertilizers, smoke detectors, and televisions. Actual doses vary depending on such factors as geographic location, building ventilation, and personal health and habits.

lionth (10^{-12}) of a curie, equal to $3.7x10^{-2}$ disintegrations per second, or 2.22 disintegrations per minute.

Measurement of Dose

The amount of energy absorbed by the receiving material is measured in rads (radiation absorbed dose). A rad is 100 ergs of radiation energy absorbed per gram of material. (An erg is the amount of energy necessary to lift a mosquito about one-sixteenth of an inch.) "Dose" is a means of expressing the amount of energy absorbed, taking into account the effects of different kinds of radiation. Alpha, beta, and gamma radiation affect the body to different degrees. Each type of radiation is given a quality factor that indicates the extent of human cell damage it can cause compared with equal amounts of other ionizing radiation energy. Alpha particles cause twenty times as much damage to internal tissues as x-rays, so alpha radiation has a quality factor of 20 compared to gamma rays, x-rays, or beta particles, which have a quality factor of 1.

The unit of dose measurement to humans is the rem (roentgen-equivalent-man). Rems are equal to the number of rads multiplied by the quality factor for each type of radiation. Dose can also be expressed in sieverts. One sievert equals 100 rem.

Environmental Monitoring Program Overview

Human beings may be exposed to radioactivity primarily through air, water, and food. At the WVDP all three pathways are monitored, but air and surface water pathways are the two primary means by which radioactive material can move off-site.

The geology of the site (kinds and structures of rock and soil), the hydrology (location and flow of surface and underground water), and meteorological characteristics of the site (wind speed, patterns, and direction) are all considered in evaluating potential exposure through the major pathways.

The on-site and off-site monitoring program at the WVDP includes measuring the concentration of alpha and beta radioactivity, conventionally referred to as "gross alpha" and "gross beta," in air and water effluents. Measuring the total alpha and beta radioactivity from key locations, which can be done within a matter of hours, produces a comprehensive picture of on-site and off-site levels of radioactivity from all sources. In a facility such as the WVDP, frequent updating and tracking of the overall levels of radioactivity in effluents is an important tool in maintaining acceptable operations.

More detailed measurements are also made for specific radionuclides. Strontium-90 and cesium-137 are measured because they are normally present in WVDP waste streams. Radiation from other important radionuclides such as tritium or iodine-129 are not sufficiently energetic to be detected by gross measurement techniques, so these must be analyzed separately using methods with greater sensitivity. Heavy elements such as uranium, plutonium, and americium require special analysis to be measured because they exist in such small concentrations in the WVDP environs.

The radionuclides monitored at the Project are those that might produce relatively higher doses or that are most abundant in air and water effluents. Because manmade sources of radiation at the Project have been decaying for more than twenty years, the monitoring program does not routinely include short-lived radionuclides, i.e., isotopes with a half-life of less than two years, which would have only 1/1,000 of the original radioactivity remaining. (See *Appendix A* [pp. A-1 through A-44] for the schedule of samples and radionuclides measured and *Appendix B*, Table B-1 [p. B-3] for related Department of Energy [DOE] protection standards, i.e., derived concentration guides

[DCGs] and half-lives of radionuclides measured in WVDP samples.)

Data Reporting

Because the decay of radioactive atoms is a random process, there is an inherent uncertainty associated with all environmental radioactivity measurements. This can be demonstrated by repeatedly measuring the number of atoms that decay in a radioactive sample over some fixed period of time. The result of such an experiment would be a range of values for which the average value would provide the best indication of how many radioactive atoms were present in the sample.

However, in actual practice a sample of the environment usually is measured for radioactivity just once, not many times. The inherent uncertainty of the measurement, then, stems from the fact that it cannot be known whether the result that was obtained from one measurement is higher or lower than the "true" value, i.e., the average value that would be obtained if many measurements had been taken.

The term *confidence interval* is used to describe the range of measurement values above and below the test result within which the "true" value is expected to lie. This interval is derived mathematically. The width of the interval is based primarily on a predetermined *confidence level*, i.e., the probability that the *confidence interval* actually encompasses the "true" value (the average value that would be obtained if many measurements were taken). The WVDP environmental monitoring program uses a 95% *confidence level* for all radioactivity measurements and calculates *confidence intervals* accordingly.

The confidence interval around a measured value is indicated by the plus-or-minus (±) value following the result (e.g., 5.30 ± 3.6E-09 μCi/mL, with the exponent of 10^{-9} expressed as "E-09." Expressed in decimal form, the number would be 0.0000000053 ± 0.0000000036 μCi/mL). A sample measurement expressed this way is correctly interpreted to mean "there is a 95% probability that the concentration of radioactivity in this sample is between 1.7E-09 μCi/mL and 8.9E-09 μCi/mL."

If the confidence interval for the measured value includes zero (e.g., 5.30 ± 6.5E-09 μCi/mL), the value is considered to be below the detection limit. The values listed in tables of radioactivity measurements in the appendices include the confidence interval regardless of the detection limit value.

In general, the detection limit is the minimum amount of constituent or material of interest detected by an instrument or method that can be distinguished from background and instrument noise. Thus, the detection limit is the lowest value at which a sample result shows a statistically positive difference from a sample in which no constituent is present.

Chemical data are expressed by the detection limit prefaced by a "<" if that analyte was not measurable. (See also **Data Reporting** [p. 5-7] in *Chapter 5, Quality Assurance*.)

1996 Changes in the Environmental Monitoring Program

Changes in the 1996 environmental monitoring program enhanced the environmental sampling and surveillance network in order to support current activities and to prepare for future activities.

• The vitrification heating, ventilation, and air conditioning (HVAC) stack monitoring and sampling systems were brought on-line in November 1995. The actual volumetric discharge rate was verified in February 1996. Final isokinetic sampling system specifications were prepared in February also, and the equipment was installed in March 1996. The vitrification system began radioactive operations with the first transfer of high-level waste in June 1996, followed by the start of vitrification in July 1996.

• A permanent air-emission monitoring and sampling system for the container sorting and packaging facility (CSPF) emissions stack was installed.

• The groundwater monitoring program was reviewed. The number of monitoring points was reduced and the sampling frequency and the analytes measured were tailored to address site-wide monitoring parameters as well as constituents of concern specific to super solid waste management units (SSWMUs).

Appendix A (pp. A-i through A-53) summarizes the program changes and lists the sample points and parameters measured in 1996.

Vitrification Overview

High-level radioactive waste from NFS operations was originally stored in two of four underground tanks (tanks 8D-2 and 8D-4). The waste in 8D-2, the larger of the active tanks, had settled into two layers: a liquid — the supernatant — and a precipitate layer on the tank bottom — the sludge.

To solidify the high-level waste, WVDP engineers designed and developed a process of pretreatment and vitrification.

Pretreatment Accomplishments

The supernatant (in tank 8D-2) was composed mostly of sodium and potassium salts dissolved in water. Radioactive cesium in solution accounted for more than 99% of the total radioactivity in the supernatant. During pretreatment, sodium salts and sulfates were separated from the radioactive constituents in both the liquid portion of the high-level waste and the sludge layer in the bottom of the tank.

Derived Concentration Guides

A derived concentration guide (DCG) is defined by the DOE as the concentration of a radionuclide in air or water that, under conditions of continuous exposure by one exposure mode (i.e., ingestion of water, submersion in air, or inhalation), for one year, would result in an effective dose equivalent of 100 mrem (1 mSv) to a "reference man." These concentrations — DCGs — are considered screening levels that enable site personnel to review effluent and environmental data and to decide if further investigation is needed. (See Table B-1, Appendix B, p. B-3 for a list of DCGs.)

DOE Orders require that the hypothetical dose to the public from facility effluents be estimated using specific computer codes. (See Dose Assessment Methodology [p. 4-6] in Chapter 4, Radiological Dose Assessment.) Doses estimated for WVDP activities are calculated using actual site data and are not related directly to DCG values.

Dose estimates are based on a sum of isotope quantities released and the dose equivalent effects for that isotope. For liquid effluent screening purposes, percentages of the DCGs for all radionuclides present are added: if the total percentage of the DCGs is less than 100, then the effluent released complies with the DOE guideline.

Although the DOE provides DCGs for airborne radionuclides, the more stringent U.S. Environmental Protection Agency (EPA) National Emissions Standards for Hazardous Air Pollutants (NESHAP) apply to Project airborne effluents. As a convenient reference point, comparisons with DCGs are made throughout this report for both air and water samples.

Pretreatment of the supernatant began in 1988. A four-part process, the integrated radwaste treatment system (IRTS), reduced the volume of the high-level waste needing vitrification by producing low-level waste stabilized in cement.

The supernatant was passed through zeolite-filled ion exchange columns in the supernatant treatment system (STS) to remove more than 99.9% of the radioactive cesium.

The resulting liquid was then concentrated by evaporation in the liquid waste treatment system (LWTS).

This low-level radioactive concentrate was blended with cement in the cement solidification system (CSS) and placed in 269-liter (71-gal) steel drums. This cement-stabilized waste form has been accepted by the U.S. Nuclear Regulatory Commission (NRC).

Finally, the steel drums were stored in an on-site aboveground vault, the drum cell.

Processing of the supernatant was completed in 1990, with more than 10,000 drums of cemented waste produced.

The sludge that remained was composed mostly of iron hydroxide. Strontium-90 accounted for most of the radioactivity in the sludge.

Pretreatment of the sludge layer in high-level waste tank 8D-2 began in 1991. Five specially designed 50-foot-long pumps were installed in the tank to mix the sludge layer with water in order to produce a uniform sludge blend and to dissolve the sodium salts and sulfates that would interfere with vitrification. After mixing and allowing the sludge to settle, processing of the wash water through the integrated radwaste treatment system began. Processing removed radioactive constituents for later solidification into glass, and the wash water containing salts was then stabilized in cement.

Sludge washing was completed in 1994 after approximately 765,000 gallons of wash water had been processed. About 8,000 drums of cement-stabilized wash water were produced.

In January 1995, high-level waste liquid stored in tank 8D-4 was transferred to tank 8D-2. (Tank 8D-4 contained THOREX high-level radioactive waste. This waste had been produced by a single reprocessing campaign of a special fuel containing thorium that had been conducted by the previous facility operators from November 1968 to January 1969.) The resulting mixture was washed and the wash water was processed. The IRTS processing of the combined wash waters was completed in May 1995.

In all, through the supernatant treatment process and the sludge wash process, more than 1.7 million gallons of liquid had been processed by the end of 1995, producing a total of 19,877 drums of cemented low-level waste.

As one of the final steps, the ion-exchange material (zeolite) used in the integrated radwaste treatment system to remove radioactivity was blended with the washed sludge before being transferred to the vitrification facility for blending with the glass-formers. In 1995 and early 1996 final waste transfers to high-level waste tank 8D-2 were completed in preparation for vitrification.

Preparation for Vitrification

Nonradioactive testing of a full-scale vitrification system was conducted from 1984 to 1989. In 1990 all vitrification equipment was removed to allow installation of shield walls for fully remote radioactive operations. The walls and shielded tunnel connecting the vitrification facility to the former reprocessing plant were completed in 1991.

The slurry-fed ceramic melter was fully assembled, bricked, and installed in 1993. In addition, the cold chemical building was completed, as was the sludge mobilization system that transfers high-level waste to the melter. This system was fully tested in 1994. A number of additional major systems components also were installed in 1994: the canister turntable, which positions the stainless steel canisters as they are filled with molten glass; the submerged bed scrubber, which cleans gases produced by the vitrification process; and the transfer cart, which moves filled canisters to the storage area.

Nonradiological testing ("cold" operations) of the vitrification facility began in 1995, and the first canister of nonradiological glass was produced. The WVDP declared its readiness to proceed with the necessary equipment tie-ins of the ventilation and utility systems to the vitrification facility building and tie-ins of the transfer lines to and from the high-level waste tank farm and the vitrification facility. In this closed-loop system, the transfer lines connect to multiple common lines so that material can be moved among all the points in the system.

1996 Activities at the WVDP

Vitrification

Solidification of the high-level waste in glass began in 1996. The high-level waste mixture of washed sludge and spent zeolite from the ion-exchange process is combined in batches with glass-forming chemicals and then fed to a ceramic melter. The waste mixture is heated to approximately 2,000°F and poured into stainless steel canisters. Approximately 300 stainless steel canisters will be needed to hold all of the vitrified waste. Each canister, 10 feet long by 2 feet in diameter, is filled with a uniform, high-level waste glass that will be suitable for eventual shipment to a federal repository.

At the end of 1996, 2,294,151 curies of radioactivity had been transferred to the vitrification facility and fifty-nine waste canisters had been filled.

Environmental Management

Aqueous Radioactive Waste

Water containing radioactive material from site process operations is collected and treated in the low-level liquid waste treatment facility (LLWTF). (Water from the sanitary system, which does not contain added radioactive material, is managed in a separate system.)

The treated process water is held, sampled, and analyzed before it is released through a State Pollutant Discharge Elimination System (SPDES)-permitted outfall. In 1996, 50.6 million liters (13.4 million gal) of water were treated in the LLWTF and released through the lagoon 3 weir.

The discharge waters contained an estimated 34 millicuries of gross alpha plus gross beta radioactivity. Comparable releases during the previous eleven years averaged about 42 millicuries per year. The 1996 release was about 81% of this average. (See **Radiological Monitoring,** *Low-level Waste Treatment Facility Sampling Location* [p. 2-2] in *Chapter 2, Environmental Monitoring*.)

Approximately 0.75 curies of tritium were released in WVDP liquid effluents in 1996. This is 43% of the eleven-year average of 1.74 curies.

Unplanned Radiological Releases

Two unplanned radiological releases were evaluated at the WVDP in 1996. On August 2, 1996, during a facility walkthrough in the north fuel receiving and storage area yard, water was observed dripping from an out-of-service cooling tower. Actions were immediately taken to stop and prevent the release from occurring.

Analysis of a sample of the released water identified cobalt-60, americium-241, and cesium-137 at levels above their respective DCGs. It was estimated that one to five gallons had been released to the ground surface. No standing water was observed. This event was categorized as an off-normal occurrence and an Occurrence Report was prepared. Since no personnel came in contact with the released water, no dose was attributed to this release. This relatively minor spill occurred within a previously contaminated controlled-access facility area.

On July 30, 1996 a drainage line, which was used to transfer groundwater from the containment pan under one of the high-level waste tanks to the LLWTF, failed a tightness test. Conservative estimates indicated that if the line had actually leaked during a transfer, a release of less than approximately 600 gallons of slightly radioactively contaminated water to the ground would have occurred. An evaluation of this incident found that the release would have been below the reportable quantity. The line was taken out of service immediately. Groundwater monitoring results in the vicinity of the main plant and the waste tank farm were evaluated as a check, and no adverse effects on the environment were noted.

No other unplanned releases occurred on-site during 1996. There were no unplanned releases in 1996 from the Project to the off-site environment.

Airborne Radioactive Emissions

Air used to ventilate the facilities where radioactive material cleanup processes are operated is passed through filtration devices before being emitted to the atmosphere.

Ventilated air from the various points in the IRTS process (high-level waste sludge treatment, main plant and liquid waste treatment system, and the cement solidification system) and from other waste management activities centered in the main plant building is sampled continuously during operation. In addition to monitors that alarm if radioactivity increases above preset levels, the sample media are analyzed in the laboratory for the specific radionuclides that are present in the radioactive materials being handled.

Air emissions in 1996, primarily from the main plant ventilation, contained an estimated 0.1 millicuries of gross alpha plus gross beta radioactivity. This compares to an estimated 0.3 millicuries of combined gross alpha and beta activity released in air emissions in 1995. (See *Chapter 2, Environmental Monitoring* [p. 2-14 through 2-17], for more detail.)

Approximately 0.053 curies of tritium (as hydrogen tritium oxide [HTO]) were released in facility air emissions in 1996. This compares with 0.036 curies in 1995 and 0.032 curies in 1994.

Waste Minimization Program

The WVDP formalized a waste minimization program in 1991 to reduce the generation of low-level waste, mixed waste, and hazardous waste. Industrial waste and sanitary waste reduction goals were added in 1994. By using source reduction, recycling, and other techniques, waste in all of these categories has been greatly reduced. In 1996, the sixth year of the program, reductions in all categories exceeded the 1996 reduction goals by as much as 65%. (For more details see the *Environmental Compliance Summary: Calendar Year 1996* [p.xlix].)

Pollution Prevention Awareness Program

The WVDP's pollution prevention awareness program is a significant part of the Project's overall waste minimization program. The program includes hazard communication training and new-employee orientation that provides information about the WVDP's Industrial Hygiene and Safety Manual, environmental pollution control procedures, and the Hazardous Waste Management Plan.

The WVDP's goal is to make all employees aware of the importance of pollution prevention both at work and at home.

Waste Management

Low-level radioactive waste has been stored at the WVDP inside structures in order to contain potential releases and to prevent exposure of the waste containers to the weather. On January 27, 1996, unusually high winds with gusts in excess of 60 mph damaged the fabric cover of the lag storage area (LSA) # 3 tent structure. This waste storage facility housed approximately 1,800 weathertight metal boxes in which radioactively contaminated materials are stored. The materials are being held temporarily in LSA # 3 while awaiting final disposition. No radioactive contamination was released, and a metal building that replaced the fabric structure was erected on the existing concrete pad.

Vessels, piping, and processing equipment removed from the chemical process cell in the main plant were relocated to the chemical process cell waste storage area (CPCWSA). The original fabric-covered tent structure had reached its expected useful life and was replaced in 1996 with a steel structure. The new structure was built in pieces and the tent was partially dismantled as the new building parts were put into place. No radioactive contamination was released as a result of the replacement.

National Environmental Policy Act Activities

Under the National Environmental Policy Act (NEPA), the Department of Energy is required to consider the overall environmental effects of its proposed actions or federal projects.The President's Council on Environmental Quality established a screening system of analyses and documentation that requires each proposed action to be categorized according to the extent of its potential environmental effect. The levels of documentation include categorical exclusions (CXs), environmental assessments (EAs), and environmental impact statements (EISs).

Categorical exclusions evaluate and document actions that will not have a significant effect on the environment. Environmental assessments evaluate the extent to which the proposed action will affect the environment. If a proposed action has the potential for significant effects, an environmental impact statement is prepared that describes proposed alternatives to an action and explains the effects.

NEPA activities at the WVDP involve facility maintenance and minor projects that support high-level waste vitrification. These projects are documented and submitted for approval as categorical exclusions, although environmental assessments are occasionally necessary. (See the *Environmental Compliance Summary: Calendar Year 1996* [p. lvii] for a discussion of specific NEPA activities in 1996.)

In December 1988 the DOE published a Notice of Intent to prepare an environmental impact statement for the completion of the WVDP and closure of the facilities at the WNYNSC. The environmental impact statement describes the potential environmental effects associated with Project completion and various site closure alternatives. The draft environmental impact statement was completed in 1996 and released for public review and comment from March through September. More than 110 individuals, agencies, and organizations submitted comments on the draft environmental impact statement.

Self-Assessments

Self-assessments continued to be conducted in 1996 to review the management and effectiveness of the WVDP environmental protection and monitoring programs. Results of these self-assessments are evaluated and corrective actions are tracked through completion. Overall results of these self-assessments found that the WVDP continued to implement and in some cases improve the quality of the environmental protection and monitoring program. (For more details see the *Environmental Compliance Summary: Calendar Year 1996* [p. lix].)

Occupational Safety and Environmental Training

The occupational safety of personnel who are involved in industrial operations is protected by standards promulgated under the Occupational Safety and Health Act (OSHA). This act governs diverse occupational hazards ranging from electrical safety and protection from fire to the handling of hazardous materials. The purpose of OSHA is to maintain a safe and healthy working environment for employees.

Hazardous Waste Operations and Emergency Response regulations require that employees at treatment, storage, and disposal facilities, who may be exposed to health and safety hazards during hazardous waste operations, receive training appropriate to their job function and responsibilities. The WVDP Environmental, Health, and Safety training matrix identifies the specific training requirements for affected employees.

The WVDP provides the standard twenty-four-hour hazardous waste operations and emergency response training. (Emergency response training includes spill response measures and controlling contamination of groundwater.) Training programs also contain information on waste minimization and pollution prevention. Besides this standard training, employees working in radiological areas receive additional training on subjects such as understanding radiation and radiation warning signs, dosimetry, and respiratory protection. In addition, qualification standards for specific job functions at the site are required and maintained. These programs have evolved into a comprehensive curriculum of knowledge and skills necessary to maintain the health and safety of employees and ensure the continued compliance of the WVDP.

The WVDP maintains a hazardous materials response team that is trained to respond to spills of hazardous materials. This team maintains its proficiency through classroom instruction and scheduled training drills.

Any person working at the WVDP who has a picture badge receives general employee training covering health and safety, emergency response, and environmental compliance issues. All visitors to the WVDP also receive a site-specific briefing on safety and emergency procedures before being admitted to the site.

Performance Measures

Performance measures can be used to evaluate effectiveness, efficiency, quality, timeliness, productivity, safety, or other areas that reflect achievements related to an organization's or process' goals. Performance measures can be used as a tool to identify the need to institute changes.

Several performance measures applicable to operations conducted at the WVDP are discussed below. These measures reflect process performance related to wastewater treatment in the low-level liquid waste treatment facility, the identification of spills and releases, the reduction in the generation of wastes, the potential radiological dose received by the maximally exposed off-site individual, and the transfer of high-level waste to the vitrification system.

Radiation Doses to the Maximally Exposed Off-Site Individual

Some of the most important information derived from environmental monitoring program data is the potential radiological dose to an off-site individual from on-site activities. As an overall assessment of Project activities and the effectiveness of the as-low-as-reasonably achievable (ALARA) concept, the effective radio-

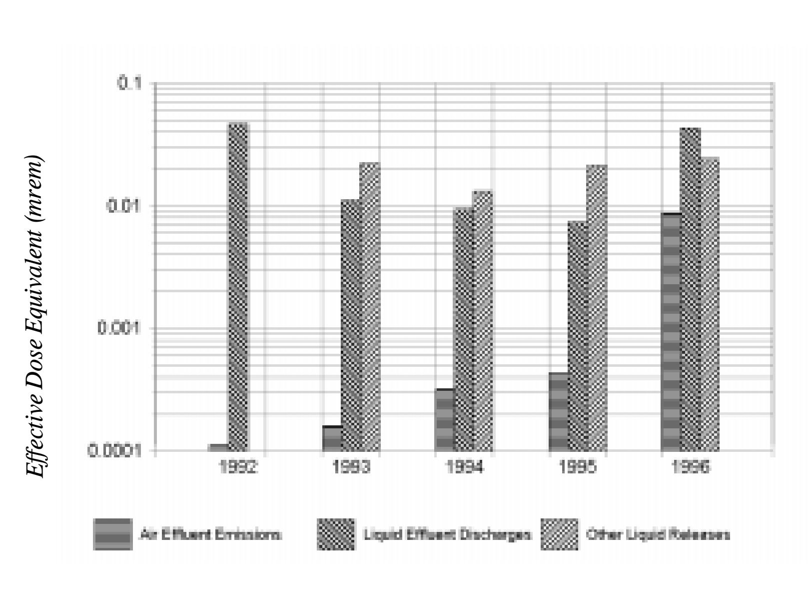


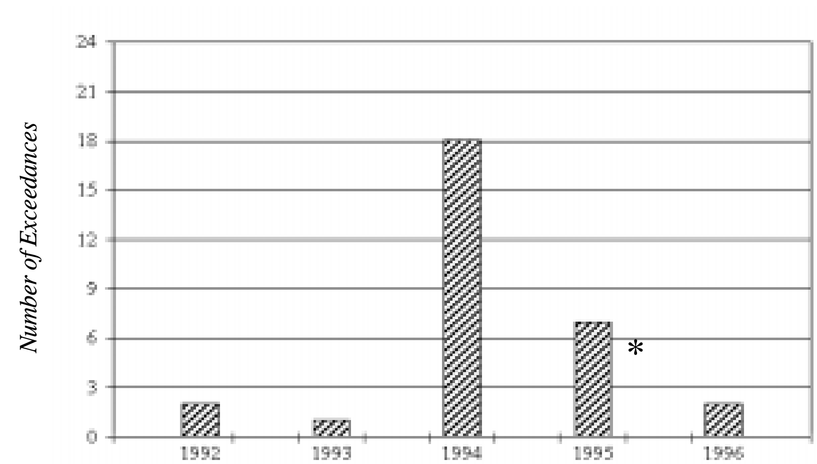
Figure 1-1. Annual Effective Dose Equivalent to the Maximally Exposed Off-site Individual

logical dose to the maximally exposed off-site individual provides an indicator of well-managed radiological operations. The effective dose equivalent for air effluent emissions, liquid effluent discharges, and other liquid releases (such as swamp drainage)from 1992 through 1996 are graphed in Figure 1-1. Note that these values are well below the DOE standard of 100 mrem. These consistently low results indicate that radiological activities at the site are well-controlled. (See also Table 4-2 [p.4-7] in *Chapter 4, Radiological Dose Assessments*.)

SPDES Permit Limit Exceedances

Effective operation of the site wastewater treatment facilities is indicated by compliance with the applicable discharge permit limitations. Approximately sixty parameters are monitored regularly as part of the SPDES permit requirements. The analytical results are reported to the state via Discharge Monitoring Reports required under the SPDES program. The goal of LLWTF and wastewater treatment facility (WWTF) operations is to operate those facilities such that effluent water quality is consistently within the permit requirements.

SPDES permit limit exceedances do occur periodically. A graph of the number of SPDES permit limit exceedances occurring in each calendar year from 1992 through 1996 is shown in Figure 1-2. Although exceedances are not always related to operating deficiencies, they still can indicate the need to institute changes. All SPDES permit limit exceedances are evaluated to determine their cause and to identify potential corrective measures, including improved operation or treatment techniques.



**One exceedance was added to the 1995 reported value to include two 1995 BOD-5 interrelated exceedances.*

Figure 1-2. SPDES Permit Exceedances by Year

Waste Minimization and Pollution Prevention

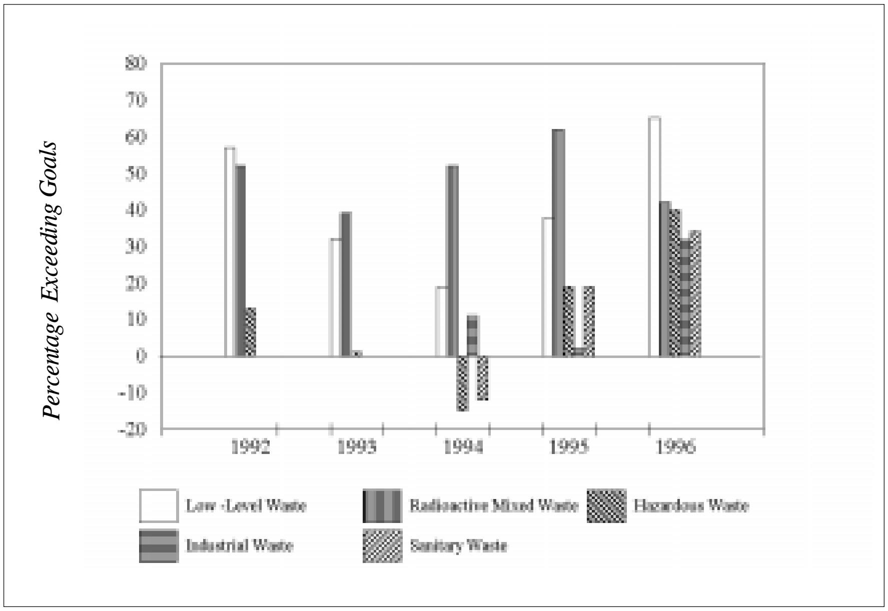


Figure 1-3. Waste Reduction Percentage Exceeding Goals

The WVDP has initiated a program to reduce the quantities of waste generated from site activities. Reductions in the generation of low-level radioactive waste, radioactive mixed waste, hazardous waste, industrial wastes, and sanitary wastes (rubbish) were targeted. To demonstrate the effectiveness of the waste minimization program, a graph of the percentage of waste reduction achieved above the annual goal for each category is presented in Figure 1-3 for calendar years 1992 through 1996. Not all waste streams have been tracked over this period. Note that the low-level radioactive waste figures from 1993 through 1995 include the volume of drummed waste produced in the cement solidification system. The hazardous waste quantity for 1994 also includes 1,891 kilograms (about 4,170 lbs) of waste produced in preparing for vitrification.

Spills and Releases

Chemical spills greater than the applicable reportable quantity must be reported immediately to NYSDEC and the National Response Center and other agencies as required. Petroleum spills greater than 5 gallons must be reported within two hours to NYSDEC. Spills of any amount that travel to waters of the state must be reported immediately to the NYSDEC spill hotline and entered in the monthly log. There were two spills of diesel fuel immediately reportable to NYSDEC in 1996. Neither of these spills resulted in any adverse environmental effect. (See the *Environmental Compliance Summary: Calendar Year 1996*, p. lv). Figure 1-4 is a bar graph of immediately reportable spills from 1992 to 1996.

Prevention is the best means of protection against oil and chemical spills or releases. WVDP em-

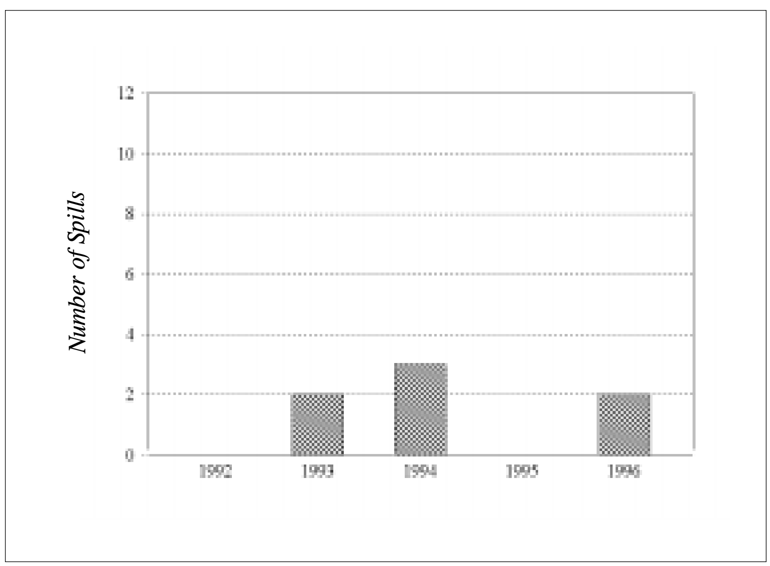


Figure 1-4. Number of Immediately Reportable Spills and Releases

ployees are trained in applicable standard operating procedures for equipment that they use, and best management practices have been developed that identify potential spill sources and present measures to reduce the potential for releases to occur. Spill training, notification, and reporting policies have also been developed to emphasize the responsibility of each employee to report spills. This first-line reporting helps to ensure that spills will be properly documented and mitigated in accordance with applicable regulations.

Vitrification

The primary objective of the West Valley Demonstration Project is to safely solidify the high-level radioactive waste at the site in borosilicate glass. To do this, the high-level waste sludge is transferred in batches from the tank where it currently is stored to the vitrification facility. After transfer, the waste is solidified into a durable glass for safe storage and future transport to a federal repository. It is estimated that 12 million curies of strontium and cesium radioactivity in the high-level waste eventually will be vitrified. (Radioactive cesium and strontium isotopes account for 98% of the long-lived radioactivity.) To quantify the progress made toward completing the vitrification goal, Figure 1-5 shows the number of curies transferred per month to the vitrification facility since start-up in June 1996. Vitrification is projected to be completed by 1999.

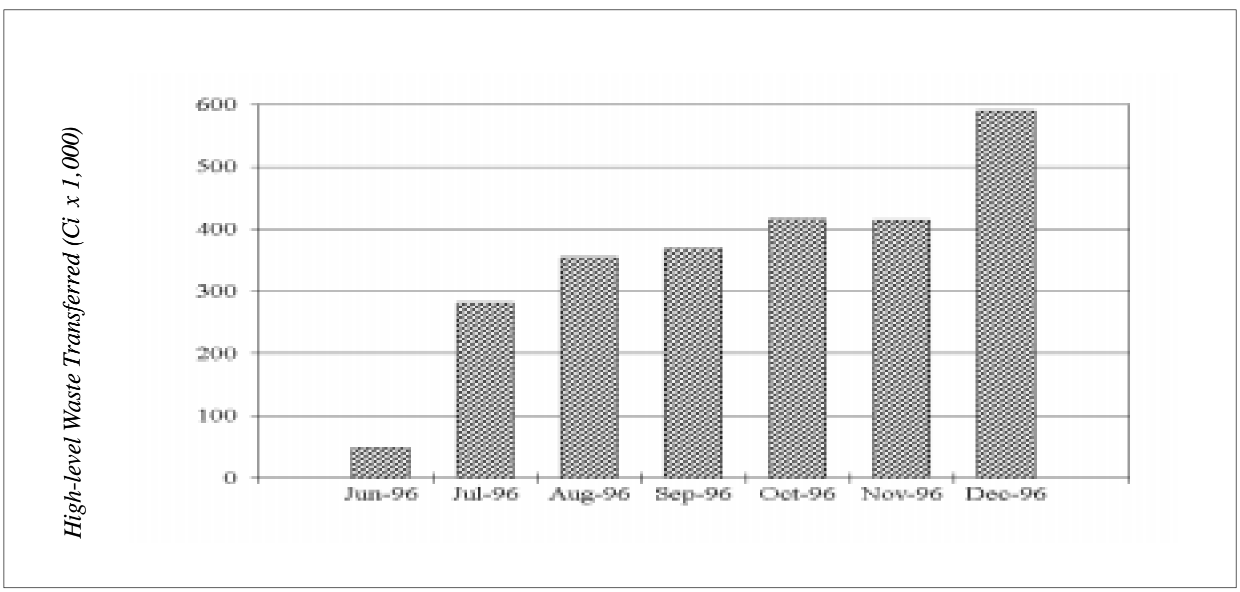


Figure 1-5. Number of Curies Transferred per Month to the Vitrification Facility

ENVIRONMENTAL MONITORING

Pathway Monitoring

The effluent and environmental monitoring program provides data on surface waters, soils, sediments, food and produce, and on the effluent air and liquids that could provide pathways for the movement of radionuclides or hazardous substances from the WVDP to the public. Both radiological and nonradiological parameters are monitored in order to ascertain the effect of Project activities.

Stream sediments are sampled upstream and downstream of the West Valley Demonstration Project (WVDP). The food pathway is monitored by collecting samples of beef, hay, milk, and produce at both near-site and remote locations, samples of fish upstream and downstream of the site, and venison samples from the on-site deer herd and from background locations. Direct radiation on-site, at the perimeter of the site, in communities near the site, and at background locations is also monitored to provide additional data.

The radionuclides present at the WVDP site are residues from the reprocessing of commercial nuclear fuel during the 1960s and early 1970s. A very small fraction of these radionuclides is released off-site during the year through ventilation systems and liquid discharges and makes a negligible contribution to the radiation dose to the surrounding population through a variety of exposure pathways. (See Chapter 4, Table 4-2.)

The primary focus of the monitoring program, however, is on air and water pathways, as these are the primary means of transport of radionuclides from the site.

Air and Water Pathways

Air and liquid effluents are monitored on-site by collecting samples at locations where radioactivity or other regulated substances are released or might be released. These include plant ventilation stacks and water effluent outfalls.

Surface water samples are collected from the tributaries of Cattaraugus Creek that flow through the Western New York Nuclear Service Center (WNYNSC) and from drainage channels within the Project site.

Both air and water samples are collected at site perimeter locations where the highest off-site concentrations of transported radionuclides might be expected. Samples are also collected at remote locations to provide background concentration data.

Sampling Codes

The complete environmental monitoring schedule and maps are located in *Appendix A* (pp. A-i through A-53). This schedule provides information on monitoring and reporting requirements and the types and extent of sampling and monitoring at each location. An explanation of the codes that identify the sample medium and the specific sampling or monitoring location is also found in *Appendix A* (p. A-iii). For example, a sample location code such as AFGRVAL indicates an air sample (A), off-site (F), at the Great Valley (GRVAL) sampling station. These codes are used throughout this report for ease of reference and to be consistent with the data reported in the appendices.

Air Sampler Location and Operation

Air samplers are located at points remote from the WVDP, at the perimeter of the site, and on the site itself. Figure 2-1 (p. 2-4) shows the locations of the on-site air effluent monitors and samplers and the on-site ambient air samplers; Figure 2-2 (p. 2-5) and Figure A-9 in *Appendix A* (p. A-53) show the locations of the perimeter and remote air samplers, respectively.

Air samples are collected by drawing air through a very fine filter with a vacuum pump. The total volume of air drawn through the filter is measured and recorded. The filter traps particles of dust that are then tested in the laboratory for radioactivity. At the Rock Springs Road, Great Valley, and New York State-licensed disposal area (SDA) ambient air locations samples are also collected for iodine-129 and tritium analyses. (A more detailed description of the air sampling program follows below.)

Water Sampler Location and Operation

Automatic samplers collect surface water at points along drainage channels within the WNYNSC that are most likely to show any radioactivity released from the site and at a background station upstream of the site. (Grab samples are collected at several other surface water locations both on- and off-site.) Figure 2-3 (p. 2-6) shows the location of the on-site surface water monitoring points. (On-site automatic samplers operate at locations WNSP006, WNNDADR, WNSW74A, and WNSWAMP.) Figure 2-4 (p. 2-7) shows the location of the off-site automatic surface water monitoring points. (Off-site locations are WFBCTCB, WFFELBR, and the background location, WFBCBKG.)

Water samplers draw water through a tube extending to an intake below the stream surface. An electronically controlled battery-powered pump first blows air through the sample line to clear any residual water or debris. The pump then reverses to collect a sample, reverses again to clear the line, then resets for the next sampling event. The cycle is repeated after a preset interval. The pump and sample container are housed in an insulated and heated shed to allow sampling throughout the year. (A more detailed description of the water sampling program follows below.)

Radiological Monitoring

Surface Water and Sediment Monitoring

On-site Surface Water Sampling

A map of on-site surface water sampling locations is found on Figure 2-3 (p. 2-6).

Low-level Waste Treatment Facility Sampling Location

The largest single source of radioactivity released to surface waters from the Project is the discharge from the low-level waste treatment facility through the lagoon 3 weir (WNSP001 on Fig. 2-3 [p. 2-6]) into Erdman Brook, a tributary of Frank's Creek. There were seven batch releases totaling about 50.6 million liters (13.4 million gal) in 1996. In addition to composite samples collected near the beginning and end of each discharge, a total of fifty-five effluent grab samples, one for each day of discharge, were collected and analyzed.

The total amounts of radioactivity from specific radionuclides in the lagoon 3 effluent are listed in *Appendix C-1*, Table C-1.1 (p. C1-3). The observed annual average concentration of each radionuclide released is divided by its corresponding Department of Energy derived concentration guide (DCG) in order to determine what percentage of the DCG was released. (DOE standards and DCGs for radionuclides of interest at the WVDP are found in *Appendix B* [p. B-3].) As a DOE policy, the sum of the percentages calculated for all radionuclides released should not exceed 100%. In 1996 the annual average isotopic concentrations from the lagoon 3 effluent discharge weir combined to be approximately 35% of the DCGs, compared to about 43% in 1995. (See *Appendix C-1,* Table C-1.2 [p. C1-4].)

Variations in liquid effluent isotopic ratios continued to reflect the dynamic nature of the waste streams being processed through the low-level waste treatment facility (LLWTF) and of the process itself.

Frank's Creek Sampling Location

A water sampling station (WNSP006) is located on Frank's Creek where Project site drainage leaves the security-fenced area, more than 4.0 kilometers (2.5 mi.) from the nearest public access point. (See Fig. 2-3 [p. 2-6].) This sampler collects a 50-mL aliquot (a small volume of water) every half-hour. Samples are retrieved weekly and composited both monthly and quarterly. (Data are found in Table C-1.4 [p. C1-6].) Weekly samples are analyzed for tritium and gross alpha and beta radioactivity as well as pH and conductivity. The monthly composite is analyzed for strontium-90 and gamma-emitting isotopes. (See *Glossary*, "gamma isotopic.") A quarterly composite is analyzed for carbon-14, iodine-129, technetium-99, alpha-emitting radionuclides, and total uranium.

The most significant beta-emitting radionuclides at WNSP006 were cesium-137 at 3.48E-08 μCi/mL (1.29 Bq/L) and strontium-90 at 3.61E-08 μCi/mL (1.34 Bq/L) during the months of highest concentration. This corresponds to less than 1.2% of the DCG for cesium-137 and 3.6% of the DCG for strontium-90. The annual average concentration of cesium-137 at WNSP006 was less than 0.5% of the DCG, and the strontium-90 concentration was 2.2% of the strontium-90 DCG. Tritium, at an annual average of 8.17E-07 μCi/mL (3.05E+01 Bq/L), was 0.04% of the DCG value. The annual gross alpha average was less than 1.26E-09 μCi/mL (4.66E-02 Bq/L), or less than 4.2% of the DCG for americium-241. The 1996 data are comparable to 1995 data.

The ten-year trends of gross alpha, gross beta, and tritium concentrations at location WNSP006 are shown on Figure 2-5 (p. 2-8).The long-term trend plot for WNSP006 is dominated by fluctuations related to treated WVDP liquid effluent discharges into the creek. Concentrations observed farther downstream at the Felton Bridge sampling location, the first point of public access to surface waters leaving the WVDP site, continue to be nearly indistinguishable from background.

North Swamp and Northeast Swamp Sampling Locations

The north and northeast swamp drainages on the site's north plateau are two major channels collecting surface water and emergent groundwater. Samples from the north swamp drainage at location WNSW74A and from the northeast swamp drainage at sampling point WNSWAMP are collected from the automated sampler every week. (See Fig. 2-3 [p. 2-6].) Samples from both locations are analyzed weekly for gross alpha, gross beta, tritium, pH, and conductivity. Composites

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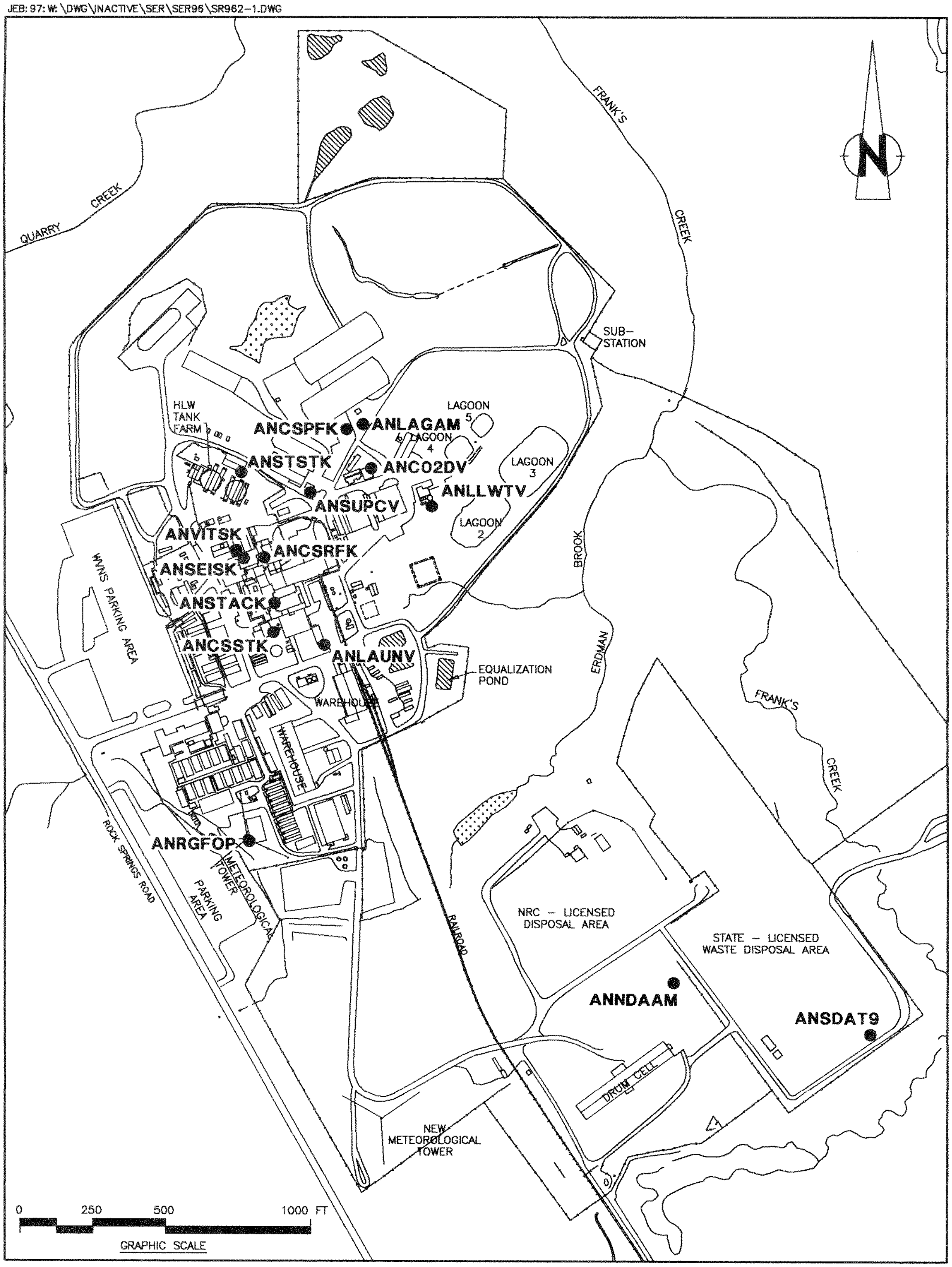

Figure 2-1. On-site Air Monitoring and Sampling Points.

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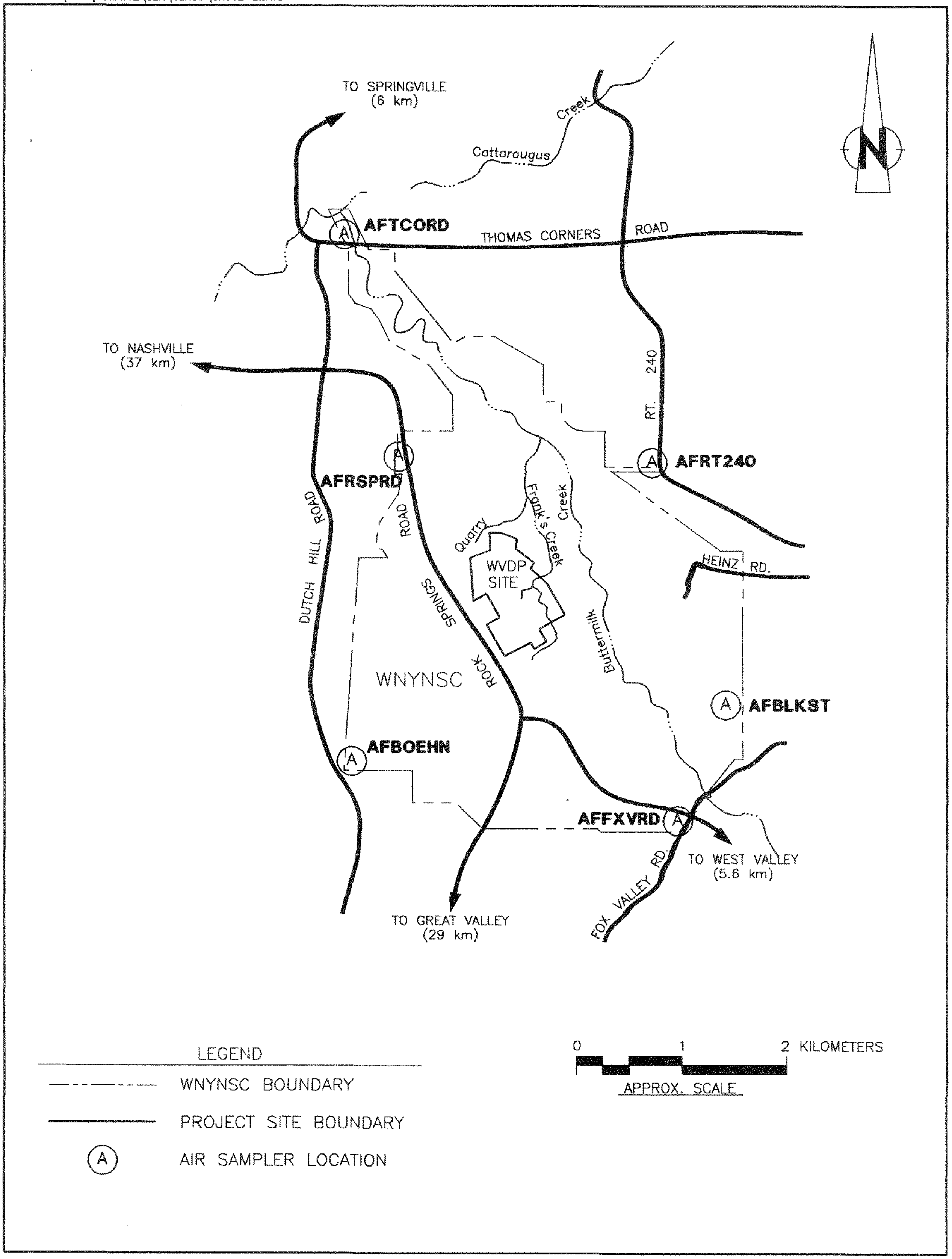

Figure 2-2. Location of Perimeter Air Samplers.

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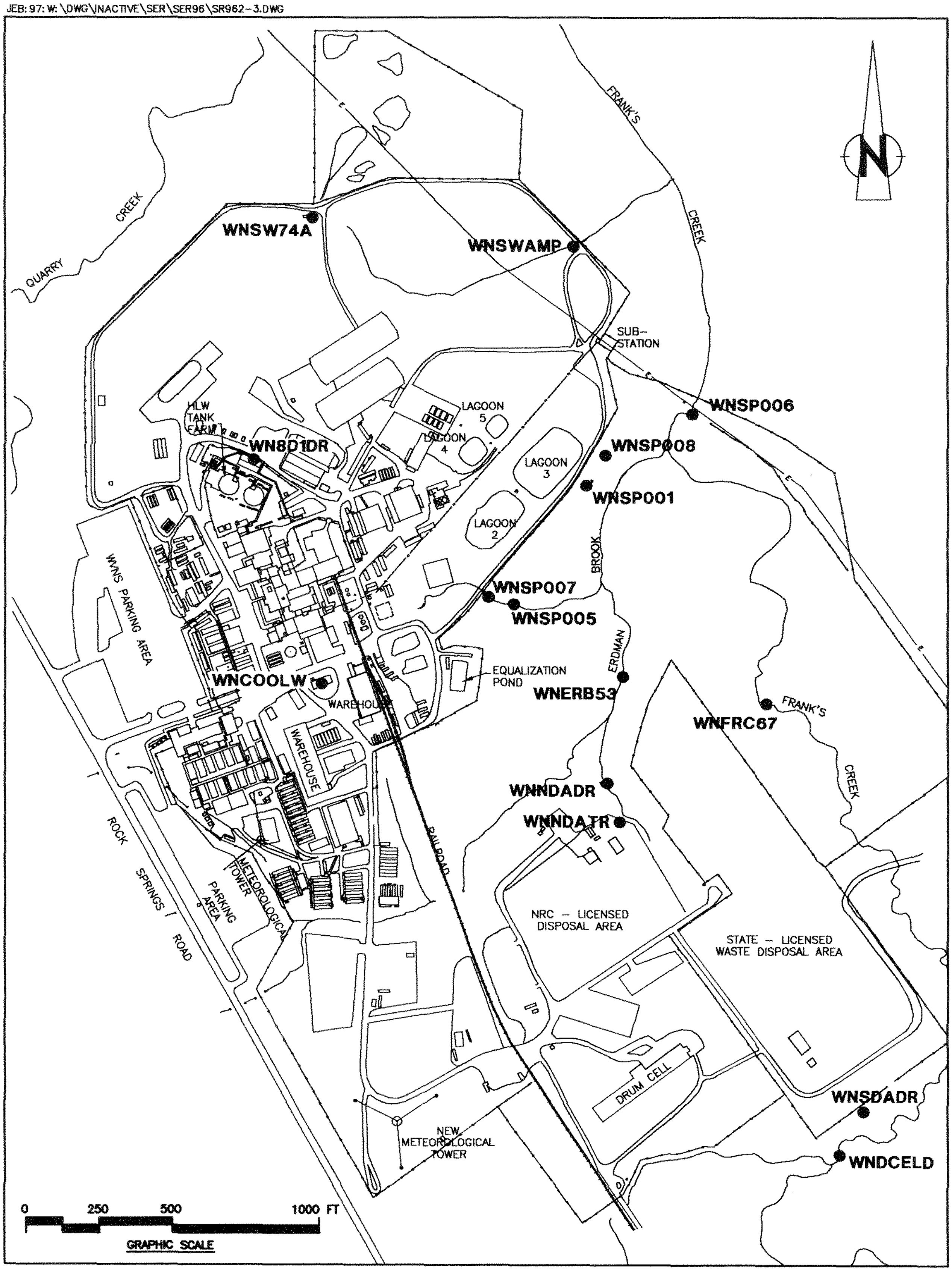

Figure 2-3. On-site Surface Water Sampling Locations.

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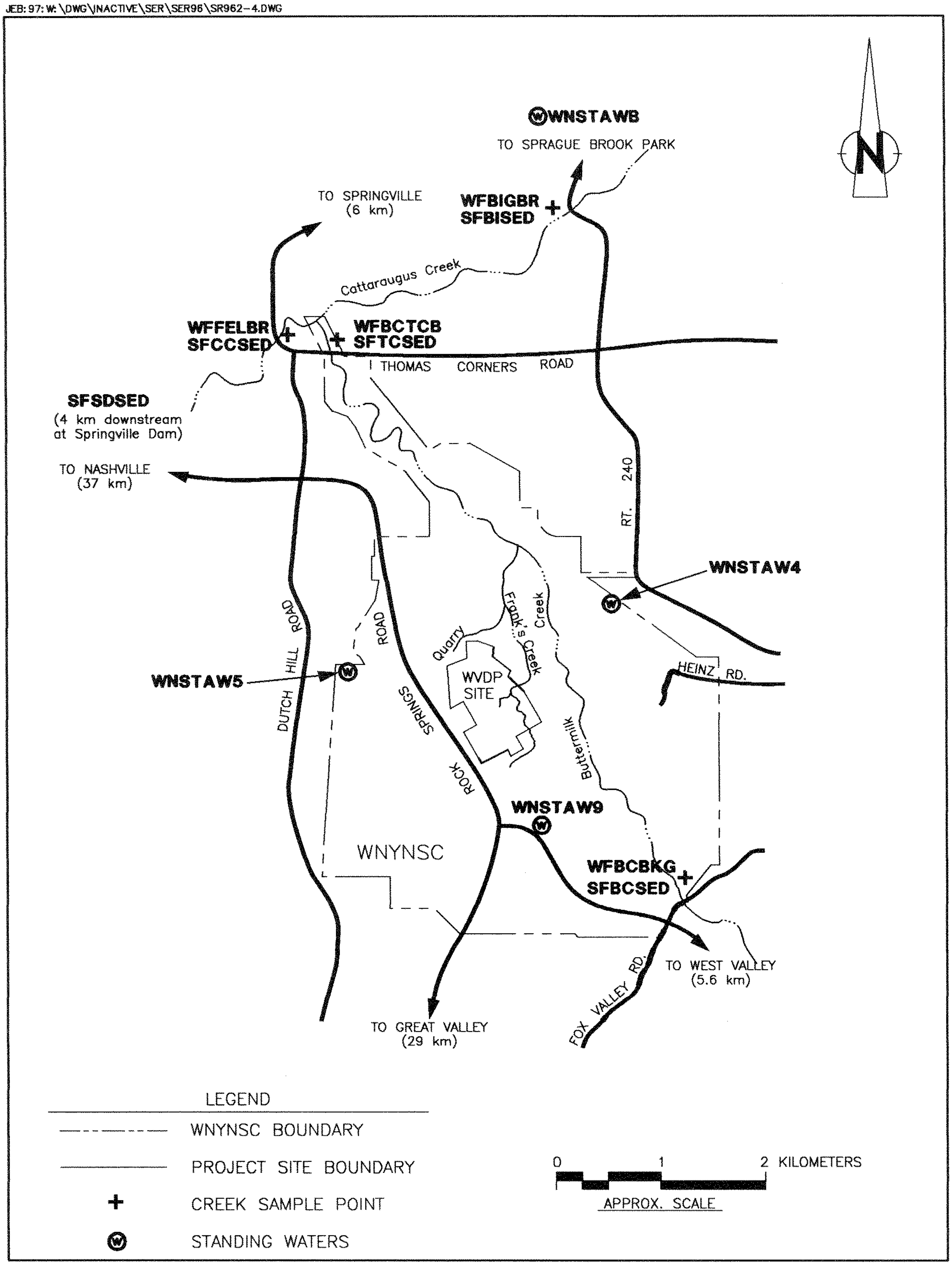

Figure 2-4. Off-site Surface Water and Sediment Sampling Locations.

of weekly samples are also analyzed for a full range of specific radionuclides. Semiannual grab samples from these locations are analyzed for additional chemical parameters.

Results for samples collected at location WNSW74A, which monitors drainage to Quarry Creek from the northern end of the Project premises, are summarized in *Appendix C-1*, Table C-1.8 (p. C1-9). The highest monthly strontium-90 result at WNSW74A was less than 1.6% of its DCG. The highest monthly tritium result at WNSW74A was only 0.006% of its DCG. Tritium at this location typically is below the detection limit.

Sampling point WNSWAMP also monitors surface water drainage from the site's north plateau. (See Tables 2-1 and 2-2 and *Appendix C-1*, Table C-1.7 [p.C1-8].) Waters from this drainage run into Frank's Creek downstream of location WNSP006. An upward trend in gross beta concentration from 1993 through 1996 at location WNSWAMP is discussed later in this chapter under **Special Monitoring,** *Northeast Swamp Drainage Monitoring* (p. 2-32). The average monthly tritium concentration at this location in 1996 was 2.57E-07 μCi/mL, which is above that observed at the background location WFBCBKG but below the 2E-03 μCi/mL DCG for tritium.

Other Surface Water Sampling Locations

Sampling point WNSP005, which monitors drainage from the east side of the main plant, and WNFRC67, which monitors surface waters draining from the east side of the SDA, are both grab-sampled on a monthly basis. Samples are analyzed for pH, gross alpha, gross beta, and tritium.

Another sampling point, WN8D1DR, is at a storm sewer manhole access that originally collected surface and shallow groundwater flow from the high-level waste tank farm area. Notable increases in gross beta and tritium activity at this location, attributable to historical site contamination, were described in the 1993 and 1994 annual site environmental reports. Since July 1993 the access has been valved off from the original high-

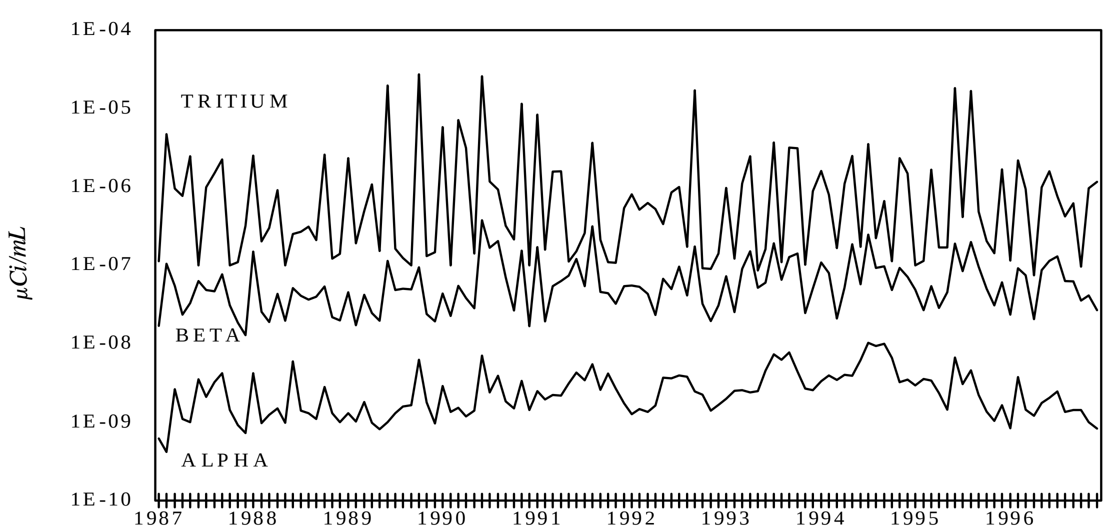

Figure 2-5. Ten-Year Trends of Gross Alpha, Gross Beta, and Tritium Concentrations at Sampling Location WNSP006

Table 2-1
1996 Gross Alpha Concentrations at Surface Water Sampling Locations

Location	Number of Samples	Range (µCi/mL)	Range (Bq/L)	Annual Average (µCi/mL)	Annual Average (Bq/L)
OFF-SITE					
WFBIGBR	12	<5.66E-10 – 2.09E-09	<2.09E-02 – 7.74E-02	6.79±7.30E-10	2.51±2.70E-02
WFBCBKG	12	4.04E-10 – 2.48E-09	1.49E-02 – 9.18E-02	1.08±0.74E-09	3.99±2.73E-02
WFBCTCB	12	<4.64E-10 – 1.71E-09	<1.72E-02 – 6.33E-02	6.98±7.23E-10	2.58±2.67E-02
WFFELBR	52	5.41E-10 – 4.97E-09	2.00E-02 – 1.84E-01	1.12±1.00E-09	4.13±3.69E-02
ON-SITE					
WNNDADR	12	<1.10E-09 – 1.85E-09	<4.07E-02 – 6.85E-02	0.68±1.62E-09	2.52±5.99E-02
WNSWAMP	52	<7.90E -10 – 3.25E-09	<2.92E-02 – 1.20E-01	0.54 ±1.53E-09	2.00±5.65E-02
WNSW74A	52	<7.40E-10 – 4.54E-09	<2.74E-02 – 1.68E-01	0.48 ±1.38E-09	1.79±5.12E-02
WNSP006	52	<5.22E-10 – 1.19E-08	<1.93E-02 – 4.40E-01	1.23 ±1.26E-09	4.56±4.67E-02

Table 2-2
1996 Gross Beta Concentrations at Surface Water Sampling Locations

Location	Number of Samples	Range (µCi/mL)	Range (Bq/L)	Annual Average (µCi/mL)	Annual Average (Bq/L)
OFF-SITE					
WFBIGBR	12	1.84E-09 – 4.14E-09	6.81E-02 – 1.53E-01	2.33±0.94E-09	8.61±3.47E-02
WFBCBKG	12	<1.31E-09 – 4.39E-09	<4.85E-02 – 1.62E-01	2.18±1.24E-09	8.07±4.59E-02
WFBCTCB	12	4.39E-09 – 1.44E-08	1.62E-01 – 5.33E-01	7.98±1.51E-09	2.95±0.56E-01
WFFELBR	52	<1.22E-09 – 2.62E-08	<4.51E-02 – 9.69E-01	3.75±1.48E-09	1.39±0.55E-01
ON-SITE					
WNNDADR	12	9.24E-08 – 2.09E-07	3.42E+00 – 7.73E+00	1.49±0.07E-07	5.51 ±0.25E+00
WNSWAMP	52	8.23E-07 – 4.80E-06	3.05E+01 –1.78E+02	2.63±0.03E-06	9.75 ±0.10E+01
WNSW74A	52	7.54E-09 – 2.62E-08	2.79E-01– 9.69E-01	1.37±0.25E-08	5.07 ±0.94E-01
WNSP006	52	1.38E-08 – 3.34E-07	5.11E-01–1.23E+01	6.43±0.46E-08	2.38 ±0.17E+00

level waste tank farm drainage area to prevent collected waters from draining freely to the surface. A sample is taken from the access point and is analyzed weekly for gross alpha and beta, tritium, and pH. A monthly composite is analyzed for gamma radionuclides and strontium-90. However, samples collected from this location are not thought to be indicative of either local groundwater or surface water conditions.

NDA Sampling Locations

The surface water drainage path downstream of the Nuclear Regulatory Commission (NRC)-licensed disposal area (NDA) is monitored at location WNNDADR using an automated sampler. Weekly samples are analyzed for tritium. Samples also are analyzed for nonpurgeable organic carbon (NPOC) and total organic halogens (TOX). Samples are composited and analyzed on a monthly basis for gross alpha, gross beta, tritium, and gamma-emitting radionuclides. Quarterly composites are analyzed for strontium-90 and iodine-129.

Gross beta concentrations at location WNNDADR averaged 1.49E-07 μCi/mL in 1996. (See Table 2-2 and Table C-1.19 [p. C1-15] in *Appendix C-1*.) Concentrations at this location were above the average measured at background location WFBCBKG but are all well below the DCG for strontium-90 in water (1E-06 μCi/mL). In fact, the highest quarterly composite isotopic strontium-90 result was only 8.4% of its DCG. The overall trend for gross beta concentrations at this location has remained relatively constant or shown a slight decrease (Fig. 2-6). Except for seasonal variations, the same is true of tritium.

A key indicator of any possible migration of nonradiological organic contaminants from the NDA would be the presence of significant iodine-129 in samples from WNNDADR. Iodine-129 is known to travel with the organic contaminants present in the NDA, but it is typically more soluble in water. In 1996 there were no positive detections of iodine-129 in water samples collected at this location. In addition, although NPOC and TOX

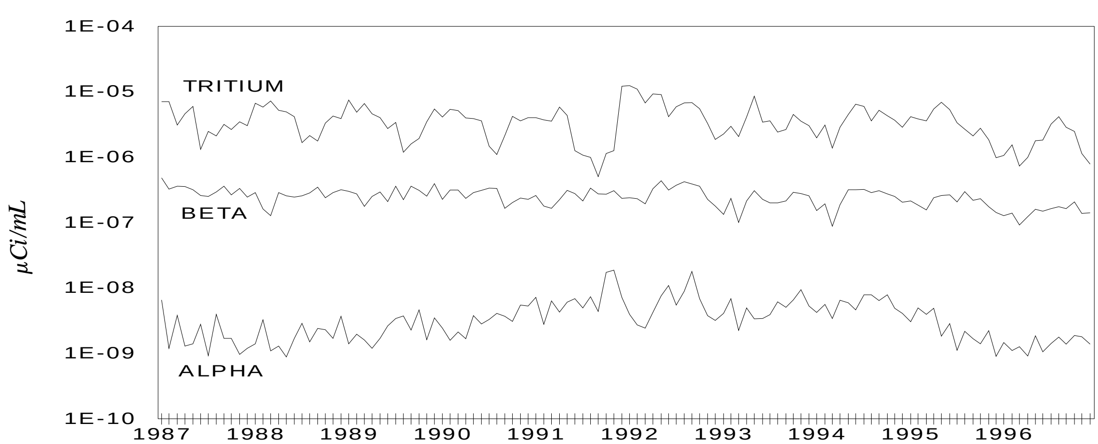

Figure 2-6. Ten-Year Trends of Gross Alpha, Gross Beta, and Tritium Concentrations at Sampling Location WNNDADR

values are elevated slightly above background surface water (WFBCBKG) values, it is believed that NPOC and TOX values observed at WNNDADR reflect only seasonal variations.

Iodine-129 values obtained from waters collected from the NDA interceptor trench (WNNDATR), closer to the NDA, were all below the analytical detection limit as well. (See *Appendix C-1*, Table C-1.20 [p. C1-16].) It should be noted that while tritium activity in trench waters is generally higher than that measured at WNNDADR farther downstream, gross beta activity is actually higher downstream at WNNDADR than in waters from the interceptor trench. Residual contamination from past waste burial activities in soils outside the NDA are the likely source of gross beta activity in samples from WNNDADR.

Downstream of WNNDADR, on Erdman Brook and to the west of the SDA, is sampling point WNERB53. Weekly samples collected from this point are analyzed for pH, gross alpha, gross beta, and tritium. In addition to samples collected by the WVDP, independent samples are collected and analyzed by the New York State Department of Health (NYSDOH) at this location and at WNFRC67, which monitors waters draining from the east side of the SDA. Although radiological samples collected at WNERB53 and WNFRC67 do reflect, in some cases, historical waste disposal activities, none of the observed concentrations exceed or even approach the most conservative DCG.

Near-site Standing Pond Water

In addition to sampling water from flowing streams, samples from ponds and lakes within the retained premises (WNYNSC) also are collected. Tests for various radiological and water quality parameters are performed annually to verify that no major changes in standing water within the Project facility environs are occurring. Four on-site ponds were tested in 1996; values for gross alpha, gross beta, and tritium were not significantly different from historical background values. The background samples are collected from a pond 14 kilometers (8.7 mi) north of the Project (WNSTAWB, Fig. 2-4 [p. 2-7]. See Table C-1.21 [p. C1-17].)

Off-site Surface Water Sampling

A map showing off-site surface water and sediment sample locations is found on Figure 2-4 (p. 2-7). Data from off-site sample points show that average gross beta radioactivity concentrations in Buttermilk Creek downstream of the WVDP site generally tend to be higher than concentrations upstream of the site, because small amounts of radioactivity from the site enter Buttermilk Creek via Frank's Creek. This is particularly observable during periods of lagoon 3 discharge. Tables 2-1 and 2-2 (p. 2-9) list the ranges and annual averages for gross alpha and gross beta activity at surface water locations. Additional information is available in the *Appendix C-1* tables for all off-site surface water monitoring locations.

Cattaraugus Creek at the Felton Bridge Sampling Location

An off-site sampler (WFFELBR) is located on Cattaraugus Creek at Felton Bridge just downstream of Cattaraugus Creek's confluence with Buttermilk Creek, which is the major surface drainage from the WNYNSC. (See Fig. 2-4 [p. 2-7].) The sampler collects a 50-mL aliquot from the creek every half-hour. A chart recorder registers the stream depth during the sampling period so that a flow-weighted weekly sample can be proportioned into a monthly composite. The weekly samples are analyzed for gross alpha, gross beta, tritium, and pH, and the sample composite is analyzed for gross alpha, gross beta, tritium, strontium-90, and gamma-emitting radionuclides.

The highest concentrations in monthly composite water samples from Cattaraugus Creek during 1996 show strontium-90 to be only 0.5% of the DCG for strontium-90 in water. There were no positive detections of cesium-137 in Cattaraugus Creek during 1996. (See Table C-1.24 [p. C1-19].) Although gross beta levels at the Felton Bridge sampling location are elevated slightly during months of lagoon 3 discharge, overall, the yearly average gross beta activity for Cattaraugus Creek at Felton Bridge is nearly indistinguishable from background. Figure 2-7 shows the ten-year trends for Cattaraugus Creek samples analyzed for gross alpha, gross beta, and tritium. Note that for the most part, tritium concentrations represent method detection limits and not detected radioactivity. Gross beta activity appears to have remained constant at this location since 1987.

Fox Valley Road and Thomas Corners Bridge Sampling Locations

In addition to the Cattaraugus Creek sampler, two surface water monitoring stations are located on Buttermilk Creek, one upstream and one downstream of the WVDP. (See Fig. 2-4 [p. 2-7].) Samplers collect water from a background location upstream of the Project at Fox Valley Road (WFBCBKG) and from a location at Thomas Corners Road that is downstream of the plant and upstream of Buttermilk Creek's confluence with Cattaraugus Creek (WFBCTCB).

These samplers collect a 50-mL aliquot every half-hour. Samples are retrieved weekly and analyzed for pH and conductivity. Samples are composited monthly and analyzed for tritium, gross alpha, and gross beta radioactivity. A quarterly composite is analyzed for gamma-emitting radionuclides and strontium-90.

Quarterly composite samples from the Fox Valley Road location also are analyzed for carbon-14, iodine-129, technetium-99, alpha radionuclides, and total uranium. (Table C-1.22 [p. C1-18] shows monthly and quarterly radioactivity concentrations upstream of the site at Fox Valley; Table C-1.23 [p. C1-19] shows monthly and quarterly radioactivity concentrations downstream of the site at Thomas Corners.)

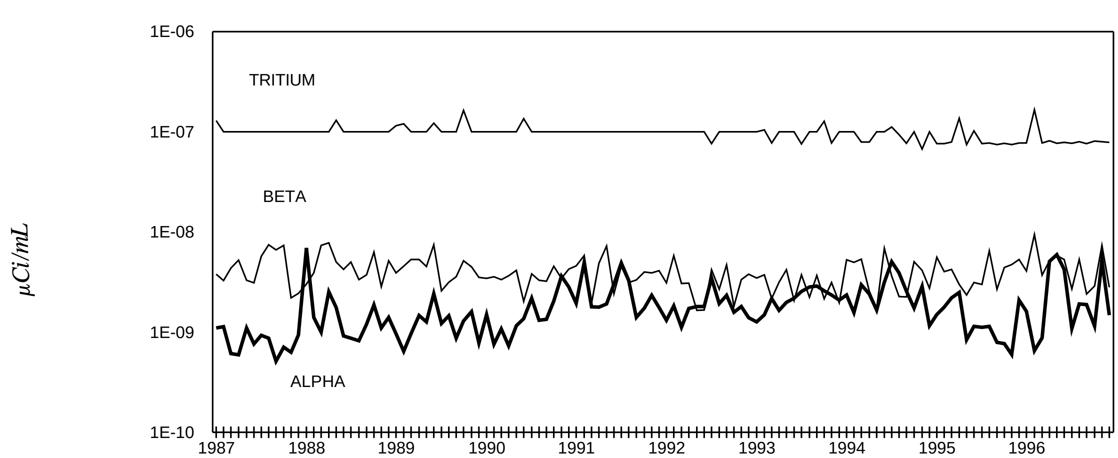

Figure 2-7. Ten-Year Trends of Gross Alpha, Gross Beta, and Tritium Concentrations at Sampling Location WFFELBR

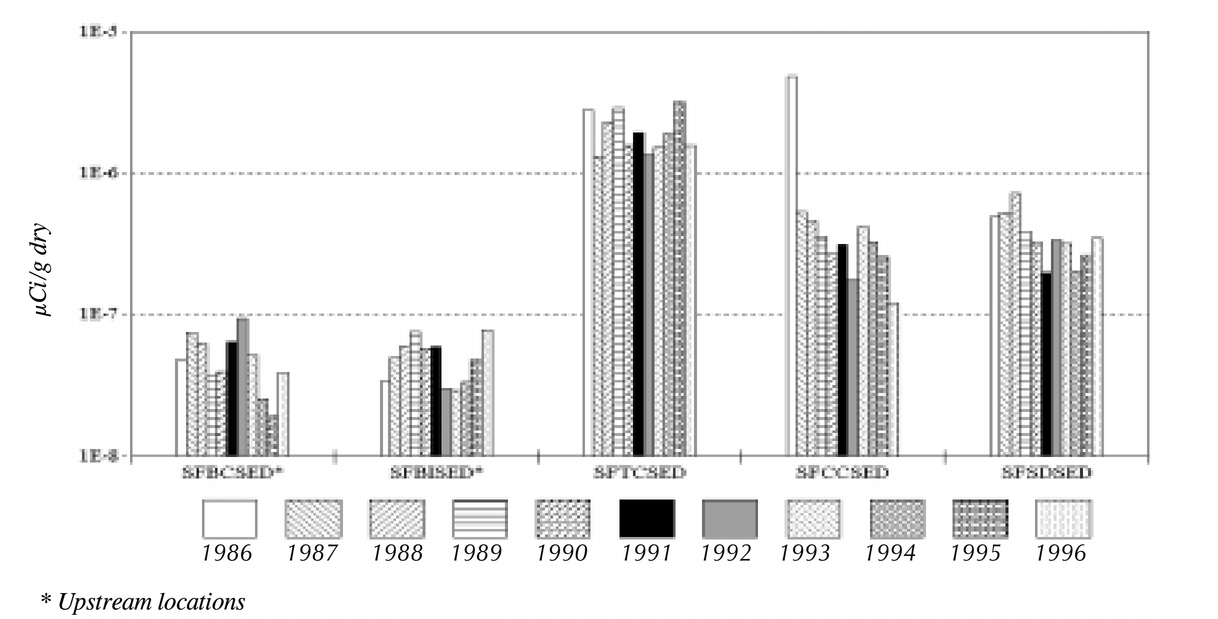

Figure 2-8. Eleven-Year Trends of Cesium-137 in Stream Sediment at Two Locations Upstream and Three Locations Downstream of the WVDP

The data from these locations show that tritium and gross beta concentrations downstream of the site are only marginally higher than background concentrations upstream of the site.

Because dairy cattle have access to waters at the Thomas Corners Bridge sampling point, this sample point represents an important link in the pathway to humans. In actuality, gross beta includes other radionuclides from naturally occurring sources as well as from manmade sources. If the maximum beta concentration in Buttermilk Creek downstream of the Project at Thomas Corners Bridge were, however, attributable entirely to strontium-90, then the radioactivity would represent only 1.4% of the DCG.

Sediment Sampling

A map showing sediment sampling locations is found on Figure 2-4 (p. 2-7). Sediments are grab-sampled annually at or near three of the automatic water sampling locations and at two additional points. Downstream locations are Buttermilk Creek at Thomas Corners Road (SFTCSED), Cattaraugus Creek at Felton Bridge (SFCCSED), and Cattaraugus Creek at the Springville dam (SFSDSED). Upstream background locations are Buttermilk Creek at Fox Valley Road (SFBCSED) and Cattaraugus Creek at Bigelow Bridge (SFBISED).

A comparison of annual averaged cesium-137 concentrations from 1986 through 1996 for these five sampling locations is illustrated in Figure 2-8. As reported in previous years, cesium-137 concentrations in sediments collected downstream of the WVDP are higher than those observed in samples collected from background locations (SFBCSED or SFBISED). As the figure indicates, concentrations appear to be staying constant with time at the downstream locations. While the cesium-137 activity in downstream Cattaraugus Creek sediments (at locations SFCCSED and SFSDSED) is elevated relative to upstream values, it is comparable to or less than historical background concentrations (as measured at SFGRVAL and SFNASHV) in surface soil in Western New York. (See *Appendix C-1*, Table C-1.30 [p.C1-23])

A comparison of cesium-137 to the naturally occurring gamma-emitter potassium-40 (Fig. 2-9) for the downstream location nearest the Project (Buttermilk Creek at Thomas Corners Road — SFTCSED) indicates that cesium-137 is present at levels lower than naturally occurring gamma emitters. Results of sediment sampling upstream and downstream of the Project are tabulated in *Appendix C-1*, Table C-1.31 (p. C1-24). When alpha isotopic results for background location SFBCSED are compared to those for SFTCSED, downstream of the site, no significant differences are observed.

Air Monitoring

On-site Ventilation Systems

Permits obtained from the U.S. Environmental Protection Agency (EPA) allow air with small amounts of radioactivity to be released from plant ventilation stacks during normal operations. The air released must meet criteria specified in the NESHAP regulations to ensure that the environment and the public's health and safety are not adversely affected. Dose-based comparisons of WVDP emissions against NESHAP criteria are presented in Chapter 4. Although generally less stringent than NESHAP criteria, DOE DCGs are more conducive to concentration-based comparisons and are used in this chapter for evaluating concentrations of radionuclides in WVDP emissions. Parameters measured include gross alpha and gross beta, tritium, and various radionuclides such as cesium-137 and strontium-90. When comparing concentrations with dose limits for screening purposes, gross alpha and beta radioactivities are assumed to come from americium-241 and strontium-90, respectively, because the dose effects for these radionuclides are the most limiting for major particulate emissions at the WVDP. (DOE standards and DCGs for radionuclides of interest at the WVDP are found in *Appendix B* [p.B-3])

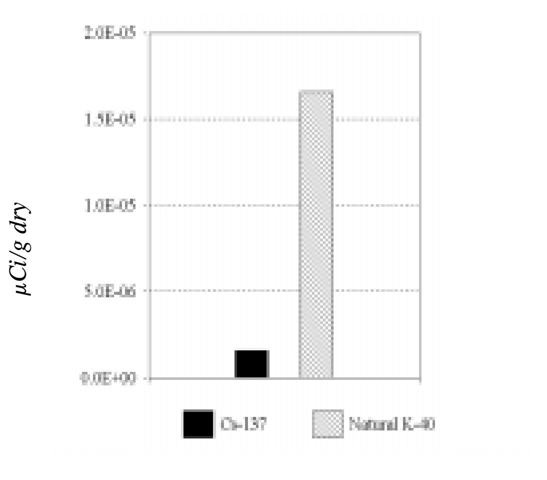

Figure 2-9. Comparison of Cesium - 137 with Naturally Occurring Potassium-40 Concentrations in 1996 at Downstream Sampling Location SFTCSED

The exhaust from each permitted fixed ventilation system on-site is continuously filtered, monitored, and sampled as it is released to the atmosphere. Specially designed isokinetic sampling nozzles continuously remove a representative portion of the exhaust air, which is then drawn through very fine glass fiber filters to trap any particles. Sensitive detectors continuously monitor the radioactivity on these filters and provide readouts of alpha and beta radioactivity levels.

A separate sampling unit on the ventilation stack of the permitted systems contains another filter that is removed every week and tested in the laboratory. This sampling system also may contain an activated carbon cartridge used to collect a sample that is analyzed for iodine-129. Iodine-129 is not detected in measurements of gross alpha and gross beta on the particulate matter captured on the glass fiber filter.

In addition to these samples, water vapor from the main plant ventilation stack (ANSTACK) and the supernatant treatment system (ANSTSTK) is collected by trapping moisture in silica gel desiccant columns. The trapped water is distilled from the silica gel desiccant and analyzed for tritium.

Because tritium, iodine, and other isotopic concentrations are quite low, the large-volume samples collected weekly from the main plant stack and from other emission-point samplers provide the only practical means of determining the amount of specific radionuclides released from the facility. In addition to scheduled sampling and analysis of ANSTACK filters for those parameters defined in *Appendix A* of this report, filters are routinely analyzed for strontium-89 and cesium-137 as part of operational monitoring.

The Main Plant Ventilation Stack

Figure 2-1 (p. 2-4) shows the locations of on-site air monitoring and sampling points.

The main ventilation stack is potentially the greatest contributor to airborne releases. The main stack sampling system collects a continuous air sample from this emission point. A high sample-collection flow rate through multiple intake nozzles ensures a representative sample for both the weekly sample and the on-line monitoring system. The total quantity of gross alpha, gross beta, and tritium released each month from the main stack, based on weekly measurements, is shown in *Appendix C-2*, Table C-2.1 (p. C2-3).

Figure 2-10 shows the ten-year trends in main stack samples analyzed for gross alpha and gross beta activity. The figure indicates a steady five-year downward trend in activity observed for both gross alpha and gross beta from 1987 to mid-1992. From mid-1992 throughout mid-1995 both gross alpha and beta activities rose slightly and then leveled off. During the third and fourth quarters of 1995, concentrations of gross alpha, gross beta, and gamma-emitting radionuclides in ventilated air increased because of transfers of cesium-loaded zeolite from waste tank 8D-1 to 8D-2.

During the first two quarters of 1996 the concentrations returned to levels observed before the zeolite transfer period. As expected, increases were observed during the third and fourth quarters of the year, coinciding with the start-up of high-level waste vitrification.

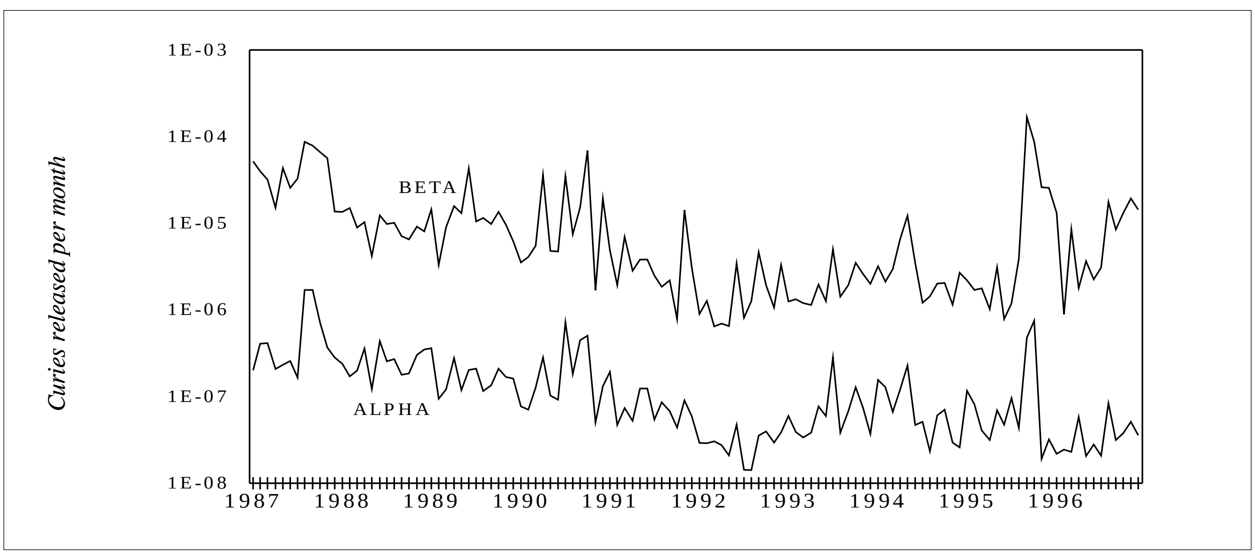

Figure 2-10. Ten-Year Trends of Gross Alpha and Gross Beta Activity at the Main Stack Sampling Location (ANSTACK)

A comparison of airborne radioactivity concentrations released from the main plant ventilation in 1996 with the DOE DCGs in Table C-2.2 (p. C2-4) indicates that at the point of stack discharge, average radioactivity levels were already below concentration guidelines for airborne radioactivity in an unrestricted environment. Airborne concentrations from the stack to the site boundary are further reduced by dilution by an average factor of about 200,000. Samples from ambient air perimeter monitors at the site boundary confirm that site operations had no discernible effect on air quality at these perimeter locations.

Vitrification Facility Sampling System

In November 1995 new sampling and monitoring equipment was brought on-line to monitor emissions from the vitrification heating, ventilation, and air conditioning (HVAC) system. The primary sampling point — ANVITSK — and the seismically protected backup sample point — ANSEISK — monitor ventilation releases from the facility. The vitrification off-gas ventilation is emitted through the main plant stack. Air exhausted to the environment is monitored for radioactivity. Results gathered before July 1996 (Tables C-2.3 and C-2.4 [pp. C2-5 and C2-6]) represent initial pre-vitrification baseline or background levels. Data obtained from July 1996 through the end of 1996 were collected during actual operation of the vitrification facility. A comparison of the two sets of data show almost no discernible difference in concentrations in emissions from this facility.

Other On-site Sampling Systems

Sampling systems similar to those of the main stack monitor airborne effluents from the 01-14 building (formerly housing the cement solidification system ventilation stack [ANCSSTK]), the contact size-reduction facility ventilation stack [ANCSRFK], and the supernatant treatment system ventilation stack [ANSTSTK]).

A temporary monitoring system was brought on-line at the container sorting and packaging facility ventilation stack (ANCSPFK) in March 1996. The container sorting and packaging facility (CSPF) is a self-contained room within lag storage area #4. Containers of radioactively contaminated materials are opened and hand-sorted in the CSPF before compaction and storage or decontamination. (Durable items such as metal piping can be reused after decontamination.) The CSPF is constantly ventilated during use. The temporary stack monitoring system operated from March 1996 to March 1997 while a permanent system was being designed and installed. The permanent system was brought on-line in March 1997.

The 1996 samples from ANCSSTK, ANCSRFK, ANSTSTK, and ANCSPFK showed detectable gross radioactivity in some cases as well as specific beta- and alpha-emitting radionuclides, but did not approach any Department of Energy effluent limitations. Tables C-2.5 through C-2.8 (pp. C2-7 through C2-10) show monthly totals of gross alpha and beta radioactivity and quarterly total radioactivity released for specific radionuclides for each of these sampling locations.

In addition, a temporary demonstration decontamination facility using carbon dioxide (CO_2) cleaning technology was brought on-site in 1996 and operated during the last two weeks of the year. Results of sampling from that facility in 1996 are included in Table C-2.15 (p. C2-16).

Three other operations are routinely monitored for airborne radioactive releases: the supercompactor volume-reduction ventilation system (ANSUPCV), the low-level waste treatment facility ventilation system (ANLLWTVH), and the contaminated clothing laundry ventilation system (ANLAUNV).

Silica Gel Column from the Rock Springs Road Ambient Air Sampler

The supercompactor ventilation (ANSUPCV) did not operate in 1996. Routine supercompactor system operation was curtailed in April 1994 because of reduced operational needs.

The low-level waste treatment facility ventilation system and the contaminated clothing laundry ventilation system are sampled for gross alpha and gross beta radioactivity. Data for these two facilities are presented in Tables C-2.9 and C-2.10 (pp. C2-11 and C2-12). These emission points are not permitted because the potential magnitude of the emissions is so low. Although only semi-annual sampling is required to verify the low emissions, the laundry emissions were sampled every week and the low-level waste treatment facility emissions were sampled from May through December.

Permitted portable outdoor ventilation enclosures (OVEs) are used occasionally to provide the ventilation necessary for the safety of personnel working with radioactive materials in areas outside permanently ventilated facilities. Air samples from OVEs are collected continuously while those emission points are discharging, and data from these units are included in annual airborne emission evaluations.

In 1996 average discharges at the point of release from portable outdoor ventilation units were well below DOE guidelines for alpha and beta radioactivity in an unrestricted environment. Dilution from the point of release to the site boundary would further reduce these concentrations.

In February 1995 ambient air monitors were installed near the lag storage area (ANLAGAM) and near the NDA (ANNDAAM). The 1996 monitoring data are presented in *Appendix C-2*, Tables C-2.11 and C-2.12 (pp. C2-13 and C2-14).

An ambient air sampler (ANSDAT9) monitors potential diffuse releases of radioactivity associated with the SDA, which is managed by the New York State Energy and Research Development Authority (NYSERDA). The ANSDAT9 sampler could also detect site-wide releases to ambient air. Radiological results for this location are all either below analytical detection limits or are no different statistically than those observed at the background air monitoring location AFGRVAL. Results of this monitoring are presented in *Appendix C-2,* Table C-2.13 (p.C2-15).

Perimeter and Remote Air Sampling

Maps of perimeter and remote air sampling locations may be found on Figure 2-2 (p. 2-5) and Figure A-9 (p. A-53).

As in previous years, airborne particulate samples for radiological analysis were collected continuously at six locations around the perimeter of the site and at four remote locations at Great Valley, West Valley, Springville, and Nashville, New York. Perimeter locations — on Fox Valley Road, Rock Springs Road, Route 240, Thomas Corners Road, Dutch Hill Road, and at the site's bulk storage warehouse — were chosen to provide historical continuity or because the location would best represent the highest potential off-site airborne concentration of radioactivity. The ten-year trends of gross alpha and gross beta concentrations at the Rock Springs Road location are shown in Figure 2-11. The remote locations provide data from nearby communities — West Valley and Springville — and from more distant background areas. Concentrations measured at Great Valley (AFGRVAL, 29 km south of the site) and Nashville (AFNASHV, 37 km west of the site in the town of Hanover) are considered representative of regional natural background radiation.

The six perimeter samplers and the four remote samplers maintain an average flow of about 40 L/min (1.4 ft^3/min) through a 47-millimeter glass fiber filter. The sampler heads for each of the locations are set at 1.7 meters above the ground, the height of the average human breathing zone. Filters from off-site and perimeter samplers are collected weekly and analyzed after a seven-day "decay" period to remove interference from short-lived naturally occurring radionuclides.

Gross alpha and gross beta measurements of each filter are made weekly using a low-background gas proportional counter. The gross alpha and gross beta ranges and annual averages for each of the ambient sampling points are provided in Tables 2-3 and 2-4. The 1996 concentration ranges are similar to those

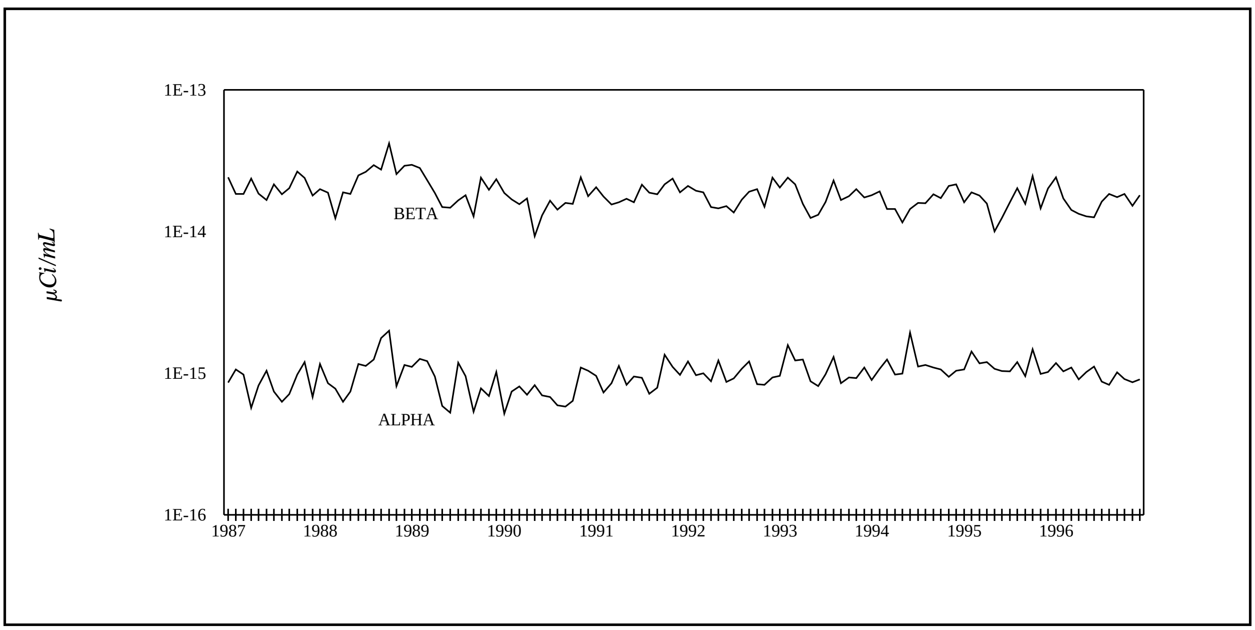

Figure 2-11. Ten-Year Trends of Gross Alpha and Gross Beta Concentrations at the Rock Springs Road Sampling Location (AFRSPRD)

Table 2-3

1996 Gross Alpha Concentrations at Off-Site, Perimeter, and On-site Ambient Air Sampling Locations

Location	Number of Samples	Range		Annual Average	
		(μCi/mL)	*(Bq/m³)*	*(μCi/mL)*	*(Bq/m³)*
AFFXVRD	52	<4.94E-16 – 2.67E-15	<1.83E-05 – 9.88E-05	0.87±1.01E-15	3.21±3.73E-05
AFRSPRD	52	<6.02E-16 – 3.65E-15	<2.23E-05 – 1.35E-04	7.48±9.81E-16	2.77±3.63E-05
AFRT240	52	<4.83E-16 – 3.02E-15	<1.79E-05 – 1.12E-04	0.98±1.04E-15	3.63±3.86E-05
AFSPRVL	52	<6.06E-16 – 1.90E-15	<2.24E-05 – 7.03E-05	6.60±9.58E-16	2.44±3.55E-05
AFTCORD	52	<5.52E-16 – 3.40E-15	<2.04E-05 – 1.26E-04	7.98±9.92E-16	2.95±3.67E-05
AFWEVAL	52	<6.50E-16 – 2.40E-15	<2.41E-05 – 8.88E-05	0.95±1.13E-15	3.53±4.18E-05
AFGRVAL	52	<5.42E-16 – 2.16E-15	<2.01E-05 – 7.99E-05	7.45±9.72E-16	2.76±3.60E-05
AFBOEHN	52	<7.01E-16 – 2.94E-15	<2.59E-05 – 1.09E-04	0.92±1.03E-15	3.42±3.81E-05
AFNASHV	52	<6.48E-16 – 2.79E-15	<2.40E-05 – 1.03E-04	8.07±9.93E-16	2.99±3.67E-05
AFBLKST	52	<4.90E-16 – 4.22E-15	<1.81E-05 – 1.56E-04	8.22±9.83E-16	3.04±3.64E-05
ANLAGAM	52	<3.81E-16 – 1.97E-15	<1.41E-05 – 7.29E-05	7.60±8.93E-16	2.81±3.30E-05
ANNDAAM*	51	<4.63E-16 – 2.26E-15	<1.71E-05 – 8.36E-05	8.91±7.77E-16	3.30±2.87E-05

Table 2-4

1996 Gross Beta Concentrations at Off-Site, Perimeter, and On-Site Ambient Air Sampling Locations

Location	Number of Samples	Range		Annual Average	
		(μCi/mL)	*(Bq/m³)*	*(μCi/mL)*	*(Bq/m³)*
AFFXVRD	52	9.93E-15 – 3.93E-14	3.67E-04 – 1.45E-03	1.82±0.34E-14	6.75±1.25E-04
AFRSPRD	52	8.76E-15 – 3.69E-14	3.24E-04 – 1.37E-03	1.64±0.33E-14	6.07±1.21E-04
AFRT240	52	1.05E-14 – 3.86E-14	3.89E-04 – 1.43E-03	1.87±0.34E-14	6.91±1.27E-04
AFSPRVL	52	7.46E-15 – 2.70E-14	2.76E-04 – 9.99E-04	1.47±0.32E-14	5.45±1.18E-04
AFTCORD	52	9.72E-15 – 3.38E-14	3.60E-04 – 1.25E-03	1.67±0.33E-14	6.17±1.21E-04
AFWEVAL	52	7.66E-15 – 3.53E-14	2.83E-04 – 1.31E-03	1.80±0.35E-14	6.64±1.31E-04
AFGRVAL	52	9.28E-15 – 3.57E-14	3.43E-04 – 1.32E-03	1.65±0.32E-14	6.10±1.20E-04
AFBOEHN	52	1.08E-14 – 3.32E-14	4.00E-04 – 1.23E-03	2.01±0.35E-14	7.45±1.30E-04
AFNASHV	52	8.68E-15 – 3.79E-14	3.21E-04 – 1.40E-03	1.81±0.34E-14	6.69±1.25E-04
AFBLKST	52	8.29E-15 – 3.25E-14	3.07E-04 – 1.20E-03	1.66±0.32E-14	6.16±1.20E-04
ANLAGAM	52	1.46E-15 – 3.94E-14	5.40E-05 – 1.46E-03	1.64±0.31E-14	6.08±1.16E-04
ANNDAAM*	51	<1.70E-15 – 3.23E-14	<6.29E-05 – 1.20E-03	1.65±0.26E-14	6.11±0.96E-04

** Any sample deemed unreliable during the data validation process is not included here.*

> ***Global Fallout Sampling***
>
> *Global fallout is sampled at four of the perimeter air sampler locations and at the base of the original on-site meteorological tower. Precipitation from all of the locations is collected and analyzed every month. Monthly gross alpha and gross beta results from these measurements are reported in nCi/m² and tritium results are reported in μCi/mL. (The 1996 data from these analyses and precipitation pH measurement data are found in Appendix C-2, Tables C-2.26 and C-2.27 [pp. C2-24 and C2-25]).*
>
> *Fallout pot data indicate short-term effects. Long-term deposition is measured by surface soil samples collected annually near each air sampling station. Soil sample data are found in Table C-1.30 [p. C1-23] of Appendix C-1.*

measured in 1995. Near-site sample concentrations are indistinguishable from background, and all reflect normal seasonal variations.

In addition, quarterly composites, which consist of filters collected each week for thirteen weeks from each sample station, are analyzed. Data from these samplers are provided in *Appendix C-2*, Tables C-2.16 through C-2.25 (pp. C2-17 to C2-23). Although tritium (as hydrogen-tritium oxide [HTO]) was positively detected on a number of occasions at the Rock Springs Road location near the site, those concentrations were the same as positive concentrations observed at the Great Valley background location. A single strontium-90 value statistically above values observed at background air sampling stations (AFNASHV and AFGRVAL) was observed at Rock Springs Road during the third quarter of 1996. It is believed that this value is a laboratory anomaly: it did not continue into the fourth quarter; it was not accompanied by an increase in other radionuclides measured at the same location; and there was no increase in airborne radioactive emissions of sufficient magnitude at any on-site effluent monitoring location to explain it.

The gross beta concentrations in air data for the three samplers that have been in operation since before 1982 — Fox Valley, Thomas Corners, and Route 240 — averaged about 1.77E-14 μCi/mL (6.56E-04 Bq/m³) in 1995, and in 1996 averaged 1.79E-14 μCi/mL (6.62E-04 Bq/m³). The average gross beta concentration at the two background sampling locations — Great Valley and Nashville — was 1.73E-14 μCi/mL (6.40E-04 Bq/m³) in 1996.

Off-site Surface Soil Sampling

Maps of off-site surface soil sampling locations may be found on Figures A-6 and A-9 (pp.A-50 and A-53).

Soil from the upper two inches of the ground near the perimeter air samplers is collected annually to measure the radioactivity deposited by worldwide fallout. Samples were collected in 1996 from ten locations: six points on the perimeter of the retained premises (WNYNSC), two in nearby communities, and two in locations 30 to 50 kilometers distant from the Project. Analyses for cesium-137, strontium-90, plutonium-239/240, and americium-241 at all ten locations and analyses for uranium radionuclides at three points were compared among the sample locations.

The measured concentrations are typical of normal background concentrations in the region, with two exceptions: Soil from the Rock Springs Road air sampler location has consistently shown a higher-than-background cesium-137 concentration. This sampler is known to be within an extended area of elevated cesium activity that was identified by a 1979 survey, well before the Project was initiated. Strontium-90 data for the Rock Springs Road and Route 240 sampling points seemed to be elevated in 1996 in comparison with previous years and with other perimeter and background locations. Repeat analyses of these samples suggested that the original high values may be the result of analytical uncertainties. In addition, these results were not accompanied by air effluent releases of significant magnitude to explain them.

The 1996 results (Table C-1.30 [p. C1-23]) show that detectable concentrations of strontium-90, cesium-137 (both present in worldwide fallout), cobalt-60, and manmade alpha-emitting radionuclides were generally within the same range of uncertainty as background samples. The slightly higher cesium-137 result remained within the range observed at background locations during the past six years.

Radioactivity in the Food Chain

Maps showing biological sampling points are found on Figures 2-12 (p. 2-22) and A-9 (p.A-53).

Each year food samples are collected from locations near the site and from remote locations (Fig. 2-12). Fish and deer are collected during periods when they would normally be taken by sportsmen for consumption. In addition, milk is collected monthly and beef semiannually from cows that graze near the site and at remote locations. Hay, corn, apples, and beans are collected at the time of harvest.

Fish

Under a collector's permit fish are obtained by electrofishing, a method that temporarily stuns the fish, allowing them to be netted for collection. Compared to sport fishing, this method allows a more species-selective control, with unwanted fish being returned to the creek essentially unharmed.

Twenty fish samples are collected every year (ten semiannually) above the Springville dam from the portion of Cattaraugus Creek that is downstream of WNYNSC drainage (BFFCATC). Ten fish samples also are collected annually from Cattaraugus Creek below the dam (BFFCATD), including species that migrate nearly forty miles upstream from Lake Erie. These specimens are representative of sport fishing catches in the creek downstream of the Springville dam.

Electrofishing in Cattaraugus Creek

Twenty control fish are taken every year (ten semiannually) from waters that are not influenced by site runoff (BFFCTRL). These

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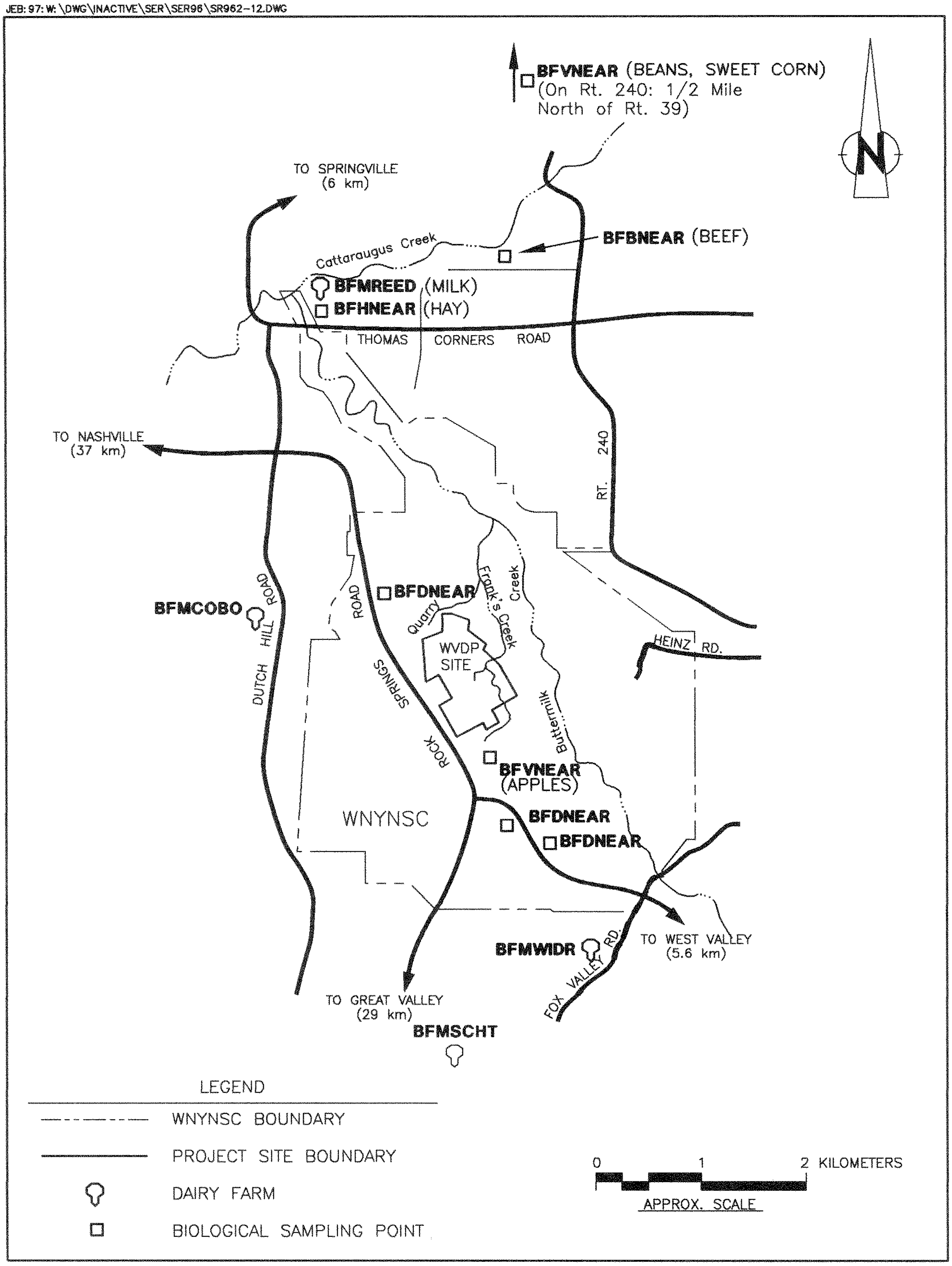

Figure 2-12. Near-site Biological Sampling Points.

Springville Dam on Cattaraugus Creek

control samples, containing no radioactivity from WVDP effluents, allow comparisons with the concentrations found in fish taken from site-influenced waters. The control samples are representative of the species collected in Cattaraugus Creek downstream from the WVDP. A combined total of fifty fish were collected from these locations.

The edible portion of each individual fish was analyzed for strontium-90 content and the gamma-emitting radionuclides cesium-134 and cesium-137. (See Table C-3.4 [p.C3-6] in *Appendix C-3* for a summary of the results.) Throughout the year concentrations of strontium-90 ranged from below the minimum detectable concentration (see *Glossary*) to a maximum of 7.93 E-08 μCi/g at BFFCATC and from below the minimum detectable concentration to 1.56 E-08 μCi/g at the control location (BFFCTRL). In both locations bottom-feeding fish tended to contain higher detectable activity, while sport fish such as trout did not. These levels are very similar to the levels observed in fish collected during 1995. All downstream fish concentrations are within the range of historical Project background values. The dose value from the consumption of fish is discussed in *Chapter 4, Radiological Dose Assessment,* p. 4-9.

Only three fish collected downstream of the site showed marginally positive detections for cesium-137. These cesium -137 concentrations were all within the range of those measured at the background location.

One downstream fish sample showed a positive detection of cesium-134 but this was not statistically different from concentrations in background fish.

Venison

Specimens from an on-site deer herd also are analyzed for radioactive components. Historically, concentrations of radioactivity in deer flesh have been very low and Project activities have not been shown to affect the local herd.

For the third year during the large-game hunting season, hunters were allowed access to the WNYNSC, excluding the WVDP premises, in a controlled hunting program established by the New York State Energy Research and Development Authority (NYSERDA). Of the 149 deer collected during this program, forty were antlered and 109 were antlerless.

Venison from three deer salvaged from vehicle-deer accidents around the WNYNSC was analyzed and the data compared to that from deer collected far from the site in the towns of Franklinville and Portville, New York. Low levels of radioactivity from cesium-137 and naturally occurring potassium-40 were detected in both near-site and control samples. Results for these samples are shown in Table C-3.2 (p.C3-4) in *Appendix C-3.*

Concentrations in near-site deer were at or below background levels for those radionuclides in 1996. The range in concentrations observed was similar to previous years. Cesium-134 was not detected in any near-site or control deer during 1996.

Tritium concentrations in near-site deer were elevated compared to previous years. However, the presence of elevated tritium concentrations in both near-site and control deer samples may be indicative of a laboratory analysis problem.

There was one positive detection of strontium-90 in near-site deer in 1996, although the value observed was still within the range of historical control values. Even if all isotopic analysis results were used as is to assess the dose to the maximally exposed individual, this dose would still be small in comparison to that received on a yearly basis from natural background radiation. (See **Environmental Media Concentrations**, *Venison*, in Chapter 4 [p. 4-10].)

Beef

In 1996, as in previous years, very little difference in isotopic concentration was observed between near-site and control herds. Beef samples taken semiannually from near-site and remote locations were analyzed for tritium, strontium-90, and gamma-emitting radionuclides such as cesium-134 and cesium-137.

In 1996 there was one marginally positive detection for strontium-90 in a control beef sample. There were no positive detections of strontium-90 in near-site beef. Results for all near-site and control samples were below the minimum detectable concentrations for cesium-134. There was one positive detection of tritium in a near-site beef sample, although the value obtained is close to the method detection limit. Two positive cesium-137 results were obtained, one from a control sample and one from a near-site sample. Both values overlap statistically. These results are presented in Table C-3.2 (p.C3-4) in *Appendix C-3.*

Milk

Monthly milk samples were taken in 1996 from dairy farms near the site and from control farms at some distance from the site. (See Fig. 2-12 [p. 2-22].) Quarterly composites of monthly samples from the maximally exposed herd to the north (BFMREED) and from a nearby herd to the northwest (BFMCOBO) were prepared. Single annual samples were taken from herds near the WVDP to the southeast (BFMWIDR) and the south (BFMSCHT). Monthly samples from control herds (BFMCTLN and BFMCTLS) were also prepared as quarterly composites. (See Fig. A-9 in *Appendix A* [p. A-53] for control sample locations.) Each milk sample was analyzed for strontium-90, iodine-129, gamma-emitting radionuclides (naturally occurring potassium-40, cesium-134, and cesium-137), and tritium. In all cases, radioisotopic concentrations, even when positive, were either still within the range of historical background values or statistically overlapped results observed at control locations. See Table C-3.1 (p. C3-3).

Fruit and Vegetables

Results from the analysis of beans, apples, sweet corn, and hay collected during 1996 are presented in Table C-3.3 (p. C3-5) in *Appendix C-3*. Tritium was not detected in near-site corn and bean samples although it does appear in the background samples at levels just above the detection limit.

In 1995 and 1996 positive strontium-90 results were obtained in all samples. Of these positive results, the near-site apple sample, collected from on-site trees not used for human consumption, indicated strontium at a concentration statistically above the 1996 control value. This value was slightly higher than that observed in 1995 but was still within the range of other biological matrix control values. The strontium-90 value in near-site corn also was statistically higher than the control sample but below other matrix control sample concentrations (e.g., beans and apples).

Near-site hay manifested the highest concentration of strontium-90 at levels three times the control level. Although high, this value was not corroborated by increases at the closest air sampling station (AFTCORD), surface soil sampling location (SFTCORD), or water sampling station (WFBCTCB). Subsequent analysis of the original sample suggested that this high value was an artifact of sample analysis.

Neither cesium-137 nor cobalt-60 were detected in these samples.

Direct Environmental Radiation Monitoring

The current monitoring year, 1996, was the thirteenth full year in which direct penetrating radiation was monitored at the WVDP using TLD-700 lithium fluoride thermoluminescent dosimeters (TLDs). These dosimeters, used solely for environmental monitoring, consist of five TLD chips laminated on a card bearing the location identification and other information. The cards are placed at each monitoring location for one calendar quarter (three months) and are then processed to obtain the integrated gamma radiation exposure.

This was the first full year in which TLD packages were processed by an independent off-site contractor. (See *Appendix C*, Tables C-4.1 and C-4.2 [pp. C4-3 and C4-4]). During the analyses of the fourth-quarter TLD packages, the vendor laboratory instruments showed random interference. Many of the initial TLD readouts were obviously biased when compared to historical data and to known facility operations. An attempt to correct for these biases was made and the final data appear very similar to historical values. Since the cause of the bias cannot be attributed to a systematic fault with the instrumentation, it was not possible to adequately validate the fourth-quarter results. Therefore, only the TLD data from the first three quarters of 1996 are presented in this report. Similarly, annual averages and hourly exposure rates discussed here were calculated using only the first three quarters of data and extrapolating for the fourth quarter. The co-located NRC TLD data for the fourth quarter were comparable to previous years' fourth-quarter data. (See *Appendix D*, Table D-4 [p.D-9].)

Monitoring points are located around the WNYNSC perimeter and the access road, at the

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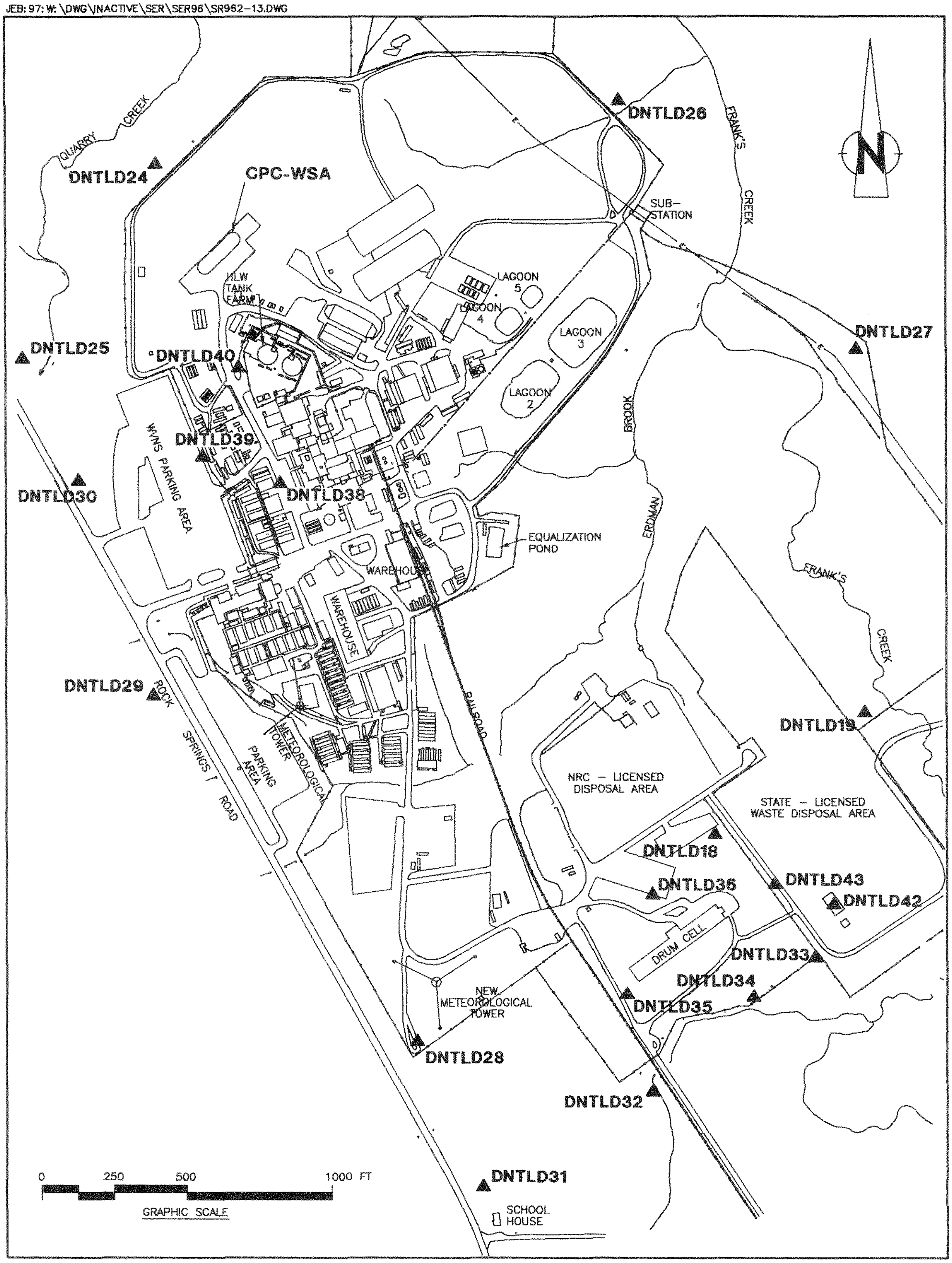

Figure 2–13. Location of On-site Thermoluminescent Dosimeters (TLDs).

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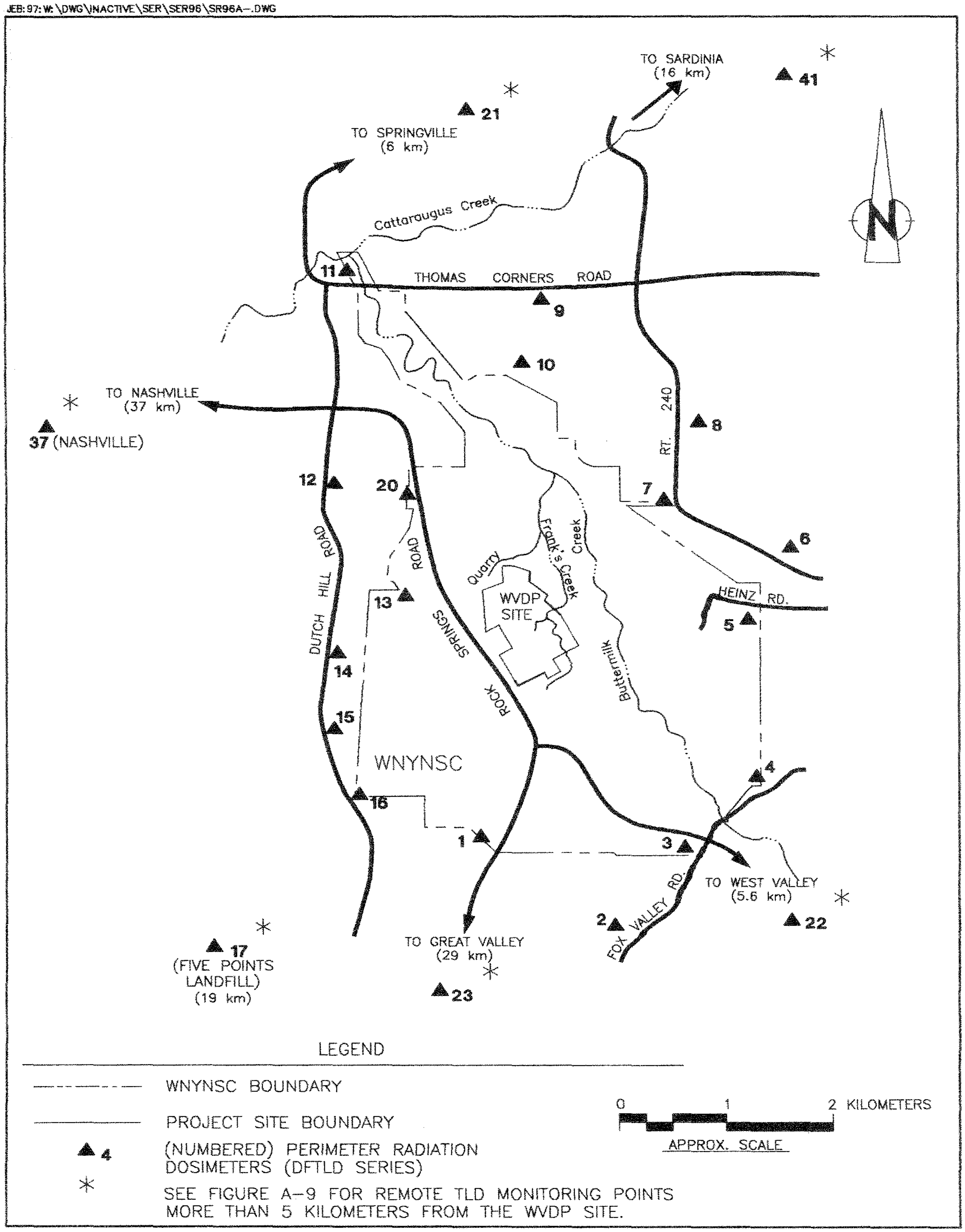

Figure 2-14. Location of Off-site Thermoluminescent Dosimeters (TLDs).

waste management units, at the site security fence, and at background locations remote from the WVDP site (Figs. 2-13 and 2-14 [pp. 2-26 and 2-27] and Fig. A-9 [p. A-53]). The TLDs are numbered in order of their installation. The monitoring locations are as follows:

THE PERIMETER OF THE WNYNSC: TLDs #1-16, #20

THE PERIMETER OF THE SITE SECURITY FENCE: TLDs #24, #26-34

ON-SITE SOURCES OR SOLID WASTE MANAGEMENT UNITS: TLDs #18, #32-36, and #43 (RTS drum cell); #18, #19, #33, #42, and #43 (SDA); #24 (component storage, near the WVDP site security fence); #25 (the maximum measured exposure rate at the closest point of public access); #38 (main plant and the previous cement solidification system); #39 (parking lot security fence closest to the vitrification facility); #40 (high-level waste tank farm).

NEAR-SITE COMMUNITIES: TLDs #21 (Springville); #22 (West Valley)

BACKGROUND: TLDs #17 (Five Points Landfill in Mansfield); #23 (Great Valley); #37 (Nashville); #41 (Sardinia).

Measured exposure rates were comparable to those of 1995. There was no significant difference between the pooled quarterly average background TLDs (#17, #23, #37, and #41) and the pooled average for the WNYNSC perimeter locations for the 1996 reporting period.

Tables C-4.1 and C-4.2 (pp. C4-3 through C4-4) provide a summary of the results by calendar quarter for each of the environmental monitoring locations along with averages for comparison. The quarterly averages and individual location results show differences due to seasonal variation. The data obtained for all four calendar quarters compared favorably to the respective quarterly data in

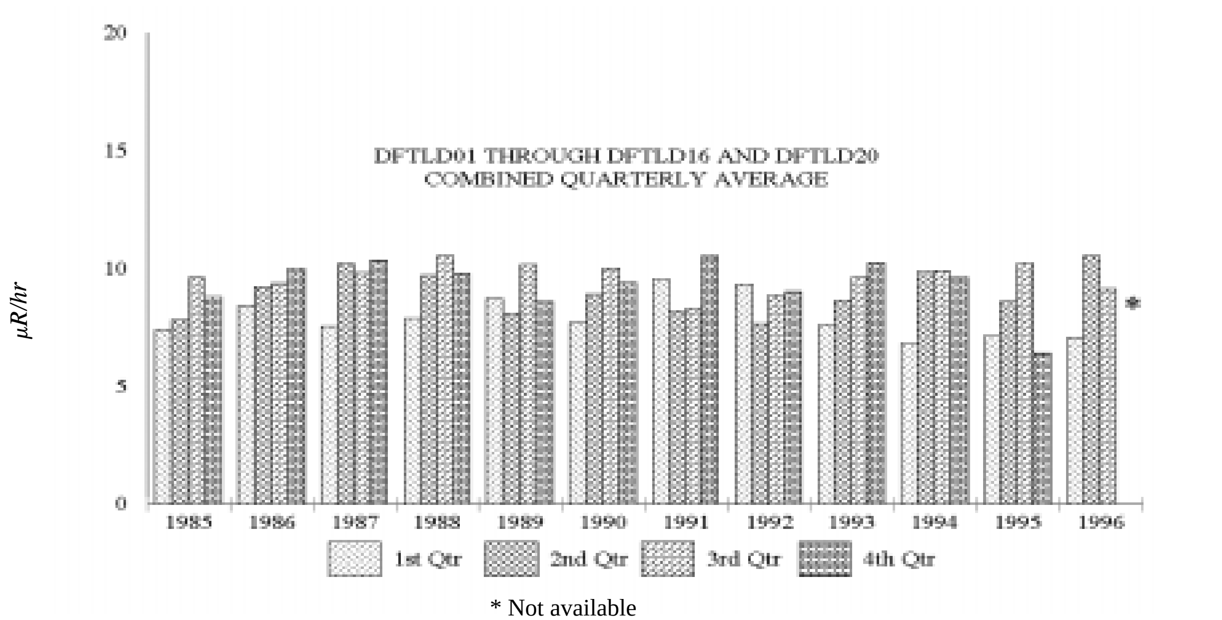

Figure 2-15. Twelve-Year Trend of Environmental Radiation Levels

1995. The quarterly average of the seventeen WNYNSC perimeter TLDs was 19.6 milliroentgen (mR) per quarter (18.7 mrem per quarter) in 1996.

The perimeter TLD quarterly averages since 1985, expressed in microroentgen per hour (μR/hr), are shown in Figure 2-15.

On-Site Radiation Monitoring

Locations #25, #29, and #30 on the public access road west of the facility, #26 at the east security fence, and #19 near the SDA showed small elevations above background. Although above background, the readings are relatively stable from year to year. (See *Appendix C-4*, Table C-4.2 [p. C4-4].)

Location #24 on the north inner facility fence is a co-location site for one NRC TLD. (See *Appendix D,* Table D-4 [p. D-9].) This point received an average exposure of 0.38 milliroentgens (mR) per hour during 1996, as opposed to 0.39 mR/hr in 1995, 0.47 mR/hr in 1994, 0.48 mR/hr in 1993, and 0.52 mR/hr in 1992. Sealed containers of radioactive components and debris from the plant decontamination work are stored nearby. The decline in exposure rate over time is due to radioactive decay of the materials stored within. The storage area is well within the WNYNSC boundary and is not accessible by the public.

Locations around the integrated radwaste treatment storage building — the drum cell — for the most part stayed the same or decreased slightly during the 1996 calendar year. The average dose rate at TLDs #18, #32, #33, #34, #35, #36, and #43 was 0.023 mR/hr in 1996, similar to the level observed in 1995. These exposure rates, which are above background levels, reflect the placement in the building of drums containing decontaminated supernatant mixed with cement. The drum cell and the surrounding TLD locations are well within the WNYNSC boundary and are not accessible by the public.

Results from locations #27, #28, and #31 at the security fence are near background. These locations are more distant from on-site radioactive waste storage areas.

Results for TLD #42 are above background, reflecting its location close to a waste tank that stores SDA leachate.

Perimeter and Off-site Radiation Monitoring

The perimeter TLDs (TLDs #1-16 and #20) are located in the sixteen compass sectors around the facility near the WNYNSC boundary. The quarterly averages for these TLDs (Fig. 2-15) indicate no trends other than normal seasonal fluctuations. TLDs #17, #21-23, #37, and #41 monitor near-site community and background locations. The results from these monitoring points are essentially the same as the perimeter TLDs. Figure C-4.1 in *Appendix C-4* (p. C4-6) shows the average quarterly exposure rate at each off-site TLD location. Figure C-4.2 (p. C4-6) shows the average quarterly exposure rate at each on-site TLD.

Confirmation of Results

The performance of the environmental TLDs is confirmed periodically using a portable high-pressure ion chamber (HPIC) detection system. In August 1996 the HPIC was transported to each of the forty-three environmental TLD locations and three instantaneous dose readings were obtained. The three readings were averaged to determine the dose rate (in μR/hr) at each location. Statistical testing showed no difference between HPIC and TLD results for forty-one of forty-three locations surveyed. Two locations showing greater variability were located near active waste management areas and would have been expected to change during the study period. Results of this study are provided in *Appendix C-4*, Table C-4.3 (p.C4-5).

Meteorological Monitoring

Meteorological monitoring at the WVDP provides representative and verifiable data that characterize the local and regional climatology of the site. These data are used primarily to assess potential effects of routine and nonroutine releases of airborne radioactive materials and dispersion models used to calculate the effective dose equivalent to off-site residents.

Since dispersive capabilities of the atmosphere are dependent upon wind speed, wind direction, and atmospheric stability (which is a function indicated by the difference in temperature between the 10-meter and 60-meter elevations), these parameters are closely monitored and are available to the emergency response organization at the WVDP.

The on-site 60-meter meteorological tower (Fig. 2-1 [p. 2-4]) continuously monitors wind speed and wind direction. Temperatures are measured at both 60-meter and 10-meter elevations. In addition, an independent, remote 10-meter meteorological station located approximately 8 kilometers south of the site on a hillcrest on Dutch Hill Road continuously monitors wind speed and wind direction. (See Fig. A-9 [p. A-53].) Dewpoint, precipitation, and barometric pressure are also monitored at the on-site meteorological tower location.

The two meteorological locations supply data to the primary digital and analog data acquisition systems located within the Environmental Laboratory. On-site systems are provided with either uninterruptible or standby power backup in case of site power failures. In 1996 the on-site system data recovery rate (time valid data were logged versus total elapsed time) was 97.9%. Figures C-6.1 and C-6.2 in *Appendix C-6* (pp. C6-3 and C6-4) illustrate 1996 mean wind speed and wind direction at the 10-meter and 60-meter elevations. Regional data at the 10-meter elevation are shown in Figure C-6.3 (p. C6-5).

Checking Data from the Meteorological Tower

Weekly and cumulative total precipitation data are illustrated in Figures C-6.4 and C-6.5 in *Appendix C-6* (p. C6-6). Precipitation in 1996 was approximately 114.5 centimeters (45 in), 10% above the annual average of 104 centimeters (41 in).

Information such as meteorological system calibration records, site log books, and analog strip charts are stored in protected archives. Electronic files containing meteorological data are copied (downloaded) weekly and stored off-site. Meteorological towers and instruments are examined three times per week for proper function and are calibrated semiannually and/or whenever instrument maintenance might affect calibration.

Special Monitoring

Radon Evaluation

Increased radon-220 emissions from the main stack ventilation system were observed shortly after the start-up of operations in the vitrification facility. (The possibility of increased emissions had been anticipated before vitrification start-up although the exact magnitude could not have been predicted.) Upon evaluation it was found that the emissions corresponded to the time during which high-level waste was concentrated in the concentrator feed make-up tank (CFMT) before being mixed with glass formers. During concentration excess water is evaporated and the waste material is prepared for the final glass-making steps. Such concentration processes are scheduled to occur about thirty-six times per year. The average duration of each CFMT operational cycle is about three days.

The radon-220 emission rate associated with thorium-232 and uranium-232 high-level waste was estimated to be less than 30 curies (Ci) per day, up from the typical 3 Ci emitted per day when the CFMT is not operating. To gauge the potential effect of elevated radon-220 emissions on human health and the environment, data from the main stack sampler (ANSTACK) were used to calculate theoretical doses to the maximally exposed off-site individual. These doses were then compared to the NESHAP (40 CFR Part 61 Subpart H) standard of 10 mrem annual exposure limit for non-radon emissions. This comparison was made only to provide a frame of reference, given that no NESHAP standard exists for radon-220 emissions from facilities such as those at the WVDP. The comparison indicated a 0.05 mrem per year effective dose to the maximally exposed off-site individual. This dose is only 0.5% of the 10 mrem standard. (See *Chapter 4, Radiological Dose Assessment*, for a detailed explanation of dose factors.)

A further evaluation to determine the maximum expected concentration of radon-220 in air downwind of the WVDP showed the concentration at the site boundary (at ground level) to be about 1E-12 μCi/mL in air during periods of typical release. This is at least 100 times lower than natural levels of radon-220 and 3,000 times below the DOE DCG for radon-220 (3E-09 μCi/mL).

In addition, lead-212 (a product of radon-220 decay) was evaluated. The maximum concentration of this isotope, at about 3E-13 μCi/mL in air, is about 300 times lower than its DOE DCG of 8E-11 μCi/mL.

Investigation of Increased Iodine Emissions from the Main Stack

The start of radioactive vitrification operations resulted in an increase in the emission rate of radioactive isotopes of iodine from the main plant stack. The reason for the increase is that gaseous iodine is not as efficiently removed by the vitrification process off-gas treatment system as are most of the other radionuclides. (For more information on the off-site effective dose attributed to this increase see *Chapter 4, Radiological Dose Assessment.)*

Iodine-129 emitted from the main stack increased in 1996. Iodine-129 is a long-lived radionuclide that has always been present in main stack emissions. In addition, iodine-131 was detected in 1996. Iodine-131, an isotope with a half-life of eight days, originates from the decay of curium-244. Curium-244 is present in the high-level waste. Iodine-131 was not detectable until vitrification processing began because the pre-vitrification storage and management of the high-level waste had prevented detectable levels of iodine-131 from reaching the air effluent. The process of preparing the high-level waste for vitrification increased quantities of iodine-129 and allowed a very small, yet detectable quantity of iodine-131 to be released to the main plant stack air effluent through the vitrification process off-gas treatment system.

Iodine-131 also was observed in sludge samples taken in September from the site's waste water treatment facility. There is no connection between the iodine-131 that was observed in the waste water treatment facility and the iodine-131 in the main plant stack ventilation system. The iodine-131 that was observed in the sludge samples was traced to the administration of this radionuclide to a site employee for a medical condition.

NRC-licensed Disposal Area (NDA) Interceptor Trench and Pretreatment System

Radioactively contaminated n-dodecane in combination with tributyl phosphate (TBP) was discovered at the northern boundary of the NDA in 1983, shortly after the Department of Energy assumed control of the WVDP site. Extensive sampling and monitoring through 1989 revealed the possibility that the n-dodecane/TBP could migrate. To contain this subsurface organic contaminant migration, an interceptor trench and liquid pretreatment system (LPS) were built.

The trench was designed to intercept and collect subsurface water, which could be carrying n-dodecane/TBP, in order to prevent the material from entering the surface water drainage ditch leading into Erdman Brook. The LPS was installed to decant the n-dodecane/TBP from the water and to remove iodine-129 from the collected water before its transfer to the low-level waste treatment facility. The separated n-dodecane/TBP would be stored for subsequent treatment and disposal. As in previous years, no water containing n-dodecane/TBP was encountered in the trench and no water or n-dodecane/TBP was treated by the LPS in 1996.

Results of surface and groundwater monitoring in the vicinity of the trench are discussed under *NDA Sampling Locations*, p. 2-10, and **Long-term Trends of Gross Beta and Tritium at Selected Groundwater Monitoring Locations**, p. 3-15.

Northeast Swamp Drainage Monitoring

In 1993 trend analyses of surface and groundwater monitoring results indicated increasing gross beta concentrations in waters discharged through the northeast swamp drainage as monitored at sampling points WNDMPNE and WNSWAMP. (WNDMPNE and WNSWAMP monitored the same location; samples collected as part of the groundwater program were identified as WNDMPNE, since discontinued, and surface water samples were identified as WNSWAMP.)

Upon examination, a small seasonal groundwater seep was discovered that appeared to be a major contributor of strontium-90 to this drainage path. An investigation was initiated to characterize the source of this seep, its effect on surface water quality, and to provide information for mitigative action, if deemed necessary. A series of samples were collected throughout the north plateau area using a Geoprobe® unit. This truck-mounted unit drives a metal sampling rod into the ground to a predetermined depth. Using this method, groundwater and soil beneath and downgradient of the process building were sampled between July 14, 1994 and October 19, 1994. During this investigation, groundwater was collected from eighty locations, and soil samples were collected from four locations.

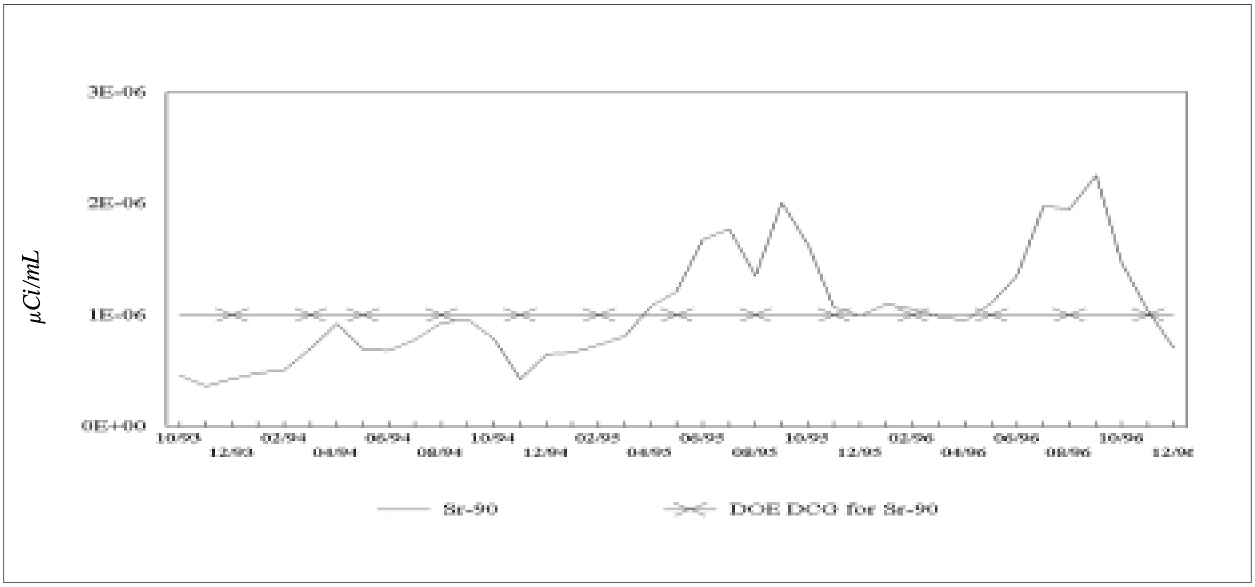

Figure 2-16. Strontium-90 Concentrations at Sampling Location WNSWAMP

Sampling results indicated that a narrow, elliptically shaped plume of elevated gross beta activity, extending northeastward from the south end of the process building to the construction and demolition debris landfill, was present in groundwater within the sand and gravel unit. The plume is approximately 300 feet wide and 800 feet long. The highest gross beta activities in groundwater and soil were measured at two locations near the south end of the process building. Isotopic characterization of the groundwater and soil suggests that strontium-90 and its daughter product, yttrium-90, contribute most of the gross beta activity in groundwater and soil beneath and downgradient of the process building. The primary source of contamination is believed to be an area in the southwest corner of the process building associated with acid recovery operations conducted by the previous site operator, Nuclear Fuel Services, Inc. (NFS), prior to any WVDP activities.

During 1996, routine surface water sampling continued to monitor radiological discharges through the northeast swamp drainage. (See *Appendix C-1*, Table C-1.7 [p. C1-8]). Overall, gross beta and strontium-90 concentrations continue to fluctuate due to seasonal effects. WNSWAMP concentrations tend to decrease during periods of rainfall or snowmelt and to increase during dry weather.

The maximum average monthly gross beta concentration observed at WNSWAMP during 1996 was 4.16 $\pm$ 0.04E-06 μCi/mL (154 $\pm$ 1.48 Bq/L) during September. The average minimum monthly gross beta concentration was 1.42$\pm$0.02E-06 μCi/mL (53 $\pm$0.7 Bq/L), observed in December. Strontium-90 values ranged from 6.96$\pm$0.24E-07 μCi/mL (26$\pm$0.9 Bq/L) in December to 2.26$\pm$ 0.04E-06 μCi/mL (84$\pm$1.5 Bq/L) in September. The DOE DCG of 1.0E-06 μCi/mL (37 Bq/L) for strontium-90 pertains to an annualized average, which currently (January 1996 to December 1996) is 1.33 $\pm$ 0.02E-06 μCi/mL (133% of the DOE DCG). Although the annualized averaged concentration of strontium-90 in surface water exceeded the DOE DCG at sampling location WNSWAMP (on the WVDP premises), monitoring downstream at the first point of possible public access (WFFELBR) continued to show gross beta concentrations to be nearly indistinguishable from background (WFBIGBR). (See ***Off-Site Surface Water Sampling*** [p. 2-11] and Fig. 2-16.)

In November 1995, the WVDP installed and began operation of a groundwater recovery system. Recovered well water is treated and then directed to the site's low-level waste treatment facility for storage before it is discharged to the environment through the monitored lagoon system. To date the system has treated more than 5 million gallons of groundwater. (See p. 3-18 in *Chapter 3, Groundwater Monitoring* for a more detailed discussion.)

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Drum Cell Monitoring

Through May 1995, when liquid pretreatment operations were completed, the integrated radwaste treatment system (IRTS) processed liquid high-level waste (the result of supernatant treatment and sludge wash) and produced 19,877 drums of low-level cement-solidified waste. Drums produced during all phases of liquid waste processing are currently being stored aboveground in the IRTS drum cell.

Most of the gamma radiation emitted from these drums is shielded by the configuration in which the drums are stacked. However, some radiation is emitted through the unshielded roof of the drum cell. Although this radiation scatters in air nearby, the amount added to the existing naturally occurring gamma-ray background at the nearest public access point is barely measurable.

Radiation exposure levels are monitored at various locations around the drum cell perimeter and at the closest location accessible by the public — approximately 300 meters (984 ft) west at the security fence along Rock Springs Road. Baseline measurements had been taken in 1987 and 1988 before the drums were placed. Two types of measurements were taken: instantaneous, using a high-pressure ion chamber (HPIC), and cumulative, using thermoluminescent dosimeters.

The strength of the gamma-ray field can vary considerably from day to day because of changes in meteorological conditions. TLD measurements provide a more accurate estimate of long-term changes in the radiation field because they integrate the radiation exposure over an entire calendar quarter. Such quarterly readings show evidence of a seasonal cycle. Background radiation levels can vary annually depending on such factors as average temperature, air pressure, humidity, precipitation (including snow cover on the ground), and solar activity during a particular year. The TLD measurements at the Rock Springs Road location (TLDs #28 and #31) are presented in *Appendix C-4*, Table C-4.2 (p. C4-4).

The most recent data show that exposure rates at Rock Springs Road are the same as or only slightly greater than those seen before any drums were placed in the drum cell.

Closed Landfill Maintenance

Closure of the on-site nonradioactive construction and demolition debris landfill (CDDL) was completed in August 1986. The landfill area was closed in accordance with the New York State Department of Environmental Conservation (NYSDEC) requirements for this type of landfill, following a closure plan (Standish 1985) approved by NYSDEC. To meet routine post-closure requirements, the CDDL cover was inspected twice in 1996 and was found to be in generally good condition. Some minor repairs were made to maintain an adequate grass cover, and the grass planted on the clay and soil cap was cut. Adequate drainage was maintained to ensure that no obvious ponding or soil erosion occurred. Results of groundwater monitoring in the general area of the closed landfill, i.e., wells 803 and 8612, are presented in *Chapter 3, Groundwater Monitoring*. (See p. 3-14.)

Off-site Soil Sampling

The WVDP periodically is asked to support special studies by local communities. In August 1996 the Seneca Nation of Indians notified the WVDP that an elementary school was being built on the Cattaraugus Indian Reservation. A substantial amount of sand and gravel fill being used in the building foundation had been obtained from a location near the Cattaraugus Creek bed, and the Seneca Nation wanted to know if past site activities had contaminated the creek gravel with radioactive material.

Several representatives from the WVDP, led by a Seneca Nation summer intern working in the on-site Environmental Laboratory, traveled to the construction site and met with tribal leaders. A sample of the fill material was collected and returned to the WVDP for radiological analysis, which showed no radioactive contamination above background levels.

Nonradiological Monitoring

Air Monitoring

Nonradiological air emissions and plant effluents are permitted under NYSDEC and EPA regulations. The regulations that apply to the WVDP are listed in Table B-2 (p. B-4) in *Appendix B*. The individual air permits (certificates to operate) held by the WVDP are identified and described in Table B-3 (pp. B-5 through B-9).

The nonradiological air permits are for emissions of regulated pollutants that include particulates, ammonia, and nitric acid mist. Emissions of oxides of nitrogen and sulfur are each limited to 100 tons per year and are reported to NYSDEC every quarter. Nitrogen oxides emissions for 1996 were approximately 15 tons; sulfur dioxide emissions were approximately 0.5 tons. Monitoring of these parameters currently is not required.

The vitrification off-gas treatment system is equipped with a nitrogen oxides abatement and monitoring system. A relative accuracy test audit performed by the WVDP and witnessed by NYSDEC on May 30, 1996, measured an 11.2% accuracy, well below the 20% standard.

Surface Water Monitoring

Liquid discharges are regulated under the State Pollutant Discharge Elimination System (SPDES). The WVDP holds a SPDES permit that identifies the outfalls where liquid effluents are released to Erdman Brook (Fig. 2-17 [p. 2-36]) and specifies the sampling and analytical requirements for each outfall. This permit was modified in 1990 to include additional monitoring requirements at outfall WNSP001. The WVDP applied for a renewed SPDES permit in 1991. It was received in early January 1994 and went into effect on February 1, 1994 with the expanded monitoring requirements and, in some cases, more stringent discharge limitations. The permit was modified in April, November, and December 1994 and in June 1995. Four outfalls are identified in the 1995 permit:

- outfall WNSP001, discharge from the low-level waste treatment facility

- outfall WNSP007, discharge from the sanitary and industrial wastewater treatment facility

- outfall WNSP008, groundwater effluent from the perimeter of the low-level waste treatment facility storage lagoons.

- outfall 116, a point where compliance with the SPDES permit limit for total dissolved solids is maintained through calculation using monitoring data from upstream sources representing flows from Frank's Creek and Erdman Brook.

The conditions and requirements of the current SPDES permit are summarized in Table C-5.1 (p. C5-3) in *Appendix C-5*.

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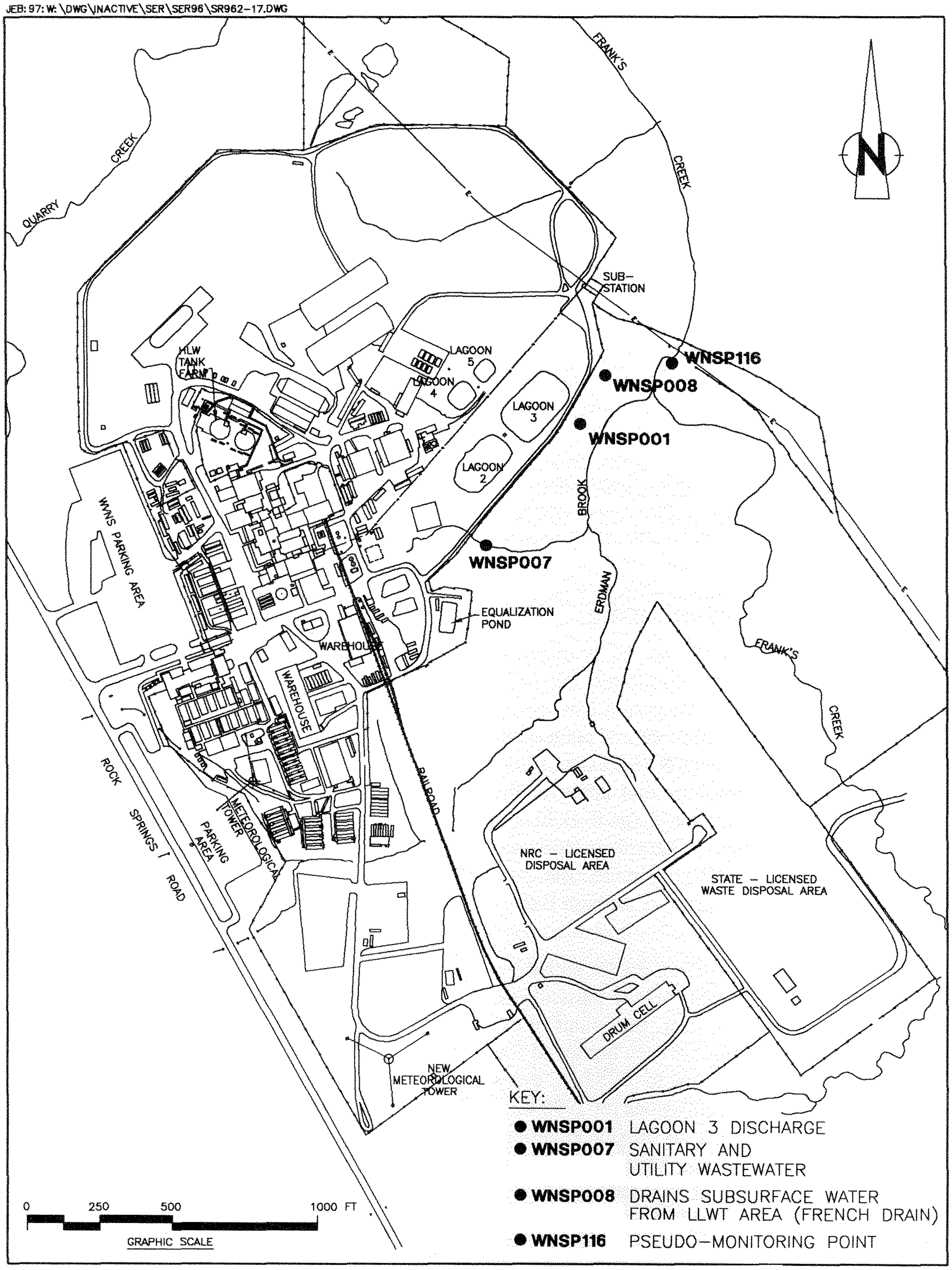

Figure 2-17. SPDES Monitoring Points.

Some of the more significant features of the SPDES permit are the requirements to report five-day biochemical oxygen demand (BOD-5), total dissolved solids, iron, and ammonia data as flow-weighted concentrations and to apply a net discharge limit for iron. The net limit allows the Project to account for amounts of iron that are naturally present in the site's incoming water. The flow-weighted limits apply to the sum of the Project effluents but allow the more dilute effluents to be factored into the formula for determining compliance with permit conditions.

The SPDES monitoring data for 1996 are displayed in Figures C-5.2 through C-5.54 in *Appendix C-5* (pp. C5-6 through C5-23). The WVDP reported two permit exceedances in 1996 (Table C-5.2 [p. C5-4]). See the *Environmental Compliance Summary: Calendar Year 1996* (p. liv).

Semiannual grab samples at locations WNSP006 (Frank's Creek at the security fence), WNSWAMP (northeast swamp drainage), WNSW74A (north swamp drainage), and WFBCBKG (Buttermilk Creek at Fox Valley) were taken in 1996. These samples are screened for organic constituents and selected anions, cations, and metals. Results of these measurements for all of these locations are found in Table C-1.27 (p. C1-21) in *Appendix C-1*.

Results of sampling for nonpurgeable organic carbon (NPOC) and total organic halogens (TOX) at two locations that help monitor the NDA, WNNDADR and WNNDATR are found in Tables C-1.19 and C-1.20 (pp. C1-15 and C1-16). (See Fig. 2-3 [p. 2-6].) When NPOC and TOX values at both locations are compared, the data suggest that even with some fluctuation there is little, if any, significant difference.

Drinking Water Monitoring

The site's drinking water is monitored to verify compliance with EPA and NYSDOH regulations. (See **Safe Drinking Water Act** in the *Environmental Compliance Summary: Calendar Year 1996* [p. lv].)

Samples are collected annually for nitrate, fluoride, and metals concentrations analyses. Sampling and analysis for copper and lead are conducted according to Cattaraugus County Health Department guidance. Except for two maximum contaminant level exceedances for turbidity that occurred early in 1996, monitoring results indicated that the Project's drinking water met NYSDOH, EPA, and Cattaraugus County Health Department drinking water quality standards.

GROUNDWATER MONITORING

Geological History of the West Valley Site

The West Valley Demonstration Project (WVDP) is located on the dissected and glaciated Allegheny Plateau at the northern border of Cattaraugus County in Western New York. The site is underlain by a thick sequence of Holocene (recent) and Pleistocene (ice age) sediments contained in a steep-sided bedrock valley. From youngest to oldest, these unconsolidated deposits consist of alluvial and glaciofluvial silty coarse-grained deposits, which are found almost exclusively in the northern part of the site, and a sequence of up to three fine-grained glacial tills of Lavery, Kent, and possible Olean age, which are separated by stratified fluvio-lacustrine deposits. These glacial sediments are underlain by bedrock composed of shales and interbedded siltstones of the upper Devonian Canadaway and Conneaut Groups, which dip southward at about 5 m/km (Rickard 1975).

The most widespread glacial unit in the site area is the Kent till, deposited between 18,000 and 24,000 years ago toward the end of the Wisconsin glaciation (Albanese et al. 1984). At that time the ancestral Buttermilk Creek Valley was covered with ice. As the glacier receded, debris trapped in the ice was left behind in the vicinity of West Valley. Meltwater, confined to the valley by the debris dam at West Valley and the ice front, formed a glacial lake that persisted until the glacier receded far enough northward to uncover older drainageways. As the ice continued to melt (between 15,500 and 18,000 years ago), more material was released and deposited to form the recessional sequence (lacustrine and kame delta deposits) that presently overlies the Kent till. Continued recession of the glacier ultimately led to drainage of the proglacial lake and exposure of its sediments to erosion (LaFleur 1979).

Between 15,000 and 15,500 years ago the ice began its last advance (Albanese et al. 1984). Material from this advance covered the recessional deposits with as much as 40 meters (130 ft) of glacial till. This unit, the Lavery till, is the uppermost unit throughout much of the site.

The retreat of the Lavery ice left behind another proglacial lake that ultimately drained, allowing the modern Buttermilk Creek to flow northward to Cattaraugus Creek. Post-Lavery outwash and alluvial fans, including the fan that overlies the northern part of the WVDP, were deposited on the Lavery till between 14,200 and 15,000 years ago (LaFleur 1979). The modern Buttermilk Creek has cut the present valley since the final retreat of the Wisconsin glacier.

Surface Water Hydrology of the West Valley Site

The Western New York Nuclear Service Center (WNYNSC) lies within the Cattaraugus Creek watershed, which empties into Lake Erie about 43 kilometers (27 mi) southwest of Buffalo.

The 80-hectare (200-acre) WVDP site is contained within the smaller Frank's Creek watershed. Frank's Creek is a tributary of Buttermilk Creek; Buttermilk Creek, a tributary of Cattaraugus Creek, drains most of the WNYNSC and all of the WVDP facilities.

The WVDP is bounded by Frank's Creek to the east and south and by Quarry Creek (a tributary of Frank's Creek) to the north. Another tributary of Frank's Creek, Erdman Brook, bisects the WVDP into a north and south plateau (Fig. 3-1).

The main plant, waste tanks, and lagoons are located on the north plateau. The drum cell, the U.S. Nuclear Regulatory Commission (NRC)-licensed disposal area (NDA), and the New York State-licensed disposal area (SDA) are on the south plateau.

Hydrogeology of the West Valley Site

The WVDP site area is underlain by glacial tills comprised primarily of clays and silts separated by coarser-grained interstadial layers. The sediments above the second (Kent) till (the Kent recessional sequence, the Lavery till, the Lavery till-sand, and the surficial sand and gravel) are generally regarded as containing all of the potential routes for the migration of contaminants (via groundwater) from the WVDP site. (See Figures 3-2 and 3-3 [pp. 3-4 and 3-5], which show the relative locations of these sediments on the north and south plateaus.)

The Lavery till and the Kent recessional sequence underlie both the north and south plateaus. On the south plateau the upper portion of the Lavery till is exposed at the ground surface and is weathered and fractured to a depth of 0.9 to 4.9 meters (3 to 16 ft). This layer is referred to as the weathered Lavery till.

The remaining thickness of the Lavery till is unweathered. This unweathered Lavery till is predominantly an olive gray, silty clay glacial till with scattered lenses of silt and sand. The till ranges up to 40 meters (130 ft) in thickness beneath the active areas of the site, generally increasing towards Buttermilk Creek and the center of the bedrock valley.

Hydraulic head distributions in the Lavery till indicate that groundwater flow in the unweathered till is predominantly vertically downward at a relatively slow rate, towards the underlying recessional sequence. The mean horizontal hydraulic conductivity of the unweathered till, as determined from sixteen wells tested in 1996, was 4.2×10^{-8} cm/sec (1.2×10^{-4} ft/day). Previous values of vertical and horizontal hydraulic conductivity obtained from laboratory analysis of undisturbed cores and field analyses of piezometer recovery data suggest that the unweathered till is essentially isotropic, i.e., it has equal hydraulic properties in both vertical and horizontal directions.

The underlying Kent recessional sequence consists of alternating deposits of lacustrine clayey silts and coarse-grained kame delta and outwash sands and gravels. These deposits underlie the Lavery till beneath most of the site, pinching out along the southwestern corner where the bedrock valley intersects the sequence.

Groundwater flow in the Kent recessional sequence is predominantly to the northeast, towards Buttermilk Creek. The mean hydraulic conductivity, as determined from thirteen wells tested in 1996,

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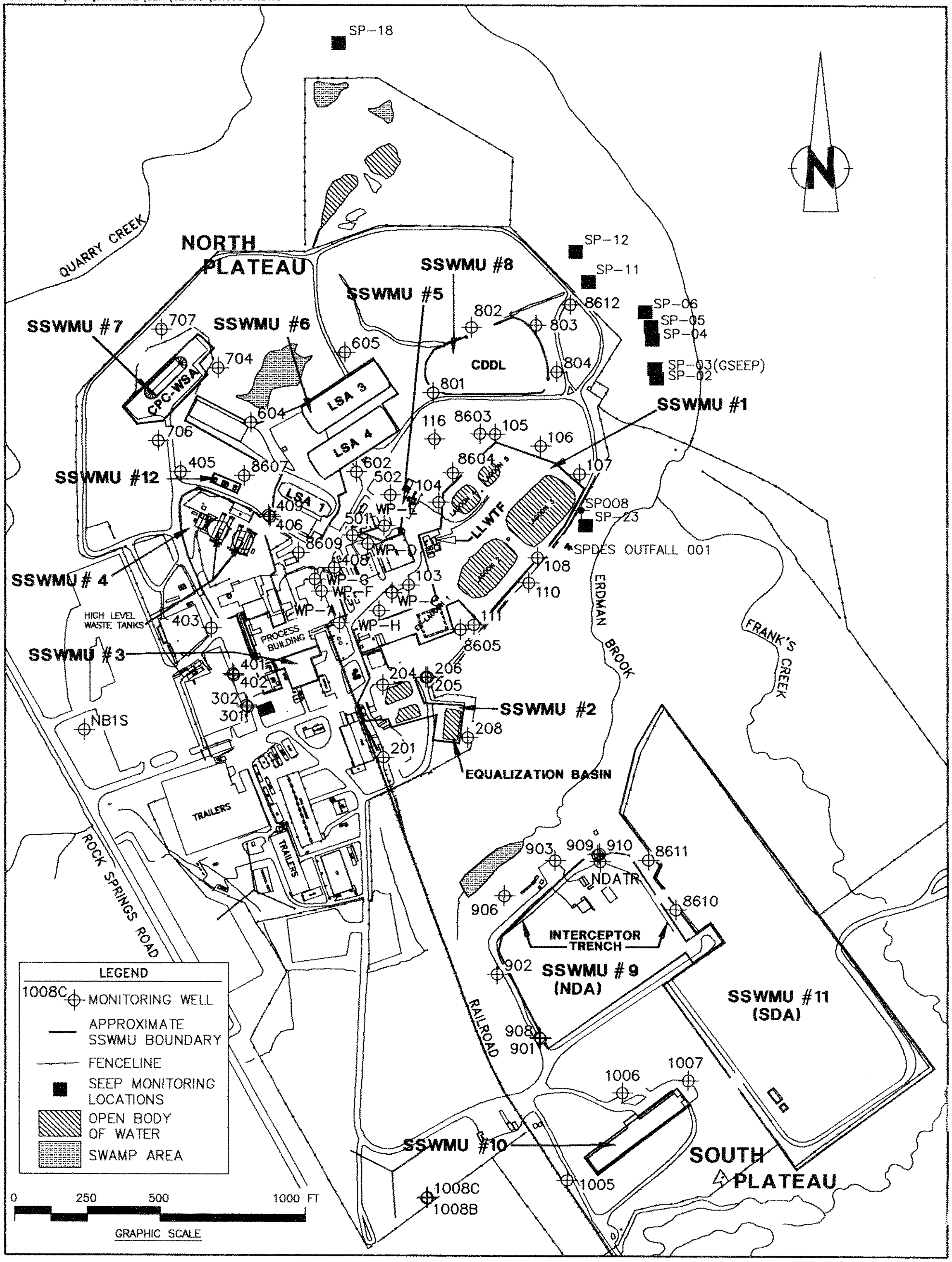


Figure 3–1. WVDP Groundwater Monitoring Program Locations Sampled in 1996.

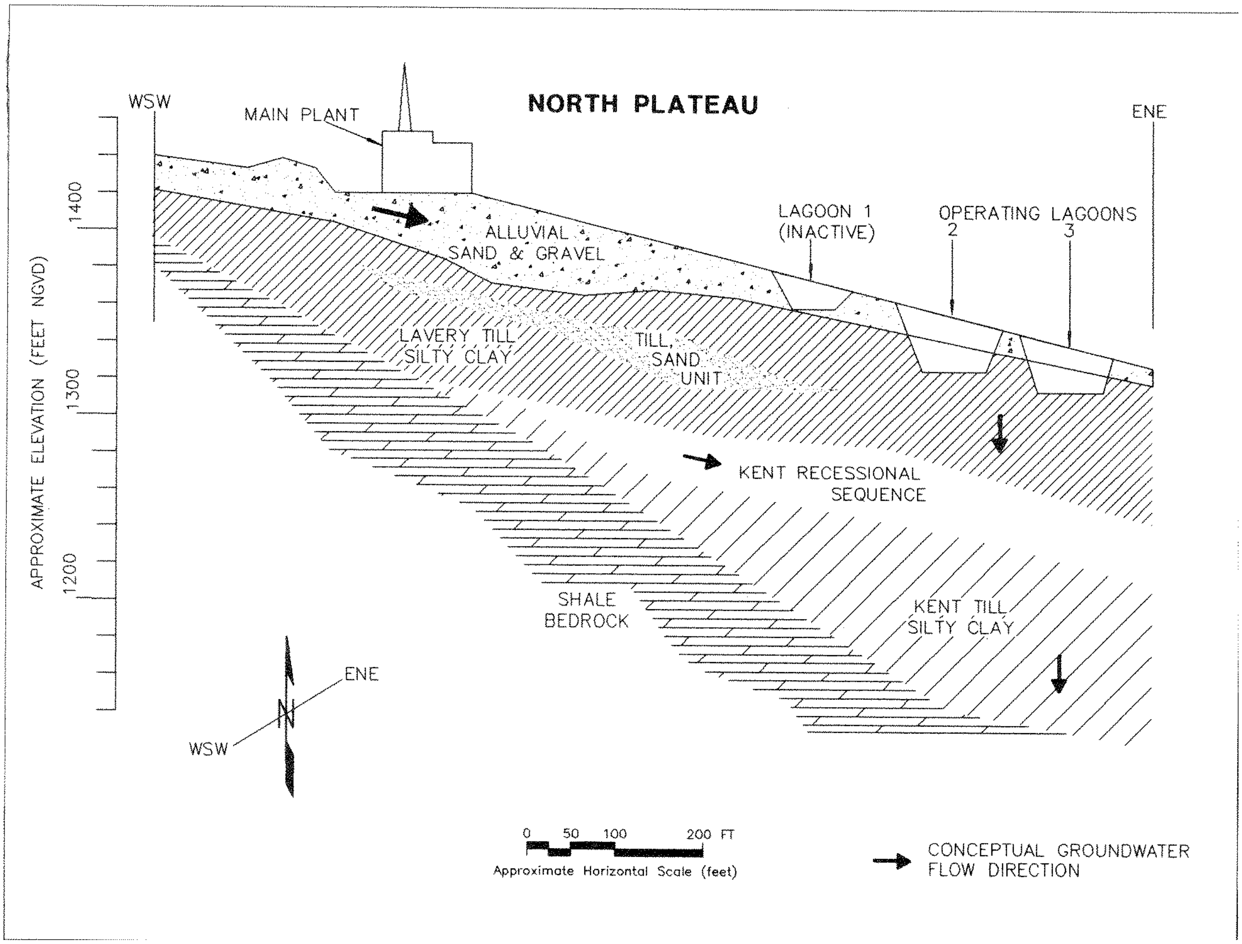


Figure 3-2. Geologic Cross Section through the North Plateau

is approximately 4 x 10^{-5} cm/sec (0.11 ft/day). Recharge comes from the overlying till and the bedrock in the southwest, and discharge is to Buttermilk Creek.

Underneath the recessional sequence is the less permeable Kent till, which does not provide a pathway for contaminant movement from the WVDP and so is not discussed here.

North Plateau

On the north plateau, where the main plant, waste tanks, and lagoons are located, the unweathered Lavery till is immediately overlain by the surficial sand and gravel layer. Within the Lavery till on the north plateau is another unit, the till-sand. A geologic cross section of the north plateau is shown on Figure 3-2.

Surficial Sand and Gravel Layer

The surficial sand and gravel is a silty sand and gravel layer composed of younger Holocene alluvial deposits that overlie older Pleistocene-age glaciofluvial deposits. Together these two layers range up to 12.5 meters (41 ft) in thickness near the center of the plateau and pinch out along the northern, eastern, and southern edges of the plateau, where they have been truncated by the downward erosion of stream channels.

Depth to groundwater within this layer varies from 0 meters to 5 meters (0 ft to 16 ft), being deepest generally beneath the central north plateau (beneath the main plant facilities) and intersecting the surface farther north towards the security fence. Groundwater in this layer generally flows across the north plateau from the southwest (near Rock Springs Road) to the northeast (towards Frank's Creek). Based on the testing of forty-one wells in 1995, the geometric mean hydraulic conductivity is 3.1 x 10^{-4} cm/sec (0.87 ft/day). These new data indicate higher velocities than noted in earlier site reports, which used a smaller data set of twenty-one wells. Groundwater near the northwestern and southeastern margins of the sand and gravel layer flows radially outward toward Quarry Creek and Erdman Brook, respectively. There is minimal groundwater flow downward into the underlying Lavery till.

Lavery Till-sand

On-site investigations from 1989 through 1990 identified a lenticular sandy unit of limited areal extent and variable thickness within the Lavery till, primarily beneath the north plateau. Groundwater flow through this unit apparently is limited by the cross sectional area of the unit's erosional exposure, and surface discharge locations have not been observed. Hydraulic testing in 1996 of seven wells screened in this unit indicated a mean conductivity of 1.1 x 10^{-3} cm/sec (3.1 ft/day).

South Plateau

A geological cross section of the south plateau is shown on Figure 3-3. The uppermost geologic

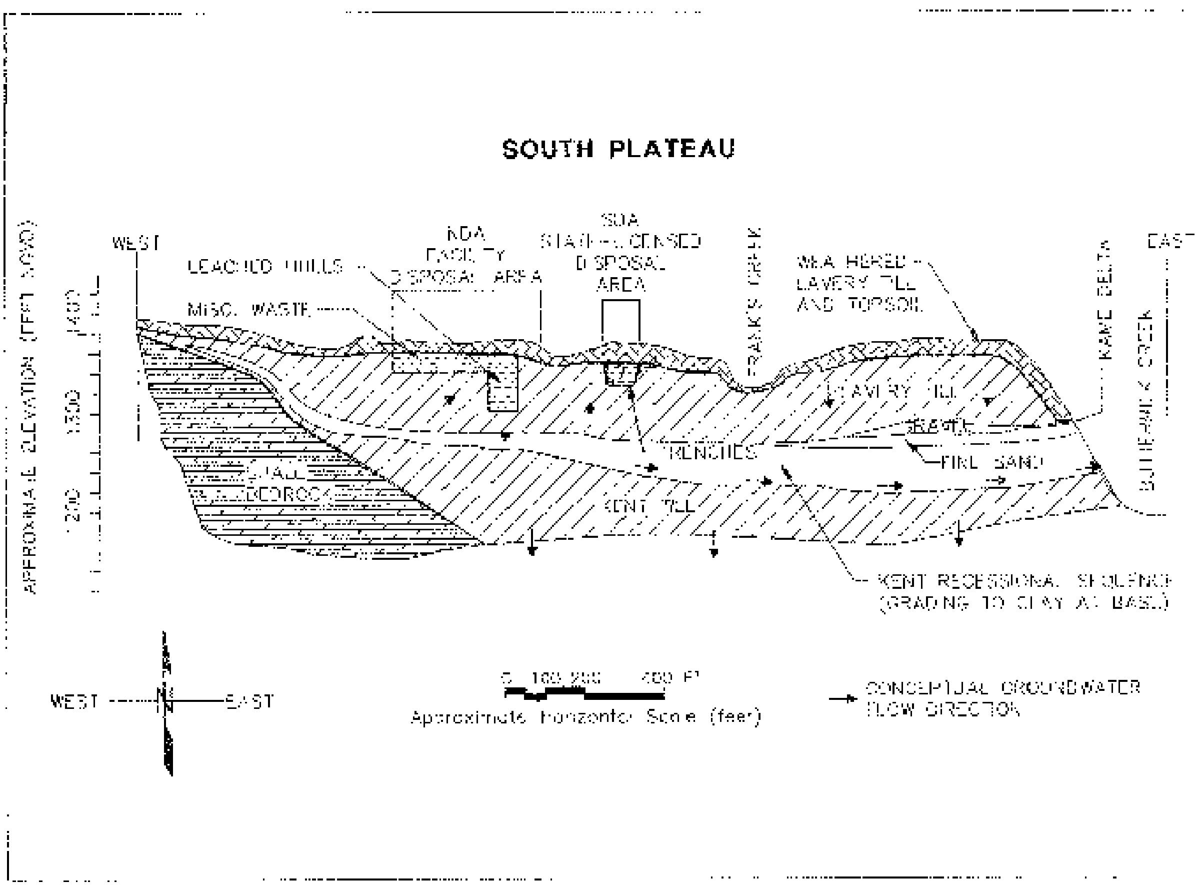


Figure 3-3. Geologic Cross Section through the South Plateau

unit, the weathered Lavery till, is discussed below. The other units (the unweathered Lavery till, the Kent recessional sequence, and the Kent till) were discussed above.

Weathered Lavery Till

On the south plateau, the upper portion of Lavery till exposed at the surface is referred to as the weathered till. It is physically distinct from the underlying unweathered till: it has been oxidized to a brown color and contains numerous fractures and root tubes. The thickness of this layer generally varies from 0.9 meters to 4.9 meters (3 ft to 16 ft). On the north plateau, the weathered till layer is much thinner or nonexistent.

Groundwater flow in the weathered till that occurs in the upper 4.9 meters (16 ft) has both horizontal and vertical components. This enables the groundwater to move laterally across the plateau before moving downward into the unweathered Lavery till or discharging to nearby incised stream channels. The hydraulic conductivity of the weathered till varies from 10^{-8} to 10^{-5} cm/sec (10^{-5} to 10^{-2} ft/day), with the highest conductivities associated with the dense fracture zones (found within the upper 2 meters [7 ft] of the unit).

Groundwater Monitoring Program Overview

Groundwater Monitoring Activities

Current groundwater monitoring activities at the WVDP are summarized in two primary documents, the Groundwater Monitoring Plan (West Valley Nuclear Services Co., Inc. December 1996) and the Groundwater Protection Management Program Plan (West Valley Nuclear Services Co., Inc. 1994). The Groundwater Monitoring Plan focuses on long-term monitoring requirements specified under the RCRA facilities investigation and DOE programs. The Groundwater Protection Management Program Plan provides additional information regarding protection of groundwater from on-site activities.

The categories of groundwater sampling parameters collected and the 1996 sampling schedule for these parameters are noted in Table 3-1. Potentiometric (water level) measurements also are collected from the wells listed in Table 3-2 (pp.3-22 through 3-27) in conjunction with the quarterly sampling schedule. Water level data is used to determine groundwater flow directions and gradients.

Monitoring Well Network

The purpose of groundwater monitoring is to detect changes in groundwater quality within the five different hydrogeologic units discussed above: the sand and gravel unit, the weathered Lavery till, the unweathered Lavery till, the Lavery till-sand unit, and the Kent recessional sequence.

Table 3-2 lists the eleven super solid waste management units (SSWMUs) monitored by the well network; the hydraulic position of each well within the waste management unit; the analytes measured in 1996; the geologic unit monitored; and the depth of each well. Note that monitoring of wells marked by an asterisk is required by the RCRA 3008(h) Administrative Order on Consent. (See the *Environmental Compliance Summary: Calendar Year 1996*, **RCRA Facility Investigation [RFI] Program** [p. xlviii].)

Figure 3-1 (p. 3-3) shows the boundaries of these eleven super solid waste management units at the WVDP. (Twenty-one of the wells are in the New York State-licensed disposal area [SDA] and are the responsibility of the New York State Energy Research and Development Authority [NYSERDA]. Although the SDA is a closed radioactive waste landfill contiguous with the Project

Table 3 - 1
1996 Groundwater Sampling and Analysis Agenda

ANALYTE GROUP	DESCRIPTION OF PARAMETERS [1]	LOCATION OF SAMPLING RESULTS IN APPENDIX E
Contamination Indicator Parameters (I)	pH, specific conductance (field measurement)	Tables E-1 through E-5 (pp.E-3 through E-10)
Radiological Indicator Parameters (RI)	Gross alpha, gross beta, tritium	Tables E-1 through E-5 (pp.E-3 through E-10)
Groundwater Quality Parameters (G)	Alkalinity, aluminum, calcium, chloride, iron, magnesium, manganese, nitrate/nitrite, phosphate, potassium, sodium, silica, sulfate, sulfide	Table E-6 (pp.E-11 through E-12)
RCRA Hazardous Constituent Metals (M)	Antimony, arsenic, barium, beryllium, cadmium, lead, chromium, mercury, nickel, selenium, silver, thallium	Table E-10 (pp. E-17 through E-24)
Volatile Organic Compounds (V)	Appendix IX VOCs (see Table E-7)	Table E-8 (p. E-16)
Semivolatile Organic Compounds (SV)	Appendix IX SVOCs (see Table E-7)	Table E-9 (p. E-16)
Expanded Compound List: V, SV, and Appendix IX Metals (E)	Appendix IX VOCs, SVOCs, and metals (see Table E-7)	Tables E-8, E-9, and E-10 (pp. E-16 and E-17 through E-24)
Radioisotopic Analyses: alpha, beta, and gamma-emitters (R)	C-14, Cs-137, I-129, Ra-226, Ra-228, Sr-90, Tc-99, U-232, U-233/234, U-235/236, U-238, total uranium	Table E-12 (pp. E-26 through E-27)
Strontium-90 (S)	Sr-90	Table E -12 (pp. E-26 through E-27)
Special Monitoring Parameters (SM)	Arsenic, aluminum, cadmium, chromium, cobalt, copper, iron, lead, manganese, nickel, selenium, vanadium, zinc	Table E-11 (p. E-25)

[1] *Analysis performed at selected active monitoring locations only. See Table 3-2 for the analytes sampled at each monitoring location.*

1996 Quarterly Sampling Schedule:
1st Qtr - December 4, 1995 to December 13, 1995
2nd Qtr - March 4, 1996 to March 13, 1996
3rd Qtr - June 3, 1996 to June 14, 1996
4th Qtr - September 3, 1996 to September 16, 1996

premises, the WVDP is not responsible for the facilities or activities relating to it. Under a joint agreement with the DOE, NYSERDA contracts with the Project to obtain specifically requested technical support in SDA-related matters. The 1996 groundwater monitoring results for the SDA are reported in this document in *Appendix F* [pp. F-1 through F-9].)

Table 3-2 identifies the position of a monitoring location relative to the waste management unit. The wells monitoring a given hydrogeologic unit (e.g., sand and gravel, weathered Lavery till) also may be arranged in a generalized upgradient to downgradient order based upon their location within the entire hydrogeologic unit. The hydraulic position of a well relative to a SSWMU, i.e., upgradient or downgradient, does not necessarily match that same well's position within a hydrogeologic unit. For example, a well that is upgradient in relation to a SSWMU may be located at any position within a hydrogeologic unit, depending on the geographic position of the SSWMU within the hydrogeologic unit. In general, the following text and graphics refer to the hydraulic position of monitoring wells within their respective hydrogeologic units, thus providing a site-wide hydrogeologic unit perspective.

History of the Monitoring Program

The groundwater monitoring program is designed to support DOE Order 5400.1 requirements and the RCRA 3008(h) Administrative Order on Consent. In general, the nature of the program is dictated by these requirements in conjunction with current operating practices and historical knowledge of previous site activities.

Groundwater Monitoring Program Highlights 1982 to 1996

• WVDP groundwater monitoring activities began in 1982 with the monitoring of tritium in the sand and gravel unit in the area of the lagoon system.

• By 1984 twenty wells in the vicinity of the main plant and the NDA provided monitoring coverage.

• Fourteen new wells, a groundwater seep location, and the french drain outfall were added in 1986 to provide monitoring of additional units.

• Ninety-six new wells were installed in 1990 to support data collection for the environmental impact statement and RCRA facility investigations.

• A RCRA facility investigation expanded characterization program was conducted during 1993 and 1994 to fully assess potential releases of hazardous wastes or constituents from on-site SSWMUs. This investigation, which consisted of two rounds of sampling for a wide range of radiological and chemical parameters, yielded valuable information regarding the presence or absence of contamination at each SSWMU and was also used to guide later monitoring program modifications.

• Long-term monitoring needs were the focus of 1995 groundwater monitoring program evaluations. A comprehensive assessment reduced the number of sampling locations from ninety-one to sixty-five, for a more efficient and cost-effective program.

• Wells, analytes, and sampling frequencies continued to be modified in 1996 in response to DOE and RCRA monitoring requirements.

1996 Groundwater Monitoring Program Highlights

Analytical Trigger Limits

A new program using "trigger limits" for all chemical and radiological analytes was instituted in 1996. These pre-set limits are conservative values for chemical or radiological concentrations that were developed to expedite a prompt focus on any monitoring anomalies.

North Plateau Seep Monitoring

A 1994 survey of groundwater seepage along the edges of the north plateau identified a number of seeps where (northeastward-flowing) groundwater from the sand and gravel unit discharges at the ground surface (Fig. 3-4 [p.3-10]).

Nine seeps were selected for quarterly sampling for radiological indicators in order to demonstrate that contamination is not emanating along the plateau edge. The nine seeps were selected because the amount of water available for sampling would be sufficient and because they are downgradient of the gross beta plume. (See **Interim Mitigative Measures Near the Leading Edge of the Gross Beta Plume on the North Plateau** [p. 3-18].) The extreme northern and southern seeps were selected for sampling in order to broaden the coverage. (See Fig. 3-4 [p.3-10].)

Evaluation of the sampling results included comparing the concentrations of the chosen analytes to concentrations in samples from GSEEP, an historical seep monitoring location that is not influenced by the gross beta plume. Concentrations in seep samples also were trended to identify any increases over time. A full year of quarterly sampling shows that the concentrations of radiological indicators at the seeps are similar to concentrations in samples from GSEEP, indicating that gross beta contamination is not emanating from the plateau edge. (See **Results of Seep Sampling** [p. 3-14].)

Monitoring at the nine seep sampling locations is scheduled to continue semiannually. Sampling pipes were installed at six of the seeps before the third-quarter 1996 sampling round to improve the quality of samples previously collected at the ground surface and to reduce potential analytical interferences caused by turbidity. The turbidity of samples from these seeps was greatly reduced, allowing more accurate results to be obtained.

North Plateau Groundwater Recovery System Upgrades

Another improvement to the groundwater monitoring system was the addition of a third recovery well in the north plateau groundwater recovery system (NPGRS) to enhance recovery of gross beta contamination on the north plateau. This contamination is the result of previous nuclear fuel reprocessing activities conducted at the facility.

Other modifications included improving surface drainage to minimize the recharge of groundwater in areas of contamination.

Monitoring at Main Plant Area Well Points

Samples obtained from the main plant area well points are analyzed annually for radiological indicator parameters. In 1996 the need for continued monitoring at these well points was assessed, and the decision made to continue sampling only at well points A, C, and H because nearby active monitoring wells provide adequate coverage.

1996 Groundwater Monitoring Results

Successful implementation of the WVDP's groundwater monitoring program includes proper placement of groundwater monitoring wells, using appropriate methods of sample collection, reviewing analytical data and quality assurance information, and presenting, summarizing, and evaluating the resulting data appropriately. Data are presented in this report through tables and graphs.

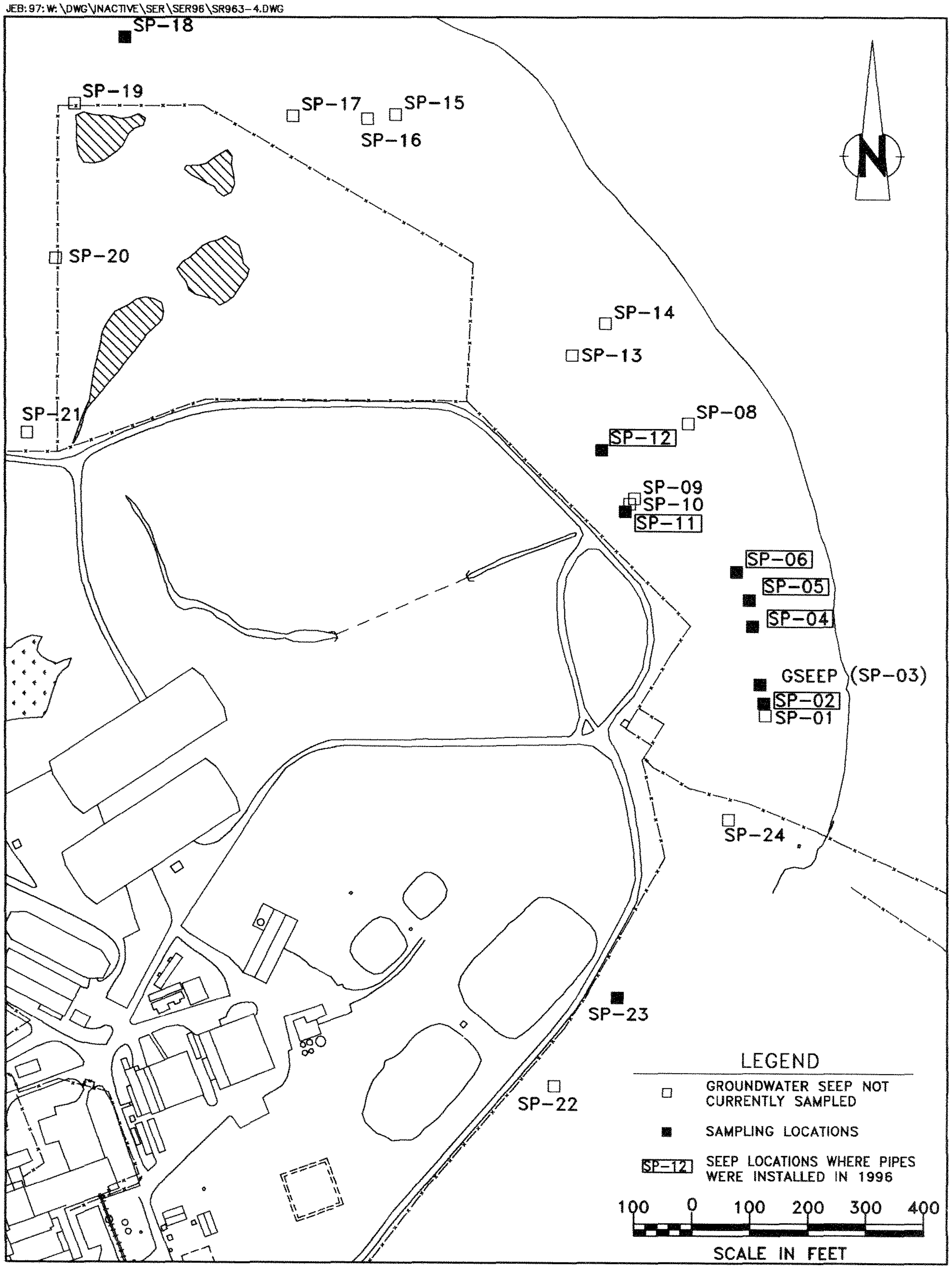


Figure 3-4. Seep Monitoring Locations in the Sand and Gravel Unit.

Four designations are often used to indicate a well's function within the groundwater monitoring program:

Upgradient well. *A well installed hydraulically upgradient of a SSWMU that is capable of yielding groundwater samples that are representative of local conditions and that are not affected by the SSWMU being monitored.*

Downgradient well. *A well installed hydraulically downgradient of a SSWMU that is capable of detecting the migration of contaminants from the SSWMU.*

Background well. *A well installed hydraulically upgradient of all SWMUs and SSWMUs that is capable of yielding groundwater samples that are representative of conditions not affected by site activities. In some cases upgradient wells may be downgradient of other SSWMUs or SWMUs, which makes them unsuitable for use as true background wells. However, they are still useful for providing upgradient information about the waste management unit under study.*

Crossgradient well. *A well installed to the side of the major downgradient flow path such that the well is neither upgradient nor downgradient of the monitored SSWMU.*

Presentation of Results in Tables

The tables in *Appendix E* (pp. E-1 through E-28) present the results of groundwater monitoring grouped according to the five hydrogeologic units monitored: the sand and gravel unit, the Lavery till-sand unit, the weathered Lavery till unit, the unweathered Lavery till unit, and the Kent recessional sequence.

These tables contain the results of 1996 sampling for the analyte groups noted on Table 3-1 (p. 3-7).

Table E-7 (pp. E-13 through E-15) lists the practical quantitation limits (PQLs) for individual analytes.

Appendix E tables also display each well's hydraulic position relative to other wells within the same hydrogeologic unit.

- Wells identified as UP refer to either background or upgradient wells that are upgradient of all other wells in the same hydrogeologic unit.

- Downgradient locations are designated B, C, or D to indicate their positions along the groundwater flow path relative to each other. Wells denoted as DOWN - B are closest to the UP wells. Wells denoted as DOWN - C are downgradient of DOWN - B wells but are upgradient of DOWN - D wells. DOWN - D wells are downgradient of all other wells on-site.

Grouping the wells by hydraulic position provides a logical basis for presenting the groundwater monitoring data in the tables and figures in this report.

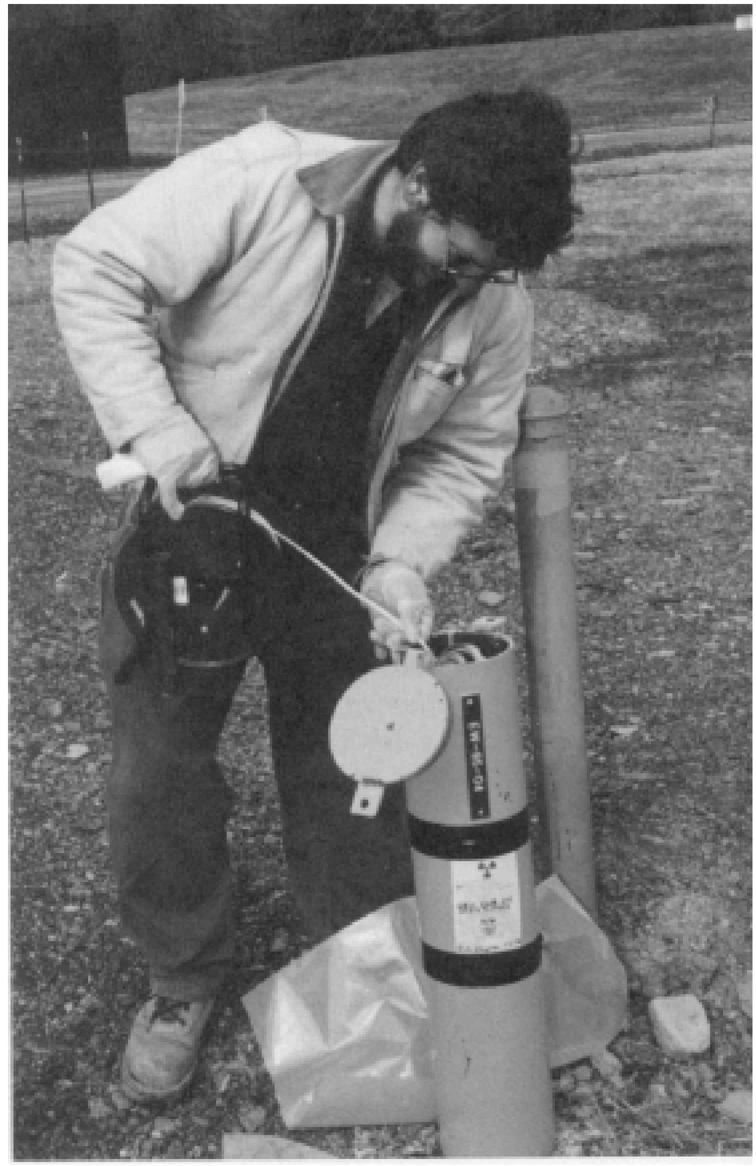
These tables also list the sample collection periods. The 1996 sampling year covers the period from December 1995 (the first quarter of 1996) through October 1996 (the fourth quarter of 1996).

Presentation of Results in Graphs

In previous years well NB1S was used as the background reference well for the sand and gravel unit. However, background comparisons now use the collective monitoring results from three upgradient wells (301, 401, and 706) as a way of better representing the natural spatial variability within the geologic unit. Both DOE and NYSDEC have accepted the use of this collective background reference instead of well NB1S, and so the range of background values will be used here for purposes of comparison.

High-Low Graphs (pp. 3-28 through 3-37)

Graphs showing the 1996 measurements for contamination and radiological indicator parameters (pH, conductivity, gross alpha, gross beta, and tritium) have been prepared for all active monitoring locations in each geologic unit. These graphs allow results for wells within a given hydrogeologic unit to be visually compared to each other.



Measuring Water Levels in a Groundwater Monitoring Well

All the high-low graphs present the upgradient wells on the left side of the figure. Downgradient locations are plotted to the right according to their relative position along the groundwater flow path.

On the nonradiological graphs (pH and conductivity), the upper and lower tick marks on the vertical bar indicate the highest and lowest measurements recorded during 1996. The middle tick represents the arithmetic mean of all 1996 results. The vertical bar thus represents the total range of the data set for each monitoring location.

On the radiological graphs (gross alpha, gross beta, and tritium), the middle tick also represents the arithmetic mean of all 1996 results. However, the upper and lower tick marks on the vertical bar indicate the upper and lower ranges of the pooled error terms for all 1996 results. This format illustrates the relative amount of uncertainty associated with the measurements. By displaying the uncertainty together with the mean, a more realistic perspective is obtained. (See also *Chapter 5*, **Data Reporting** [p. 5-7].)

The sample counting results for gross alpha, gross beta, and tritium, even if below the minimum detectable concentrations, were used to generate the high-low graphs. Thus, negative values were included. This is most common for the gross alpha analyses, where sample radiological counting results may be lower than the associated instrument background.

Trend-Line Graphs (pp. 3-37 through 3-40)

Trend-line graphs have been used to show concentrations of a particular parameter over time at monitoring locations that have historically shown concentrations above background values. Results for the volatile organic compounds 1,1-dichloroethane (1,1-DCA) at wells 8609 and 8612, dichlorodifluoromethane (DCDFMeth) at wells 803 and 8612, and 1,2-dichloroethylene (1,2-DCE) at well 8612 are plotted in Figures 3-32, 3-33, and 3-34 (pp. 3-37 and 3-38). (See also Table E-8 [p. E-16]). Trends of gross beta and tritium at selected groundwater monitoring locations (104, 111, 408, 501, 502, 801, 8603, 8604, 8605, and GSEEP) are shown in Figures 3-35 through 3-36a (pp. 3-39 and 3-40).

The radionuclides present at the WVDP site are residues from the reprocessing of commercial nuclear fuel during the 1960s and early 1970s. A very small fraction of these radionuclides is released off-site during the year through ventilation systems and liquid discharges and makes a negligible contribution to the radiation dose to the surrounding population through a variety of exposure pathways.

Radiological Parameters Measured

Samples for isotopic analyses are collected regularly from sixteen monitoring points, which are located mainly in the sand and gravel unit and the weathered Lavery till. (See Table E-12 [pp. E-26 through E-27].)

Results from 1996 confirmed historical findings. Strontium-90 remained the major contributor to elevated gross beta activity in the plume on the north plateau. Concentrations of other isotopes either remained close to detection levels or were slightly above background (at specific wells within the gross beta plume and downgradient of inactive lagoon 1). In all cases, with the exception of strontium-90, these activities remain far below the DCGs and no increasing trends are evident.

Since concentrations of strontium-90 can be inferred from historical results as a percentage of gross beta concentrations, analyzing for both parameters is no longer needed: Results from the analyses for gross beta (allowing at least ten days for samples to reach equilibrium with respect to yttrium-90 ingrowth) can be multiplied by 40% to 50% to arrive at an approximation of the strontium-90 concentrations.

Technetium-99, iodine-129, and carbon-14 radionuclides, which were previously noted at several monitoring locations at concentrations above background levels, have been demonstrated to comprise very small percentages of total gross beta concentrations. While elevated levels have been noted at specific locations since 1993, none have been above DCGs, and gross beta analyses continue to provide surveillance on a quarterly basis.

Volatile and Semivolatile Organic Compounds

Volatile and semivolatile organic compounds were sampled at specific locations (wells 8612, 8609, 803, and 111) that have shown results above their respective practical quantitation levels (PQLs) in the past. (The PQL is the lowest level that can be measured within specified limits of precision during routine laboratory operations on most matrices.[New York State Department of Environmental Conservation 1991]. See Table E-7 [pp. E-13 through E-15] for a list of PQLs.) Other locations are monitored for volatile and semivolatile organic compounds because they are downgradient of locations showing positive results.

The 1996 trends in concentrations of the compound 1,1-dichloroethane (1,1-DCA) are illustrated in Figure 3-32 (p.3-37). Concentrations of 1,1-DCA at well 8612 remained consistent with results from previous years. At well 8609 1,1-

DCA was not detected at all during 1996, and at well 803 it was detected only once (below the PQL). Very low concentrations of 1,1-DCA also were detected at groundwater seep SP-12 during the fourth quarter of 1996; during a confirmatory resampling in November 1996 the compound was reported at estimated concentrations below the PQL. (See Table E-8 [p. E-16].)

Trends of dichlorodifluoromethane (DCDFMeth) concentrations are shown in Figure 3-33 (p. 3-38). The concentrations of DCDFMeth at well 8612 remained at low levels in 1996 — near the detection limit. DCDFMeth was identified at well 803 either at concentrations below the PQL or was not detected at all. At SP-12, DCDFMeth was identified at concentrations below the PQL during the fourth quarter of 1996 and again during the resampling in November 1996.

Other VOC trends (Fig. 3-34 [p. 3-40]) include 1,2-dichloroethylene (1,2-DCE) at well 8612, which increased slightly during the fourth quarter of 1996. (This compound was first detected in 1996.) Concentrations of the compound 1,1,1-trichloroethane (1,1,1-TCA) also were detected at well 8612 close to or below the PQL.

Aqueous concentrations of tributyl phosphate (TBP) were detected at well 8605 at much lower concentrations than in 1995. At well 111, which is next to well 8605, TBP was not found above the detection limit.

Possibly related to the ongoing detection of TBP in this area, 1996 monitoring data show the continuing presence of low, positive concentrations of iodine-129 and uranium-232 in wells 0111 and 8605, as noted in previous annual Site Environmental Reports. (See Table E-12 [p. E-26].) The presence of all three contaminants is consistent with the observation that these samples reflect historical fuel reprocessing and waste disposal activities in the former lagoon 1 area.

Results of Seep Sampling

Analytical results of sampling the sand and gravel unit seepage locations for radiological parameters have been time-trended and have been compared to the levels found at GSEEP, which has been monitored since 1991 and apparently exhibits no influences from the gross beta plume. There was one round of routine sampling for VOCs at seepage location SP-12 during 1996. (See **Volatile and Semivolatile Organic Compounds** [p. 3-13]). Results were compared to concentrations in wells downgradient of the CDDL.

Gross alpha and gross beta concentrations at the sampled seeps during 1996 remained similar in magnitude to GSEEP. (Seep SP-18 could not be sampled during the fourth quarter because it was dry. Seep SP-23 was dry during all four sampling rounds.) Gross alpha concentrations have remained particularly steady, but some fluctuations in gross beta are apparent. In general, the fluctuations follow the pattern of those measured at GSEEP. (See also Table E-14 [p. E-28].)

Tritium concentrations at the seeps also appeared similar in magnitude to those at GSEEP. Concentrations in all the seeps were slightly above background, and all locations indicated slight increases in 1996. Large negative values for tritium at SP-18 are believed to have resulted from interference by dissolved organic material in the undistilled sample. This interference reduces the efficiency with which the radiation detection instrumentation can quantify tritium concentrations and thus produces results that apparently are below background levels. Sampling from pipes has improved the water quality.

The results collected to date suggest that gross beta concentrations are within background levels. Modifications to the sampling locations were made in an effort to reduce the turbidity of samples. It is believed that the sediment in the samples may have contributed to the elevated gross alpha concentrations from naturally occurring alpha-emitting radionuclides in the soil. (Gross alpha results from the first quarter of 1996 were most notably affected.) Samples from GSEEP are collected via a small-diameter polyvinyl chloride (PVC) pipe; these samples typically contain less sediment, which indicates that the grab-sampling technique used at other seeps may be introducing sediment that affects radiological results. In mid-August, small-diameter slotted PVC pipes were inserted horizontally at locations SP-02, SP-04, SP-05, SP-06, SP-11, and SP-12 and are now being used for sample collection.

Long-term Trends of Gross Beta and Tritium at Selected Groundwater Monitoring Locations

Figures 3-35 through 36a (pp. 3-39 and 3-40) show the trends of gross beta activity and tritium at selected monitoring locations. These specific groundwater monitoring locations in the sand and gravel unit were selected for trending because they have shown elevated or rising levels of gross beta activity or steady or falling levels of tritium. Results are presented on a logarithmic scale to adequately represent locations of differing concentrations.

Gross Beta

The plume of gross beta activity on the north plateau (Fig. 3-5 [p.3-16]) continues to be monitored closely. Nine wells in the sand and gravel unit (104, 111, 408, 501, 502, 801, 8603, 8604, and 8605) contain elevated levels of gross beta activity, i.e., greater than 1.0E-06 μCi/mL, the DOE DCG for strontium-90.

The average background concentration is plotted on each graph for comparison purposes. All wells shown in these figures monitor the sand and gravel unit.

Figure 3-35a (p. 3-39) shows gross beta concentrations in wells 104, 111, 408, 501, 502, and 801 over the six-year period that the WVDP's current groundwater monitoring program has been in place.

As in previous years, well 408 continues to contain the highest gross beta levels. (Fig. 3-5 [p.3-16] and 3-35a.) Wells 104, 801, and 502 show increasing gross beta activities. Wells 111 and 501 show fairly steady concentrations.

• Figure 3-35 [p. 3-39] is a graph of gross beta activity at monitoring locations 8603, 8604, 8605, and GSEEP. The trend at 8604 appears to have leveled off after several years of steep increases. Results from well 8603 have continued to show a steady upward trend. The source of the increasing gross beta activity can be traced to the groundwater plume originating from beneath the former process building.

• Lagoon 1, formerly part of the low-level waste treatment facility, has been identified as a source of the gross beta activity at wells 8605 and 111. The gross beta concentrations at both wells have remained relatively steady over the entire eleven-year (well 8605) and six-year (well 111) monitoring periods.

Tritium

• Figure 3-36 (p. 3-40) shows the eleven-year trend of tritium concentrations at monitoring locations 8603, 8604, 8605, and GSEEP. Wells 8603 and 8604 indicate gradually declining trends in tritium.

• Figure 3-36a (p. 3-40) shows the tritium concentrations in wells 104, 111, 408, 501, 502, and 801 over the six-year period that the WVDP's current groundwater monitoring program has been in place. The figure shows that tritium concentrations in well 111 apparently have decreased over recent years.

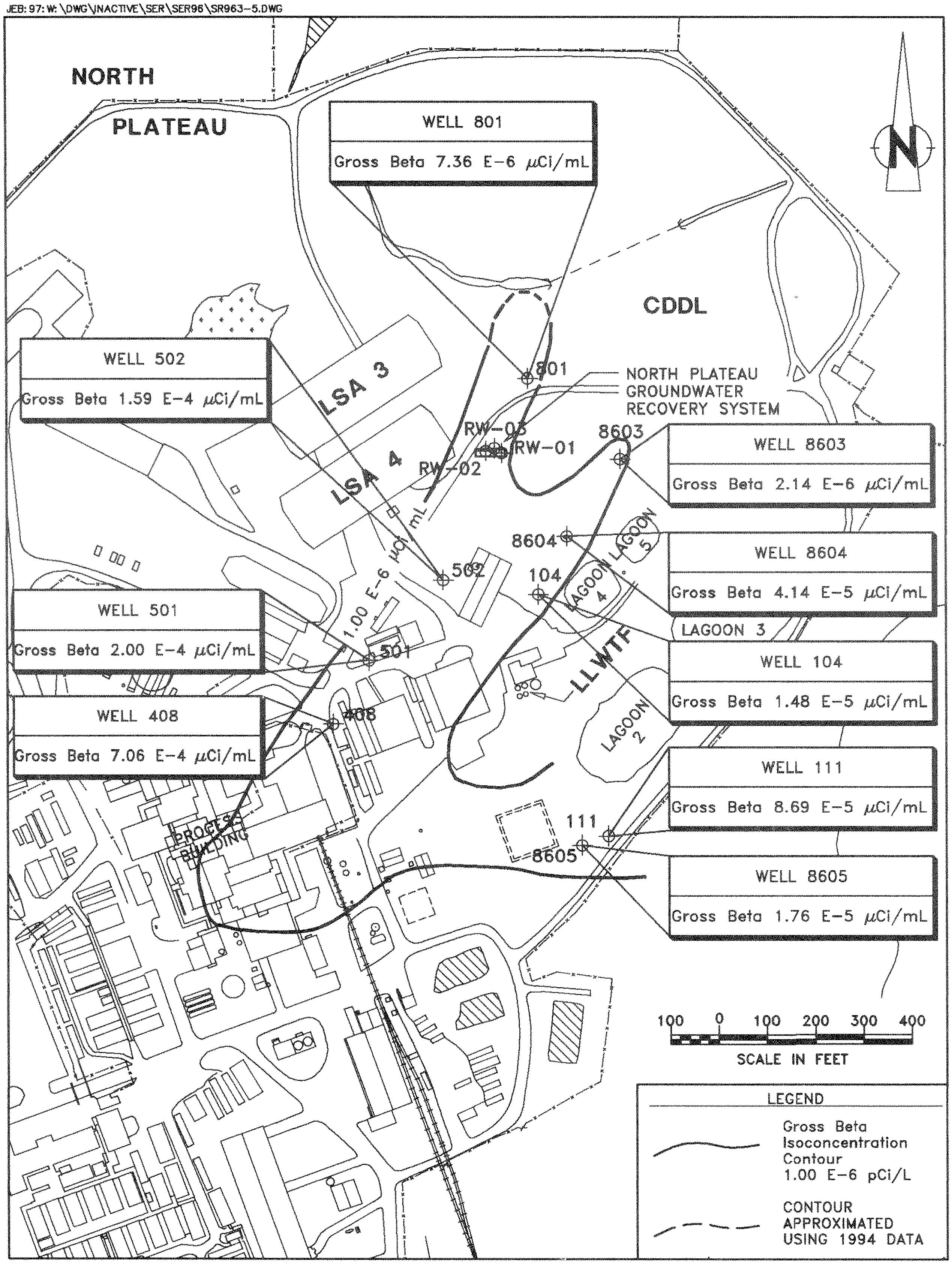


Figure 3-5. North Plateau Gross Beta Plume Area Fourth-Quarter 1996 Results.

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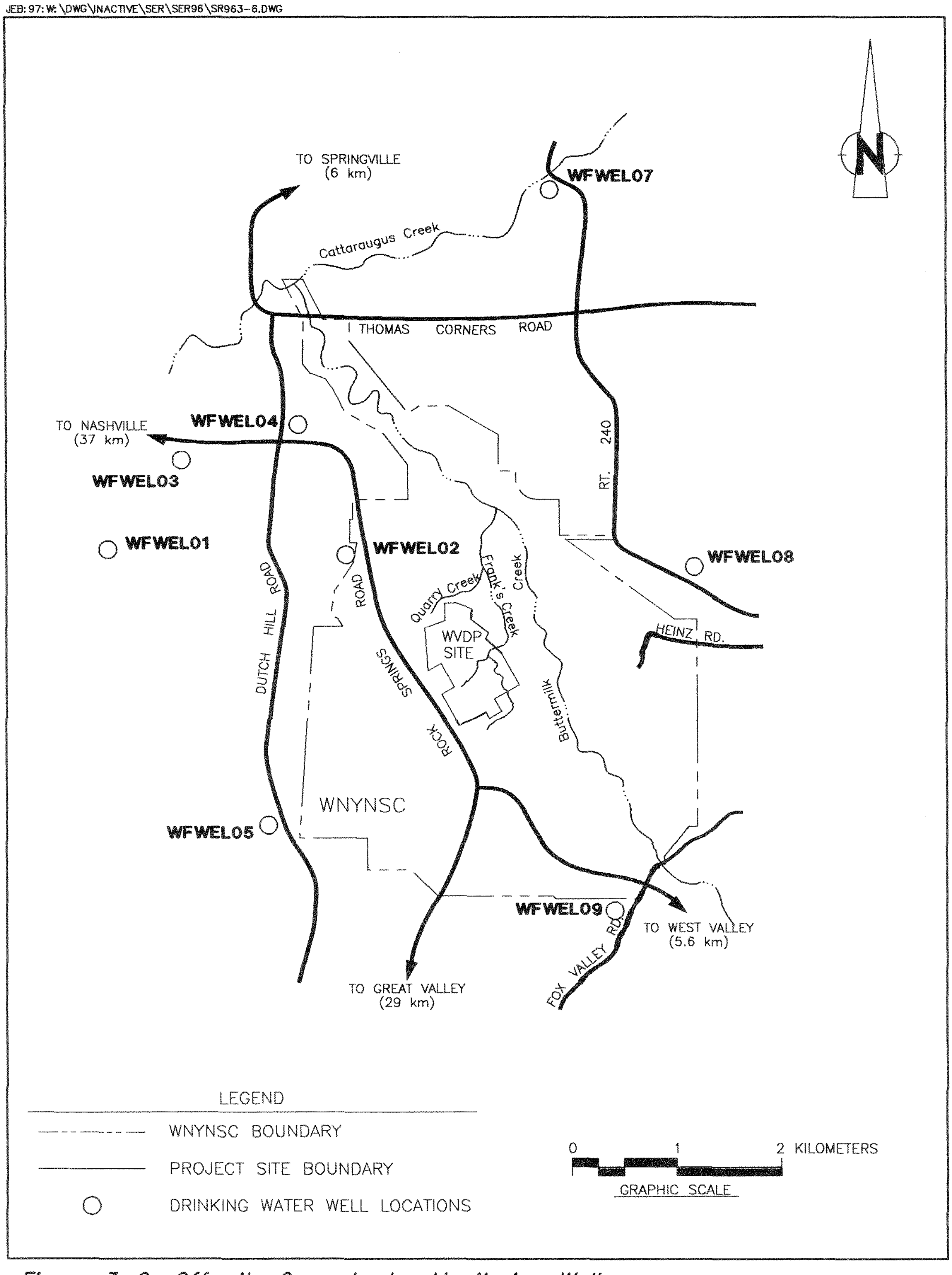


Figure 3-6. Off-site Groundwater Monitoring Wells.

Gross beta and tritium concentrations in samples from well 909 and location NDATR continued to be elevated with respect to other locations monitoring the NDA but also remained well below the DCGs. Gross beta results have historically fluctuated at these locations; the only discernible upward trend is in gross beta at well 909. Gross beta concentrations from well 909 are considerably higher than at NDATR and there has been speculation in the past concerning residual soil contamination as a possible source. As in the past, there were no monitoring results in 1996 that indicated the presence of n-dodecane/TBP.

Piezometers were installed in 1996 in the vicinity of the interceptor trench in order to assess the influence of trench pumping on the water table gradient. This data will be used to support evaluations of trench effectiveness.

Seven well points located downgradient of the process building were sampled annually between 1993 and 1996 for radiological indicator parameters. These well points are not associated with the north plateau groundwater recovery system (discussed below) and were installed in 1990 to supplement data collected from the groundwater monitoring wells installed during the same time frame.

An evaluation was conducted to determine the presence of trends, to compare concentrations to nearby wells, and to determine if adequate coverage was provided by other monitoring wells that are sampled quarterly under the current program.

The evaluation concluded that concentrations of gross alpha and gamma scan parameters (cesium-137, cobalt-60, and potassium-40) were below detection levels at all well points. While gross beta concentrations were elevated, they were within historical ranges in wells downgradient of the process building.

Well points A, C, and H have yielded samples with elevated concentrations of tritium with respect to historical monitoring of wells in the area. However, the tritium concentrations are well below the DOE derived concentration guide of 2.0E-03 μCi/mL. Data from downgradient monitoring wells have not indicated similarly elevated levels of tritium.

This area east of the process building and west of lagoon 1 may be an area of localized contamination, and it will continue to be monitored annually for contamination indicator and radiological indicator parameters in the future. Well points D, E, F, and G will not be sampled in future monitoring because adequate monitoring coverage is provided by active monitoring wells included in the groundwater monitoring program. Sampling will continue at well points A,C, and H to further evaluate the presence of tritium in this localized area.

Interim Mitigative Measures Near the Leading Edge of the Gross Beta Plume on the North Plateau

Elevated gross beta (from previous fuel reprocessing activities) has been reported historically in localized areas north and east of the former process building. In December 1993 elevated gross beta concentrations were detected in surface water at former sampling location DMPNE, located at the edge of the plateau. This detection initiated a subsurface investigation of groundwater and soil using the Geoprobe®, a mobile sampling system. The investigation was used to define the extent of the gross beta plume beneath and downgradient of the process building. The gross beta plume delineated was approximately 300 feet wide and 800 feet long.

The highest gross beta concentrations in groundwater and soil were located near the southeast corner of the process building. The maximum activity in groundwater was 3.6E-03 μCi/mL, and the maximum activity in soil reached 2.4E-02 μCi/g. Strontium-90 and its daughter product, yttrium-90, were determined to be the isotopes responsible for most of the elevated gross beta activity in the groundwater and soil beneath and downgradient of the former process building (West Valley Nuclear Services Co., Inc. 1995b).

In 1995 the north plateau groundwater recovery system (NPGRS) was installed as a mitigative measure for minimizing the spread of the gross beta plume. The NPGRS was located near the leading edge of a lobe of the plume where groundwater flows preferentially towards the edge of the plateau. The NPGRS initially consisted of two extraction wells (RW-01 and RW-02) to recover the contaminated groundwater. In September 1996 a third well (RW-03) was added to the NPGRS along with other system upgrades. The upgraded recovery system more effectively captures the contaminant plume in this area.

Water recovered by the NPGRS is treated by ion exchange to remove strontium-90. Treated water is transferred to lagoon 4 or 5 and then to lagoon 3 for ultimate discharge to Erdman Brook.

Special Monitoring for the North Plateau Groundwater Quality Early Warning Evaluation

An early warning evaluation of the monitoring well data was devised to guard against the possibility of changes in groundwater quality affecting the NPGRS or the low-level waste treatment facility (LLWTF) system. This monitoring is important since changes in the quality of recovered groundwater could ultimately affect compliance with effluent limitations on pollutants specified in the SPDES permit for outfall 001.

To guard against this possibility, an early warning system was devised: Quarterly monitoring results from three wells in the vicinity of the system are compared to early warning levels (multiples of the SPDES permit levels) in order to identify concentrations that may affect compliance with SPDES effluent limits. Two of the wells, 116 and 602, are used to monitor groundwater in the NPGRS drawdown vicinity. A third well, 502, is directly upgradient of the NPGRS and was sampled for additional parameters (mostly total and dissolved metals) not routinely analyzed under the groundwater monitoring program. Results of this special monitoring are found in Table E-11 (p. E-25).

During 1996 quarterly evaluations indicated that strontium-90 and some metals were elevated with respect to the early warning levels. A report was prepared in early 1996 that assessed the cation removal efficiencies for these and other metals (Dames & Moore June 1996). Paired influent and effluent samples from the NPGRS were analyzed to compare the concentrations and to estimate the removal efficiency of the treatment system. It was reported that up to 99% of the calcium and the beta activity (to which strontium-90 is a major contributor) were removed from the influent to the NPGRS. There also was evidence of the removal of other metals such as chromium and nickel. Best estimates for removal of chromium and nickel were reported as 76% and 26% respectively.

Results of Off-Site Groundwater Monitoring

Ten off-site wells, used by site neighbors as sources of drinking water, were sampled for radiological parameters, pH, and conductivity as part of the groundwater monitoring program during 1996. (See Fig. 3-6 [p. 3-17].) Sampling and analysis indicated no evidence of contamination by the WVDP of these off-site water supplies. Analytical results are found in Table C-1.26 (p. C1-20) in *Appendix C-1.*

Discussion of Site Groundwater Sampling

The 1996 groundwater monitoring program reflects the transition from data collection for site characterization to efficient ongoing monitoring surveillance based on process knowledge and years of groundwater data. Monitoring in areas such as the north plateau sand and gravel unit and the NDA continued in 1996. Data collection needs may be further modified as the RCRA facility investigation reports are made final and as monitoring data continue to be collected and evaluated.

Representatives from NYSDEC visited the site from June 10 through June 12, 1996, in order to conduct a comprehensive monitoring evaluation and to address the question of whether routine filtering of samples intended for radionuclide analyses was biasing the results. (Radioactive ions can adhere to colloidal particles in filtered samples.)

Both filtered and unfiltered samples were obtained from four wells and analyzed for metals and radionuclides. The wells chosen for sampling (104, 111, 801, and 8605) have shown elevated radioactivity in the past.

NYSDEC concurred that radiological parameter results from filtered and unfiltered samples were comparable and that no noticeable bias was apparent. All sampling procedures and documentation were found to be acceptable. NYSDEC also noted that the well maintenance program had been improved and that thirty-six of the older and inactive wells had been decommissioned.

Sampling Methodology

Samples are collected from monitoring wells using either dedicated Teflon® well bailers or bladder pumps. (Dedicated bailers are equipped with Teflon® -coated stainless steel leaders.)

The method of collection depends on well construction, water depth, and the water-yielding characteristics of the well. Bailers are used in wells with low standing water volume; bladder pumps are used in wells with good water-yielding characteristics.

To ensure that only representative groundwater is sampled, three well volumes are removed (purged) from the well before the actual samples are collected. If three well volumes cannot be removed because of limited recharge, purging the well to dryness provides sufficient purging. Conductivity and pH are measured before sampling and after sampling, if sufficient water is still available, to confirm the geochemical stability of the groundwater during sampling.

The bailer, a tube with a check valve at the bottom and the top, is lowered into the well until it reaches the desired point in the water column. The bailer is lowered slowly to ensure that the water column is not agitated and is then withdrawn from the well with a sample and emptied into a sample container. The bailer, bailer line, and bottom-emptying device used to drain the bailer are dedicated to the well, i.e., are used exclusively for that well at all times.

Bladder pumps use compressed air to gently squeeze a Teflon® bladder that is encased in a stainless steel tube located near the bottom of the well. When the pressure is released, new groundwater flows into the bladder. A series of check valves ensures that the water flows only in one direction. The drive air is always separated from the sample and is expelled to the surface by a separate line.

Bladder pumps reduce mixing and agitation of the water in the well. Each bladder pump system is dedicated to an individual well to reduce the likelihood of sample contamination from external materials or cross contamination. The compressor and air control box can be used from well to well because they do not contact the sample.

Immediately after the samples are collected they are put into a cooler and returned to the Project's Environmental Laboratory. The samples are preserved with chemicals, if necessary, and stored under controlled conditions to minimize chemical and/or biological changes after sample collection. The samples are then either packaged for expedited delivery to an off-site contract laboratory or kept in controlled storage to await on-site testing.

Table 3-2
Groundwater Monitoring Network: Super Solid Waste Management Units

SSWMUs and Constituent SWMUs	Well ID Number	Hydrogeologic Unit Monitored[1]	Analytes Measured in 1996[2]	Well Position in SSWMU[3]	Well Depth (ft) Below Grade
SSWMU #1 - Low-level Waste Treatment Facilities:					
	103*	S	G,M	D	21.0
• Former Lagoon 1	104	S	G,M,SV,V	U	23.0
• LLWTF Lagoons	105	S	G,M,V	D	28.0
• LLWTF Building	106	S	G,M,V	D	14.5
• Interceptors	107	T	G,M,V	D	28.0
• Neutralization Pit	108	T	G,M,V	D	33.0
	109	T	p	D	33.0
	110*	T	G,M,V	D	33.0
	111*	S	G, S, SV,M,V	D	11.0
	114	T	p	D	29.0
	115	T	p	U	28.0
	116*	S	G,M, S,V	U	11.0
	8604	S	G,M,V	U	22.6
	8605*	S	G, S,SV,M,V	D	12.0
	WNSP008	French Drain Monitoring Point	V		
SSWMU #2 - Miscellaneous Small Units:					
	201	S	M	U	20.0
• Sludge Ponds	202	TS	p	U	38.0
• Solvent Dike	203	S	p	D	18.0
• Equalization Mixing Basin	204*	TS		U	43.0
• Paper Incinerator	205	S	M	D	11.0
	206	TS		D	37.8
	207	S, (T)	p	D	11.0
	208	TS	V	D	23.0
	8606	S	p	D	12.1

** Monitoring for certain parameters is required by the RCRA 3008(h) Order on Consent.*

[1] Hydrogeologic units monitored are: WT (weathered Lavery till); T (unweathered Lavery till); S (sand and gravel); K (Kent recessional sequence); TS (till-sand). Units enclosed in parentheses indicate the hydrogeologic unit is only a secondary monitoring unit.

[2] See Table 3-1 for a description of codes and analytes. The parameters listed in this table, Table 3-2, are in addition to the contamination indicator parameters (I) and radiological indicator parameters (RI) routinely scheduled for 1996.

p: Analytical monitoring discontinued after May 1995. Well measured for potentiometric (water-level) data only.

[3] Well position in SSWMU: U (upgradient); D (downgradient); B (background); C (crossgradient).

Table 3-2 (continued)
Groundwater Monitoring Network: Super Solid Waste Management Units

SSWMUs and Constituent SWMUs	Well ID Number	Hydrogeologic Unit Monitored[1]	Analytes Measured in 1996[2]	Well Position in SSWMU[3]	Well Depth (ft) Below Grade
SSWMU #3 - Liquid Waste Treatment System:					
	301*	S	M	B	16.0
• Liquid Waste Treatment System	302	TS	M	U	28.0
• Cement Solidification System	305	S	p	D	31.0
• Main Process Bldg. (specific areas)	307	S	p	D	16.0
	NB1S	S, (WT)	M	B	13.0
SSWMU #4 - HLW Storage and Processing Area:					
	401*	S, (T)	M,R	B	16.0
• Vitrification Facility	402	TS		U	29.0
• Vitrification Test Tanks	403	S	M,V	U	13.0
• HLW Tanks	404	TS	p	U	36.5
• Supernatant Treatment System	405	T		C	12.5
	406*	S	M,R,V	D	16.8
	408*	S	M,R,V	D	38.0
	409	T		D	55.0
SSWMU #5 - Maintenance Shop Leach Field:					
	501*	S	M,S,V	U	33.0
• Maintenance Shop Leach Field	502*	S	M,S,SM,V	D	18.0

* Monitoring for certain parameters is required by the RCRA 3008(h) Order on Consent.

[1] Hydrogeologic units monitored are: WT (weathered Lavery till); T (unweathered Lavery till); S (sand and gravel); K (Kent recessional sequence); TS (till-sand). Units enclosed in parentheses indicate the hydrogeologic unit is only a secondary monitoring unit.

[2] See Table 3-1 for a description of codes and analytes. The parameters listed in this table, Table 3-2, are in addition to the contamination indicator parameters (I) and radiological indicator parameters (RI) routinely scheduled for 1996.

p: Analytical monitoring discontinued after May 1995. Well measured for potentiometric (water-level) data only.

[3] Well position in SSWMU: U (upgradient); D (downgradient); B (background); C (crossgradient).

Table 3-2 *(continued)*
Groundwater Monitoring Network: Super Solid Waste Management Units

SSWMUs and Constituent SWMUs	*Well ID Number*	*Hydrogeologic Unit Monitored*[1]	*Analytes Measured in 1996*[2]	*Well Position in SSWMU*[3]	*Well Depth (ft) Below Grade*
SSWMU #6 - Low-level Waste Storage Area:					
	601	*S*	*p*	*D*	*6.0*
• *Hardstands (old & new)*	*602*	*S*	*M,S*	*D*	*13.0*
• *Lag Storage*	*603*	*S*	*p*	*U*	*13.0*
• *Lag Storage Additions*	*604*	*S*	*M*	*D*	*11.0*
(LSAs 1, 2, 3, 4)	*605*	*S, (T)*	*M,S*	*D*	*11.0*
	*8607**	*S*	*M,S*	*U*	*17.6*
	8608	*S*	*P*	*U*	*19.0*
	*8609**	*S*	*M,S,V*	*U*	*24.7*
SSWMU #7 - CPC Waste Storage Area:					
	701	*TS*	*p*	*U*	*28.0*
• *CPC Waste Storage Area*	*702*	*T*	*p*	*C*	*38.0*
	703	*T*	*p*	*D*	*21.0*
	704	*T*	*M,V*	*D*	*15.5*
	705	*T*	*p*	*C*	*21.0*
	706	*S*	*M*	*B*	*11.0*
	707	*T, (WT)*	*M*	*D*	*11.0*
SSWMU #8 - Construction and Demolition Debris Landfill					
	*801**	*S*	*G,M,S,V*	*U*	*17.5*
• *Former Construction and Demolition*	*802*	*S, (T)*	*G,M,V*	*D*	*11.0*
Debris Landfill	*803**	*S*	*G,M,SV,V*	*D*	*18.0*
	*804**	*S*	*G,M,V*	*D*	*9.0*
	*8603**	*S*	*G,M S,R*	*U*	*24.8*
	*8612**	*S*	*G,M,SV,V*	*D*	*18.1*

* *Monitoring for certain parameters is required by the RCRA 3008(h) Order on Consent.*

[1] *Hydrogeologic units monitored are: WT (weathered Lavery till); T (unweathered Lavery till); S (sand and gravel); K (Kent recessional sequence); TS (till-sand). Units enclosed in parentheses indicate the hydrogeologic unit is only a secondary monitoring unit.*

[2] *See Table 3-1 for a description of codes and analytes. The parameters listed in this table, Table 3-2, are in addition to the contamination indicator parameters (I) and radiological indicator parameters (RI) routinely scheduled for 1996.*

p: Analytical monitoring discontinued after May 1995. Well measured for potentiometric (water-level) data only.

[3] *Well position in SSWMU: U (upgradient); D (downgradient); B (background); C (crossgradient).*

Table 3-2 (continued)
Groundwater Monitoring Network: Super Solid Waste Management Units

SSWMUs and Constituent SWMUs	*Well ID Number*	*Hydrogeologic Unit Monitored*[1]	*Analytes Measured in 1996*[2]	*Well Position in SSWMU*[3]	*Well Depth (ft) Below Grade*
SSWMU #9 - NRC-licensed Disposal Area:					
	*901**	*K, (T)*	*M*	*U*	*136.0*
• *NRC-licensed Disposal Area*	*902**	*K, (T)*	*M*	*U*	*128.0*
• *Container Storage Area*	*903**	*K, (T)*	*M*	*D*	*133.0*
• *Trench Interceptor Project*	*904*	*T*	*p*	*D*	*26.0*
	905	*S*	*p*	*D*	*23.0*
	*906**	*WT*	*M*	*D*	*10.0*
	907	*WT, (T)*	*p*	*D*	*16.0*
	*908**	*WT, (T)*	*M*	*U*	*21.0*
	*909**	*WT, (T)*	*E,M,R*	*D*	*23.0*
	*910**	*T*	*M*	*D*	*29.6*
	*8610**	*K*		*D*	*114.0*
	*8611**	*K*	*M*	*D*	*120.0*
	*NDATR**	*Interceptor Trench Manhole Sump*	*E,R*	*D*	

** Monitoring for certain parameters is required by the RCRA 3008(h) Order on Consent.*

[1] Hydrogeologic units monitored are: WT (weathered Lavery till); T (unweathered Lavery till); S (sand and gravel); K (Kent recessional sequence); TS (till-sand). Units enclosed in parentheses indicate the hydrogeologic unit is only a secondary monitoring unit.

[2] See Table 3-1 for a description of codes and analytes. The parameters listed in this table, Table 3-2, are in addition to the contamination indicator parameters (I) and radiological indicator parameters (RI) routinely scheduled for 1996.

p: Analytical monitoring discontinued after May 1995. Well measured for potentiometric (water-level) data only.

[3] Well position in SSWMU: U (upgradient); D (downgradient); B (background); C (crossgradient).

Table 3-2 (continued)
Groundwater Monitoring Network: Super Solid Waste Management Units

SSWMUs and Constituent SWMUs	Well ID Number	Hydrogeologic Unit Monitored[1]	Analytes Measured in 1996[2]	Well Position in SSWMU[3]	Well Depth (ft) Below Grade
SSWMU #10 - IRTS Drum Cell:					
	1001	K, (T)	p	U	116.0
• IRTS Drum Cell	1002	K, (T)	p	D	113.0
• Background (south plateau)	1003	K	p	D	138.0
	1004	K, (T)	p	D	108.0
	1005*	WT, (T)	M	U	19.0
	1006*	WT, (T)	M	D	20.0
	1007	WT, (T)		D	23.0
	1008B	K, (T)	M	B	51.0
	1008C*	WT, (T)	M	B	18.0
SSWMU #11 - State-licensed Disposal Area:					
	1101A	WT, (T)	See Appendix F	U	16.0
• State-licensed Disposal Area (SDA)[NYSERDA]	1101B	T		U	30.0
	1101C	K		U	110.0
	1102A	WT, (T)		D	17.0
NOTE: The SDA is sampled by NYSERDA under an independent monitoring program	1102B	T		D	31.0
	1103A	WT, (T)		D	16.0
	1103B	T		D	26.0
	1103C	K		D	111.0
	1104A	WT, (T)		D	19.0
	1104B	T		D	36.0
	1104C	K		D	114.0
	1105A	WT, (T)		D	21.0
	1105B	T		D	36.0
	1106A	K		U	16.0
	1106B	T		U	31.0
	1107A	T		D	19.0
	1108A	WT, (T)		U	16.0
	1109A	T		U	16.0
	1109B	WT, (T)		U	31.0
	1110A	WT, (T)		D	20.0
	1111A	WT, (T)		D	21.0

** Monitoring for certain parameters is required by the RCRA 3008(h) Order on Consent.*

[1] Hydrogeologic units monitored are: WT (weathered Lavery till); T (unweathered Lavery till); S (sand and gravel); K (Kent recessional sequence); TS (till-sand). Units enclosed in parentheses indicate the hydrogeologic unit is only a secondary monitoring unit.

[2] See Table 3-1 for a description of codes and analytes. The parameters listed in this table, Table 3-2, are in addition to the contamination indicator parameters (I) and radiological indicator parameters (RI) routinely scheduled for 1996.

p: Analytical monitoring discontinued after May 1995. Well measured for potentiometric (water-level) data only.

[3] Well position in SSWMU: U (upgradient); D (downgradient); B (background); C (crossgradient).

Table 3 - 2 (concluded)
Groundwater Monitoring Network: Super Solid Waste Management Units

SSWMUs and Constituent SWMUs	*Well ID Number*	*Hydrogeologic Unit Monitored*[1]	*Analytes Measured in 1996*[2]	*Well Position in SSWMU*[3]	*Well Depth (ft) Below Grade*
Motor Fuel Storage Area (Monitors underground storage tanks. Not a SSWMU.)	*R8613A*	*S, (T)*	*p*	*C*	*8.0*
	R8613B	*S*	*p*	*C*	*8.0*
	R8613C	*S*	*p*	*D*	*6.5*

Main Plant Area Well Points (Monitor groundwater in various locations north and east of the main plant)	*Well Point ID Number*	*Hydrogeologic Unit Monitored*[1]	*Sampling Agenda*	*Well Depth (ft) Below Grade*
	WP-A	*S*	*RI*	*33*
	WP-C	*S*	*RI*	*23*
	WP-D	*S*	*RI*	*26*
	WP-E	*S*	*RI*	*22*
	WP-F	*S*	*RI*	*36*
	WP-G	*S*	*RI*	*34*
	WP-H	*S*	*RI*	*17*

North Plateau Groundwater Seeps (Monitor groundwater emanating from seeps along the north plateau edge. Not in a SSWMU.)	*Seep ID Number*	*Hydrogeologic Unit Monitored*	*Sampling Agenda*
	SP02	*S*	*RI*
	SP04	*S*	*RI*
	SP05	*S*	*RI*
	SP06	*S*	*RI*
	SP11	*S*	*RI*
	SP12	*S*	*I, RI, V*
	SP18	*S*	*RI*
	SP23	*S*	*RI*
	GSEEP	*S*	*G, M, V*

** Monitoring for certain parameters is required by the RCRA 3008(h) Order on Consent.*

[1] Hydrogeologic units monitored are: WT (weathered Lavery till); T (unweathered Lavery till); S (sand and gravel); K (Kent recessional sequence); TS (till-sand). Units enclosed in parentheses indicate the hydrogeologic unit is only a secondary monitoring unit.

[2] See Table 3-1 for a description of codes and analytes. The parameters listed in this table, Table 3-2, are in addition to the contamination indicator parameters (I) and radiological indicator parameters (RI) routinely scheduled for 1996.

p: Analytical monitoring discontinued after May 1995. Well measured for potentiometric (water-level) data only.

[3] Well position in SSWMU: U (upgradient); D (downgradient); B (background); C (crossgradient).

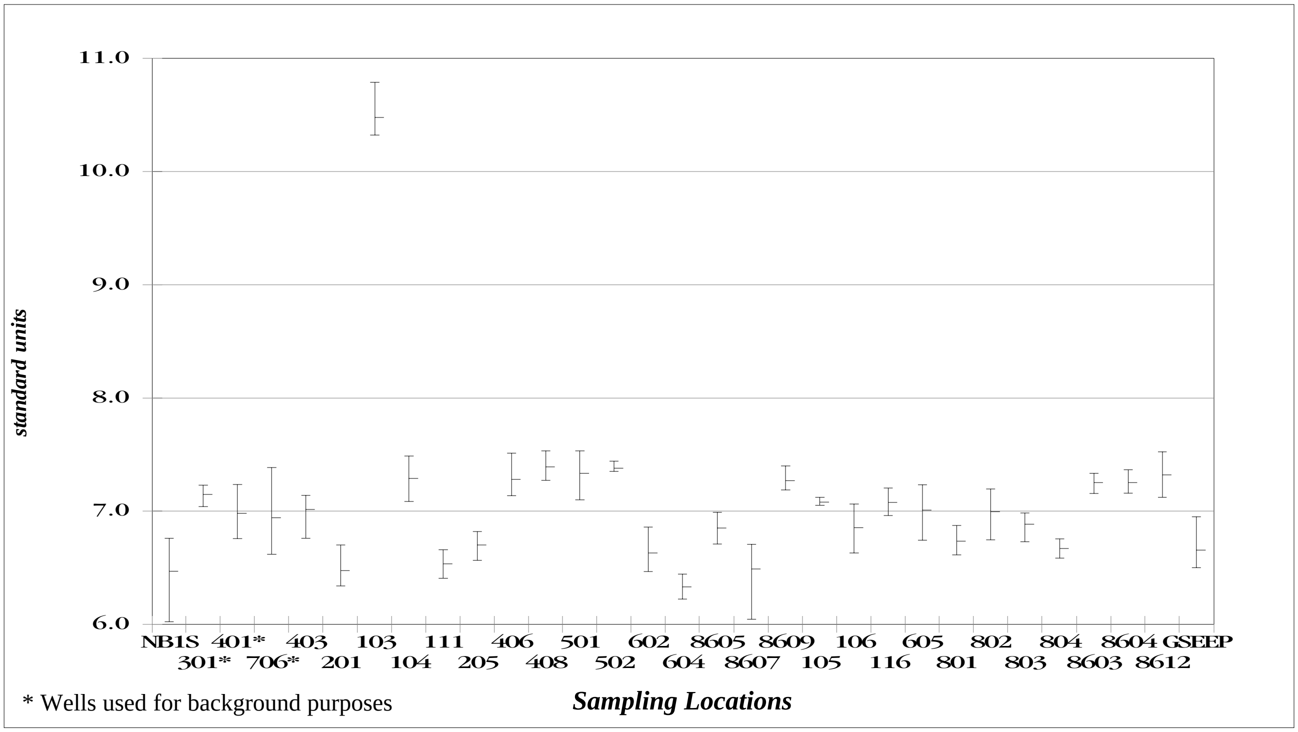


Figure 3-7. pH in Groundwater Samples from the Sand and Gravel Unit

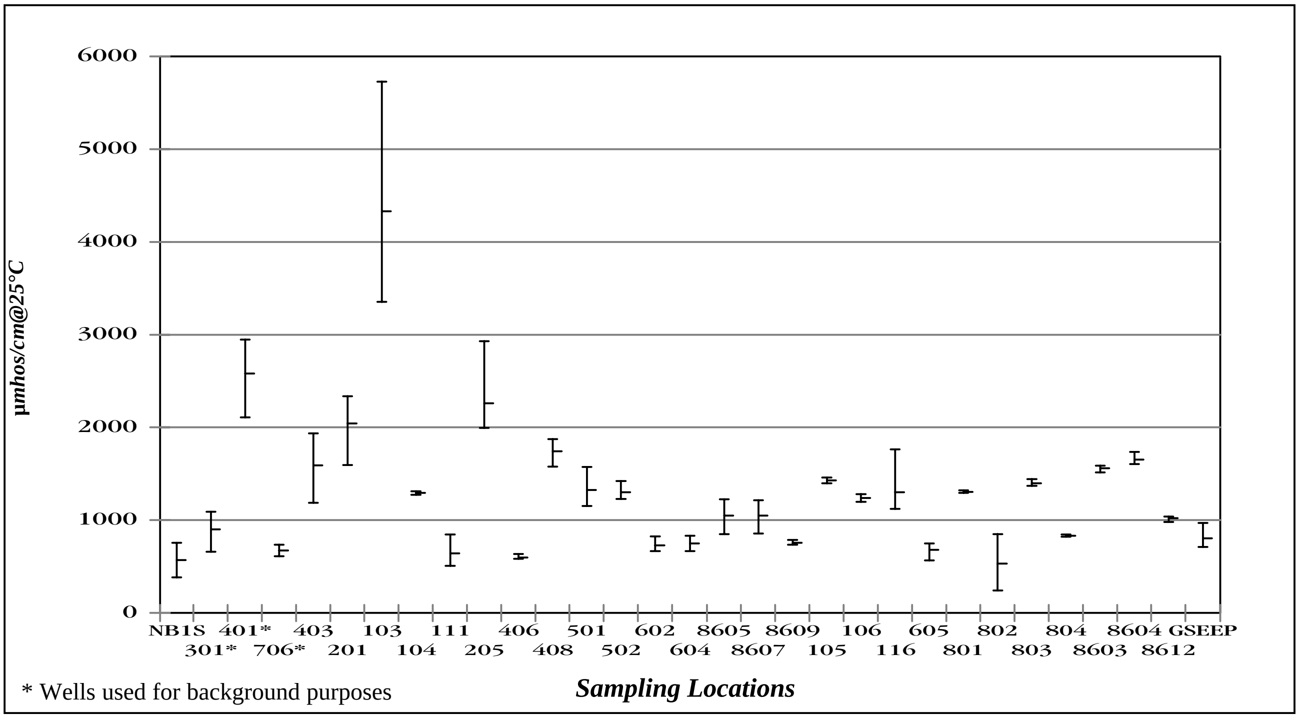


Figure 3-8. Conductivity in Groundwater Samples from the Sand and Gravel Unit

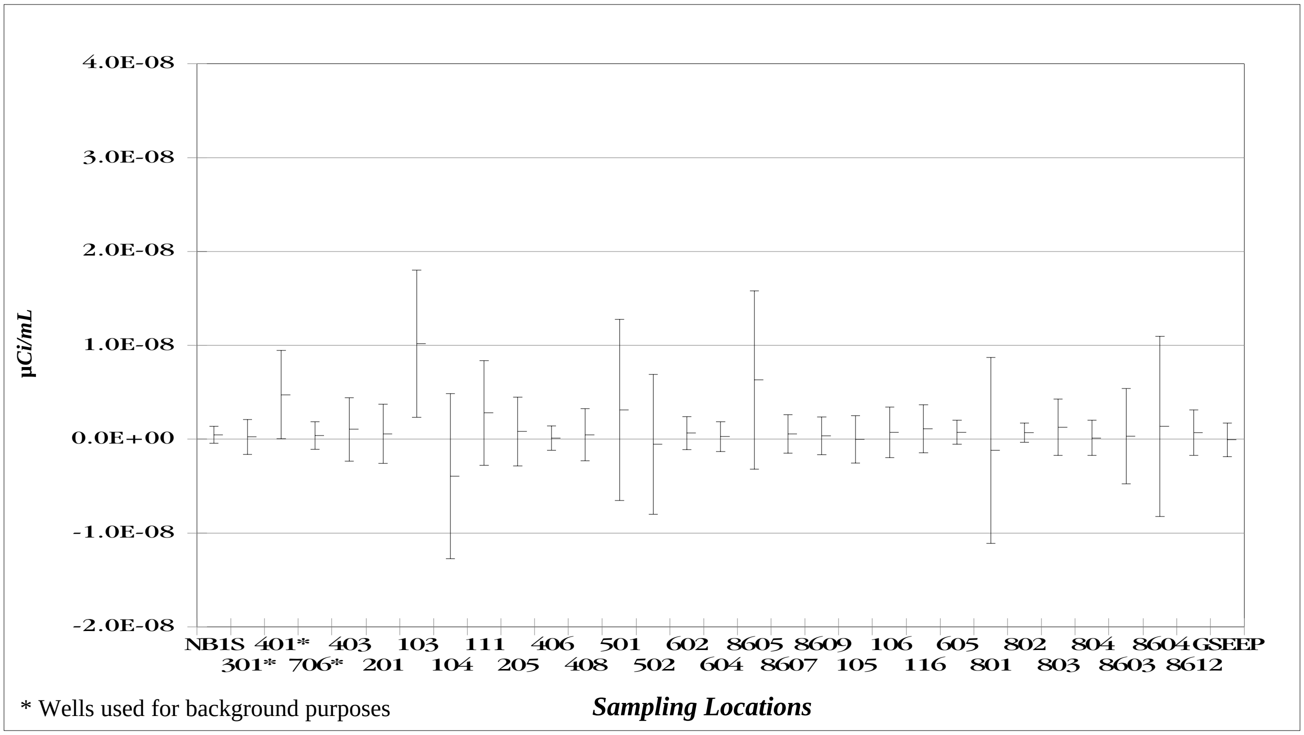


Figure 3-9. Gross Alpha in Groundwater Samples from the Sand and Gravel Unit

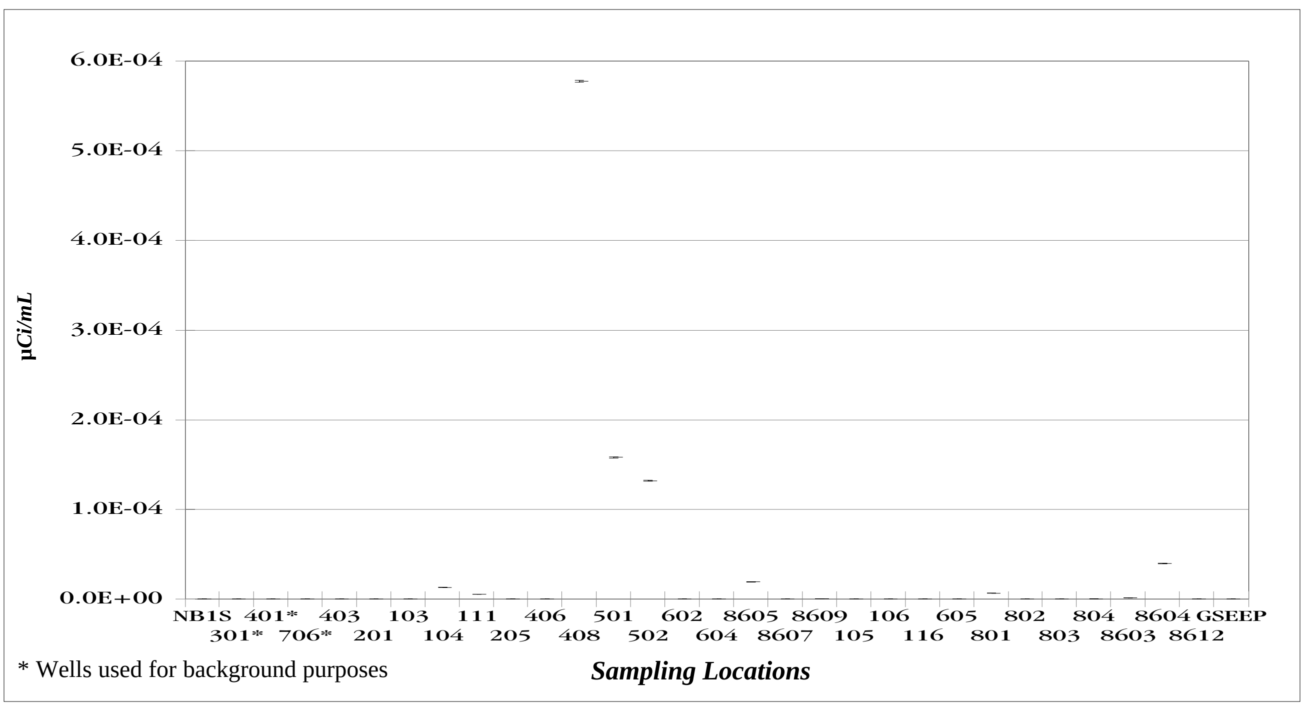


Figure 3-10. Gross Beta in Groundwater Samples from the Sand and Gravel Unit
(Figs. 3-10a and 3-10b follow with magnified scale.)

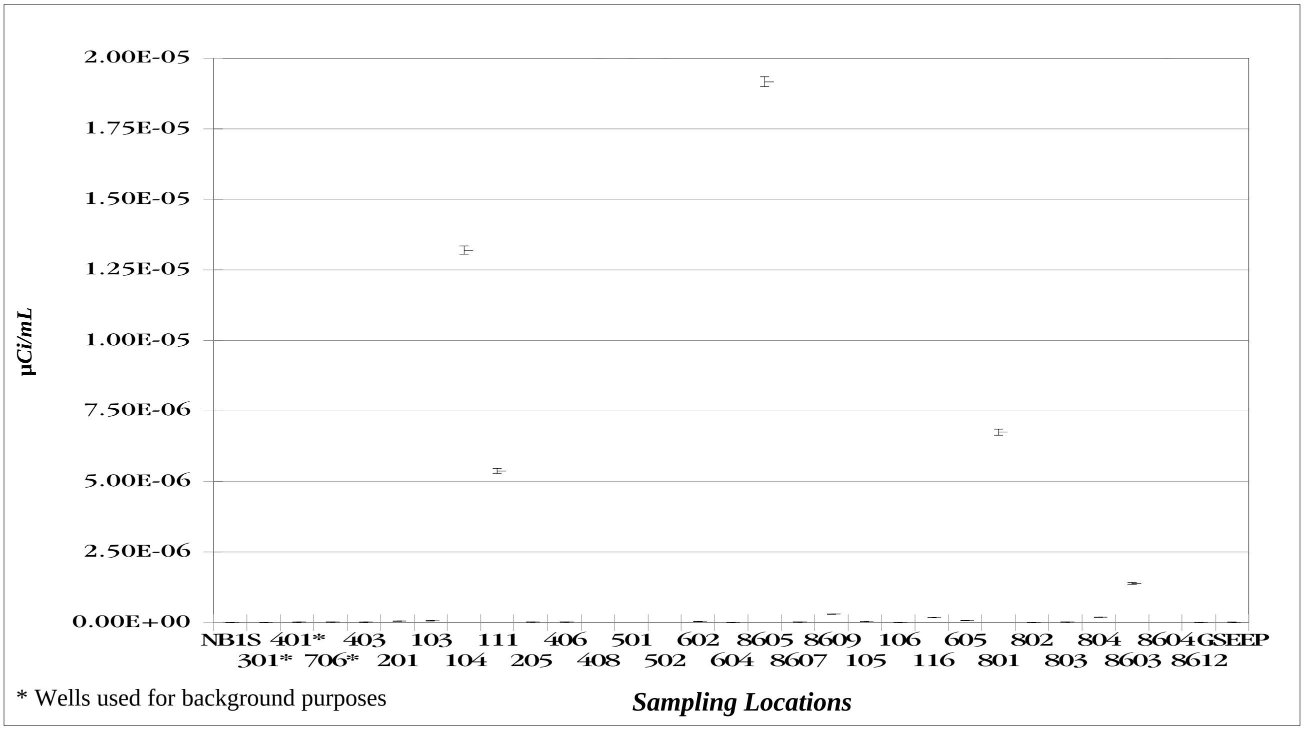


Figure 3-10a. Gross Beta in Groundwater Samples from the Sand and Gravel Unit (magnified scale of Fig. 3-10)

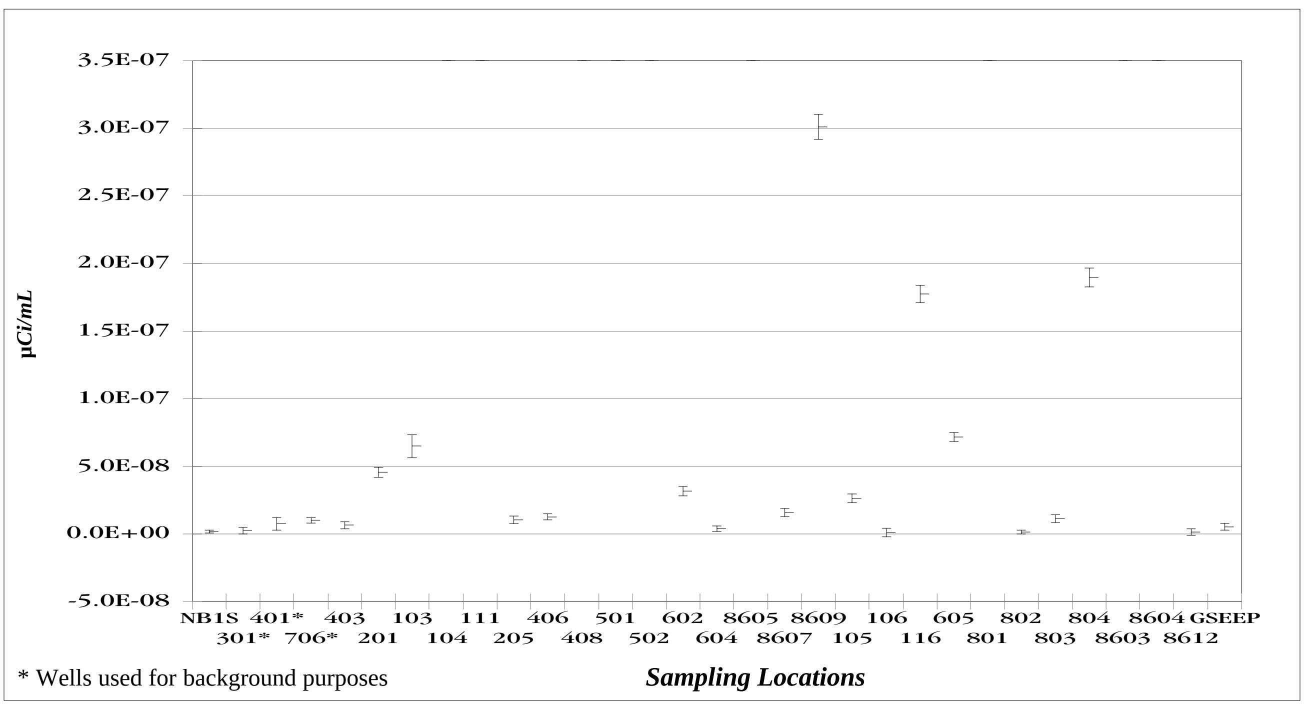


Figure 3-10b. Gross Beta in Groundwater Samples from the Sand and Gravel Unit (magnified scale of Fig. 3-10a)

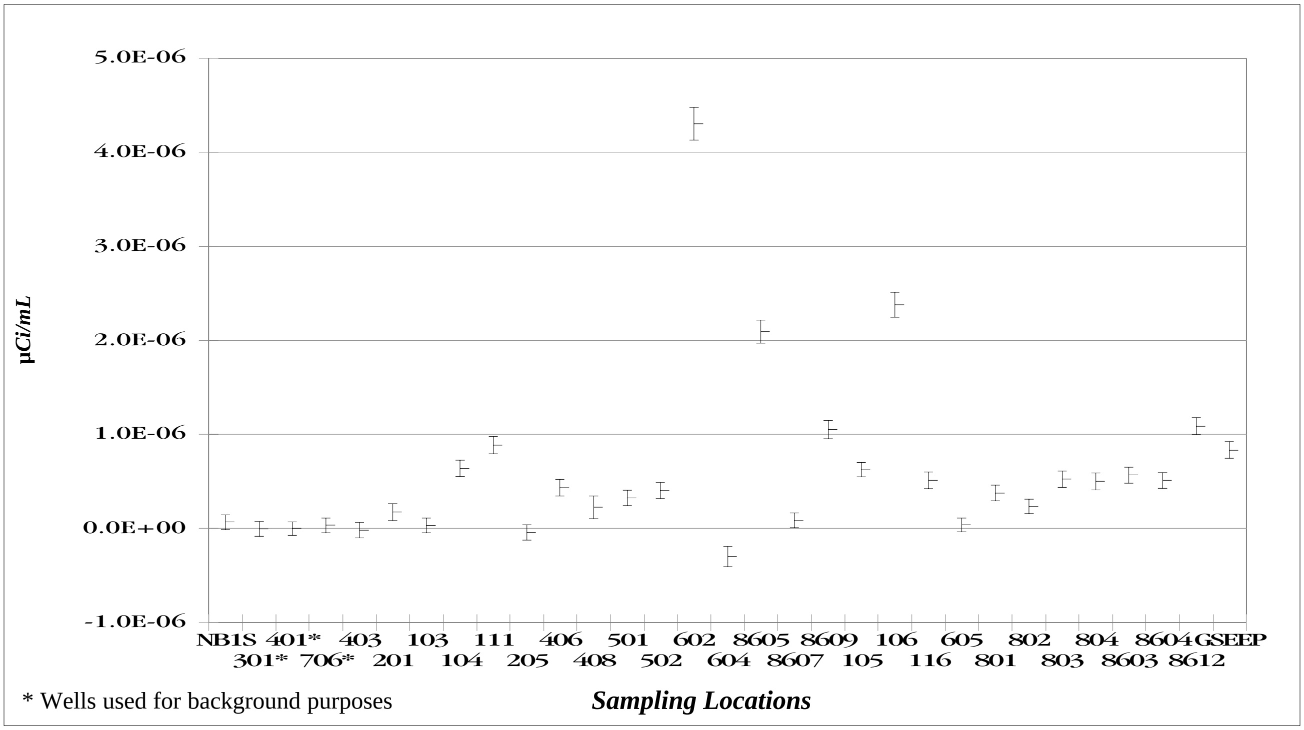


Figure 3-11. Tritium Activity in Groundwater Samples from the Sand and Gravel Unit (Fig. 3-11a follows with magnified scale.)

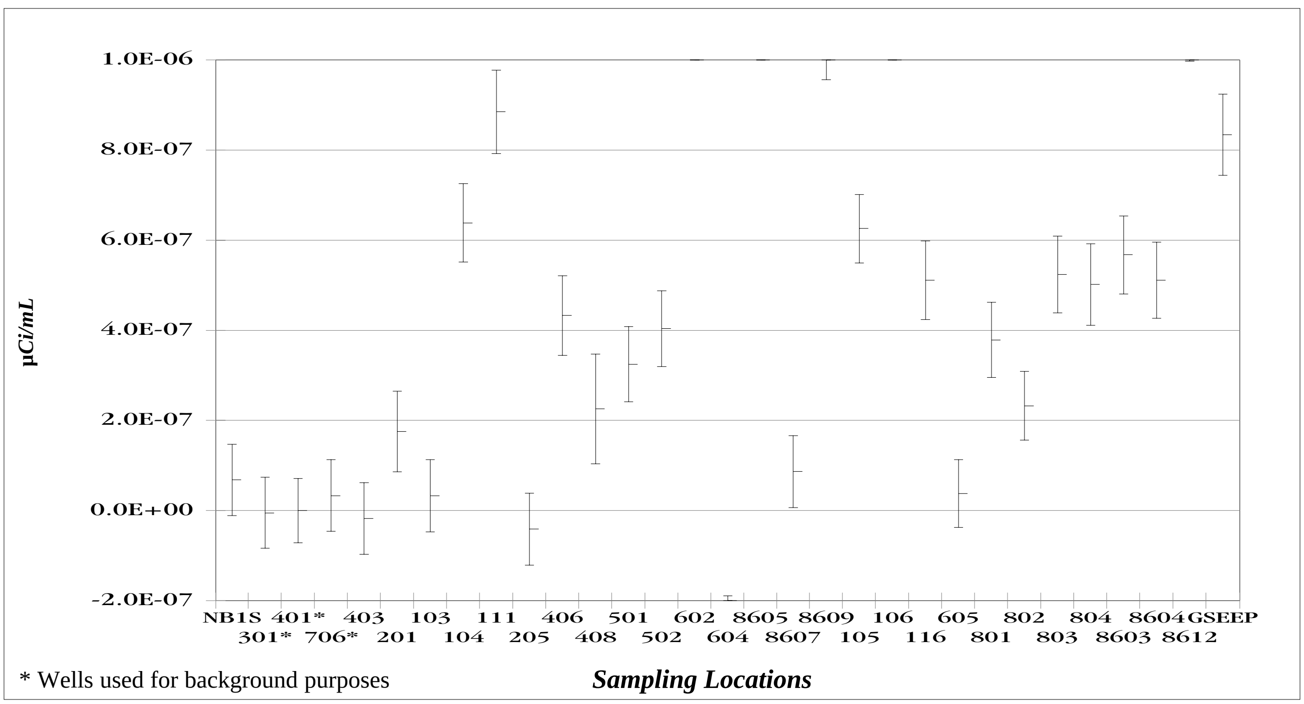


Figure 3-11a. Tritium Activity in Groundwater Samples from the Sand and Gravel Unit (magnified scale of Fig. 3-11)

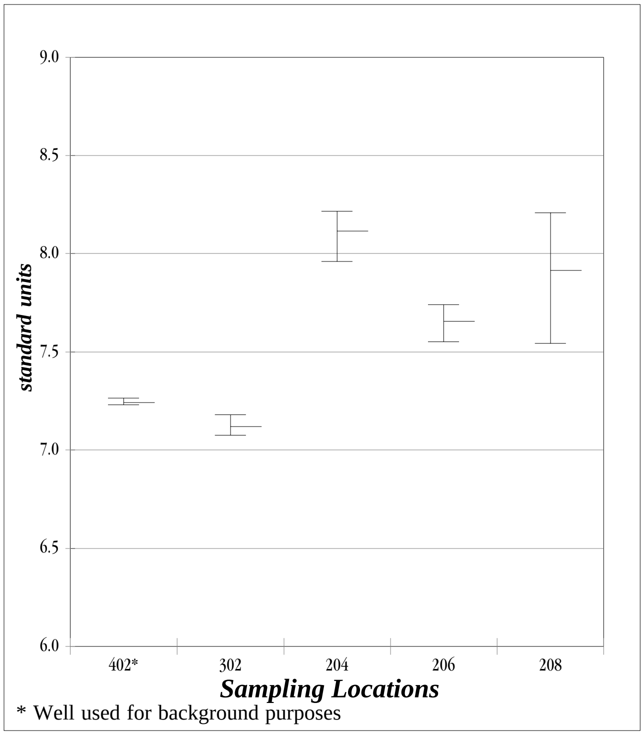


Figure 3-12. pH of Groundwater Samples from the Till-Sand Unit

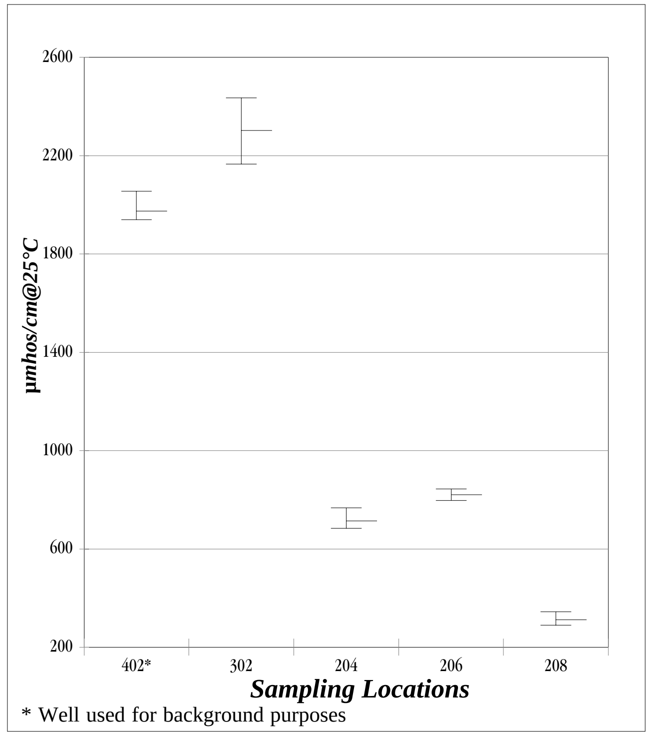


Figure 3-13. Conductivity of Groundwater Samples from the Till-Sand Unit

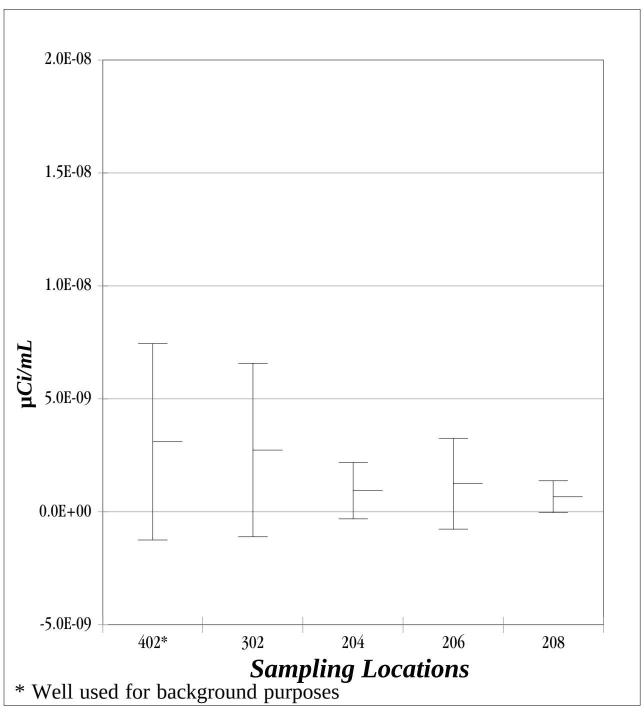


Figure 3-14. Gross Alpha in Groundwater Samples from the Till-Sand Unit

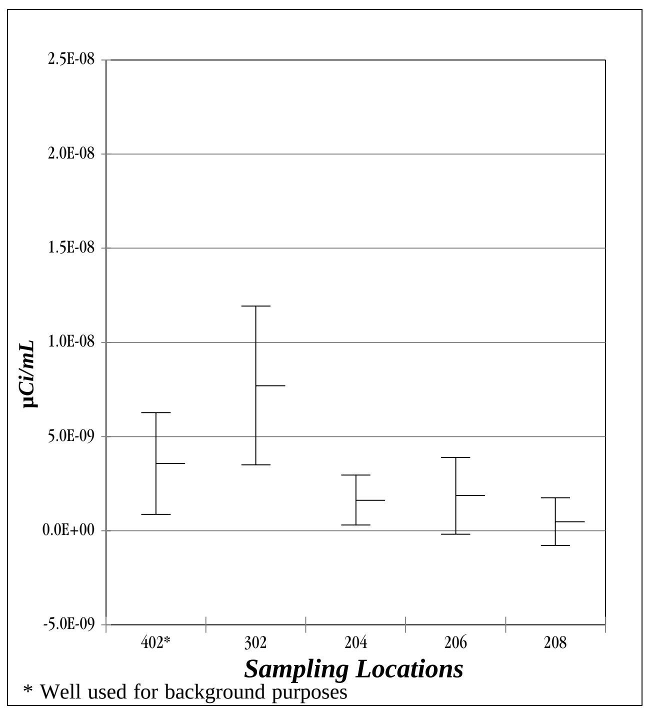


Figure 3-15. Gross Beta in Groundwater Samples from the Till-Sand Unit

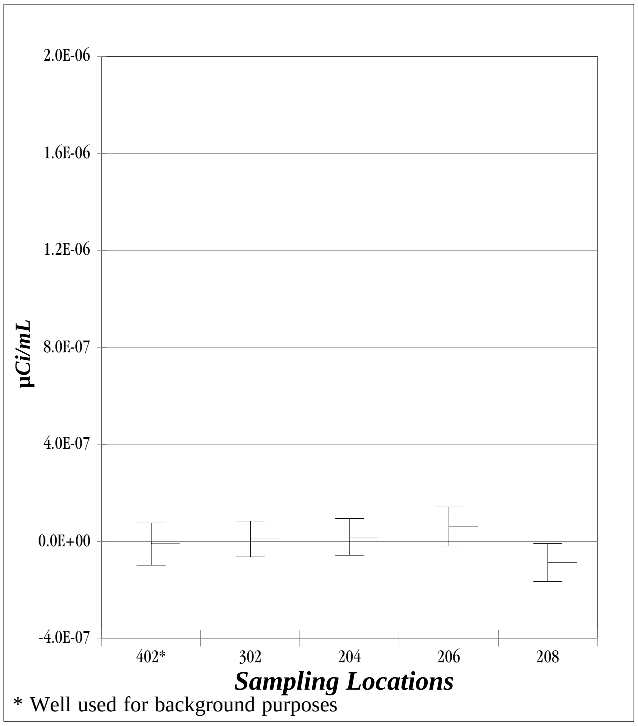


Figure 3-16. Tritium Activity in Groundwater Samples from the Till-Sand Unit

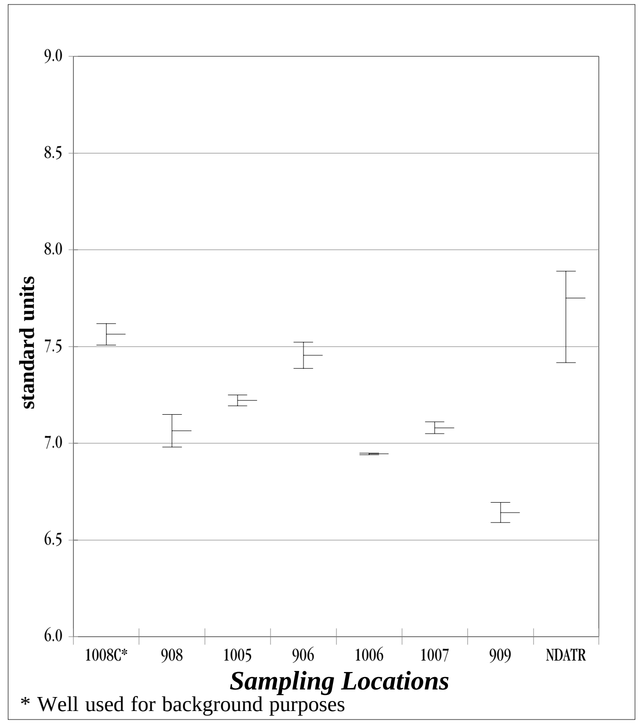


Figure 3-17. pH of Groundwater Samples from the Weathered Lavery Till Unit

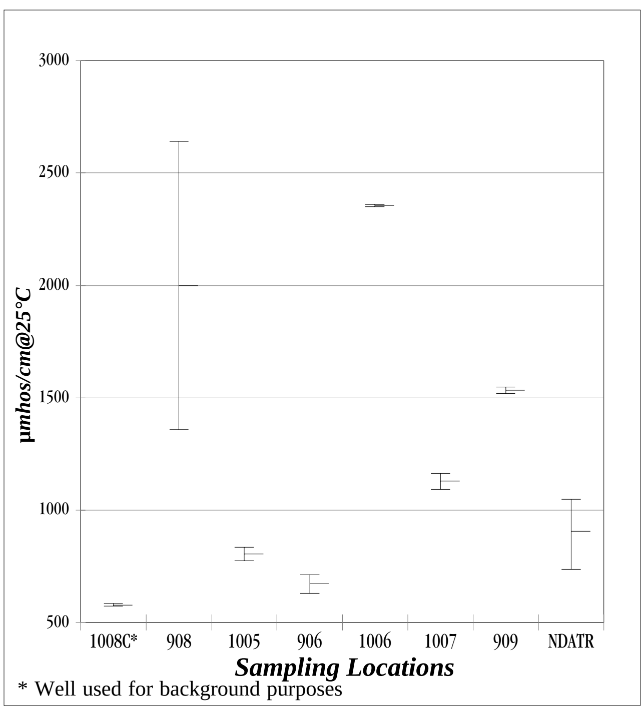


Figure 3-18. Conductivity of Groundwater Samples from the Weathered Lavery Till Unit

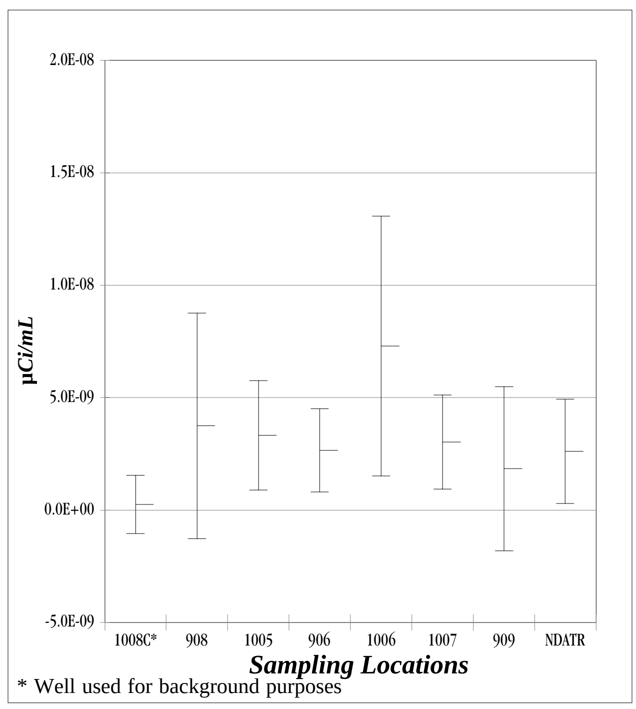


Figure 3-19. Gross Alpha in Groundwater Samples from the Weathered Lavery Till Unit

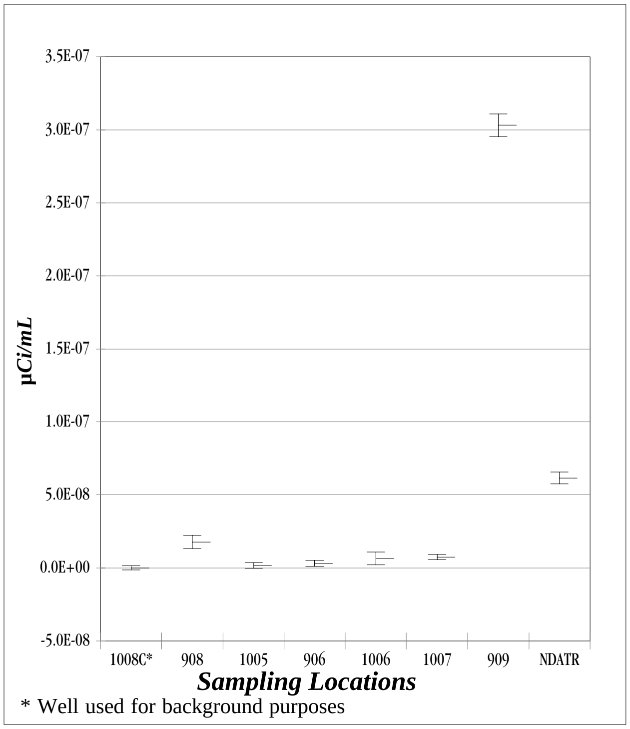


Figure 3-20. Gross Beta in Groundwater Samples from the Weathered Lavery Till Unit (Fig. 3-20a follows with magnified scale)

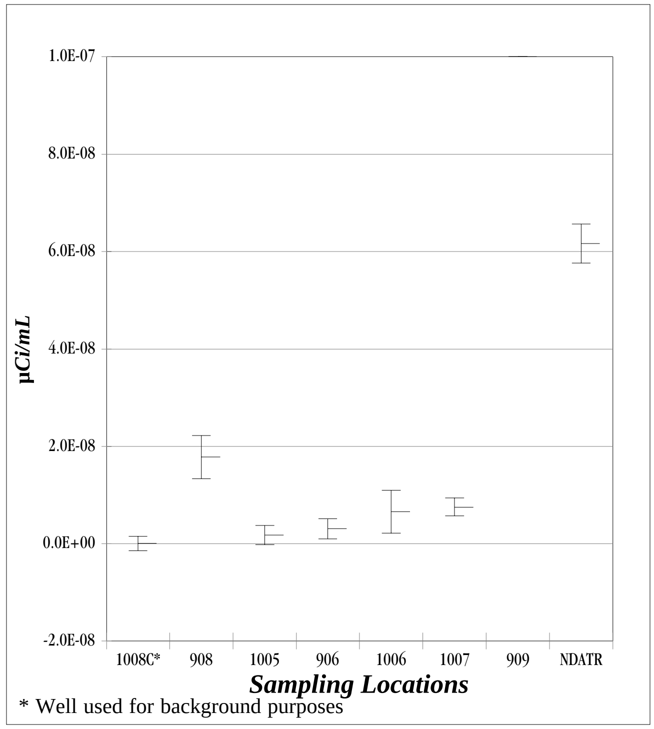


Figure 3-20a. Gross Beta in Groundwater Samples from the Weathered Lavery Till Unit (magnified scale of Fig. 3-20)

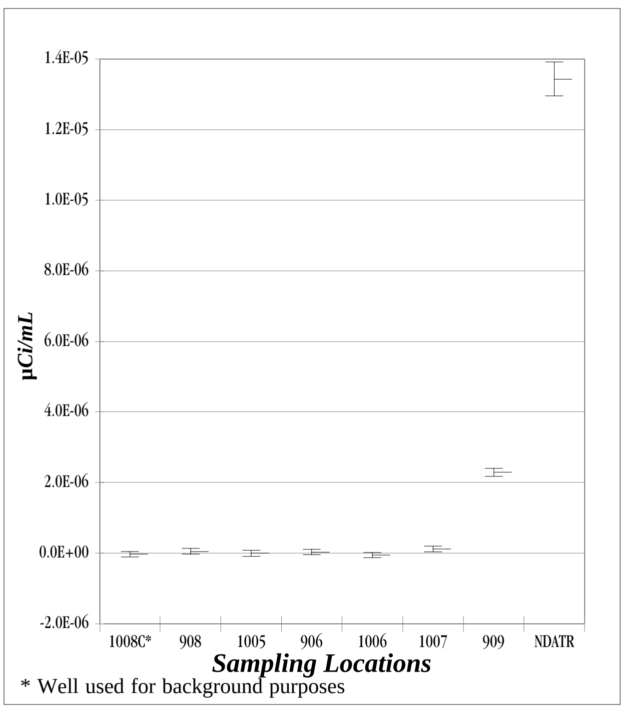


Figure 3-21. Tritium Activity in Groundwater Samples from the Weathered Lavery Till Unit (Fig. 3-21a follows with magnified scale)

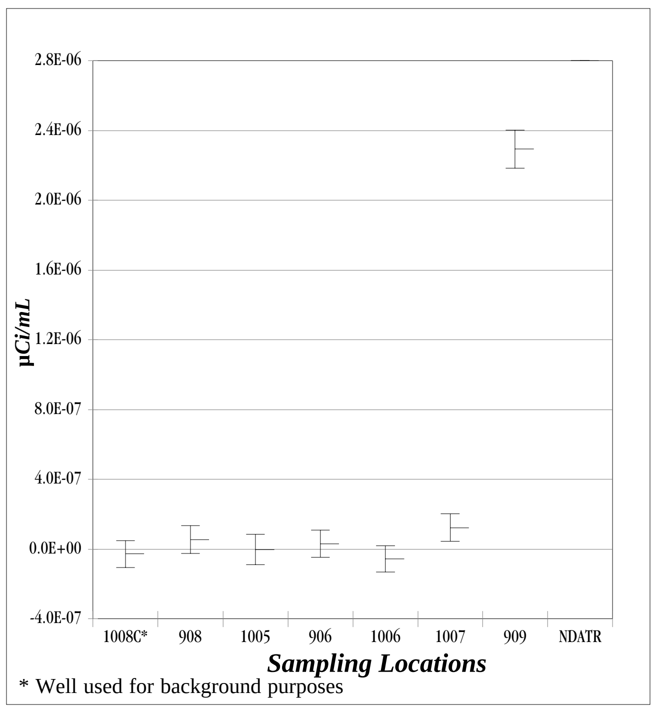


Figure 3-21a. Tritium Activity in Groundwater Samples from the Weathered Lavery Till Unit (magnified scale of Fig. 3-21)

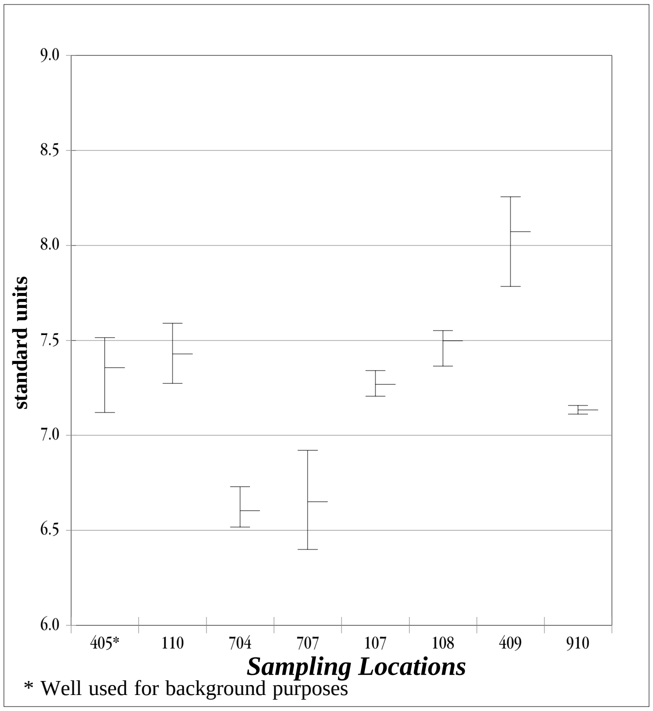


Figure 3-22. pH of Groundwater Samples from the Unweathered Lavery Till Unit

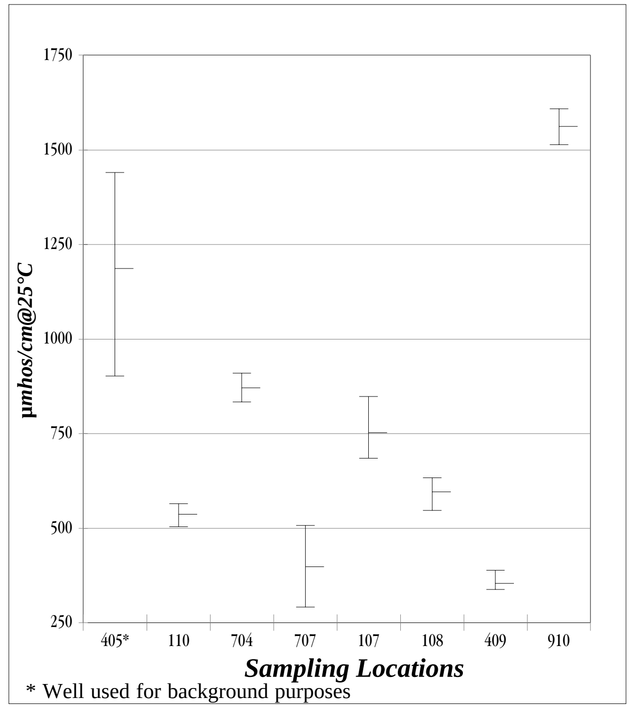


Figure 3-23. Conductivity of Groundwater Samples from the Unweathered Lavery Till Unit

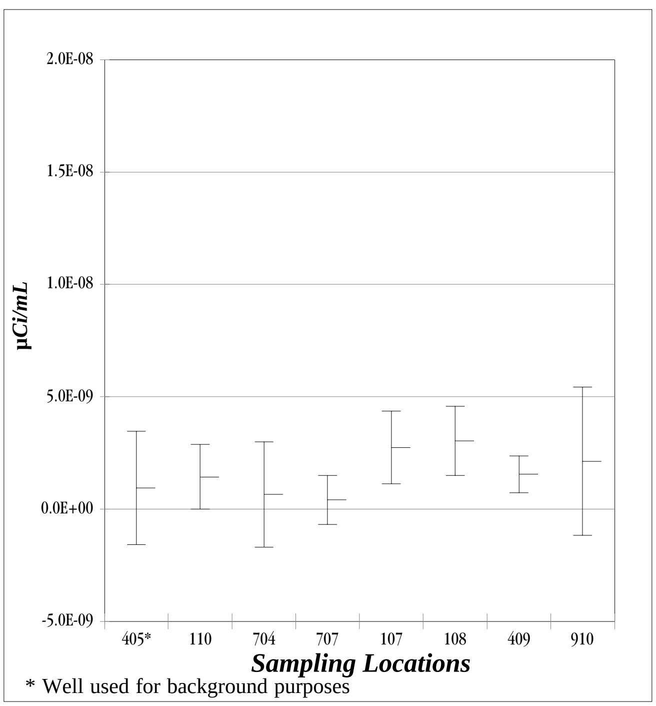


Figure 3-24. Gross Alpha in Groundwater Samples from the Unweathered Lavery Till Unit

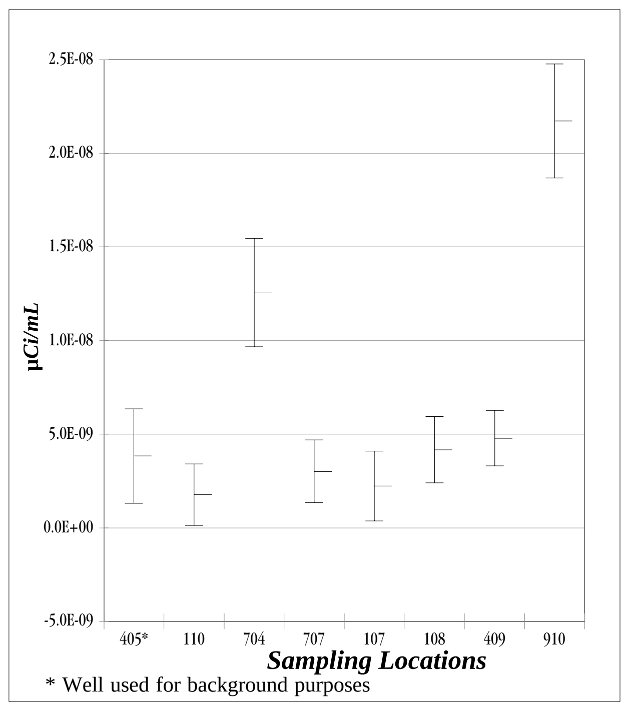


Figure 3-25. Gross Beta in Groundwater Samples from the Unweathered Lavery Till Unit

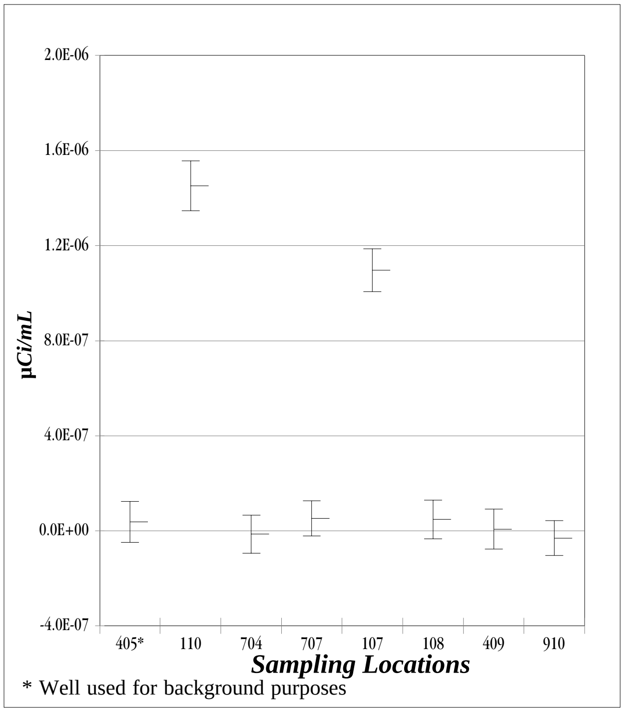


Figure 3-26. Tritium Activity in Groundwater Samples from the Unweathered Lavery Till Unit

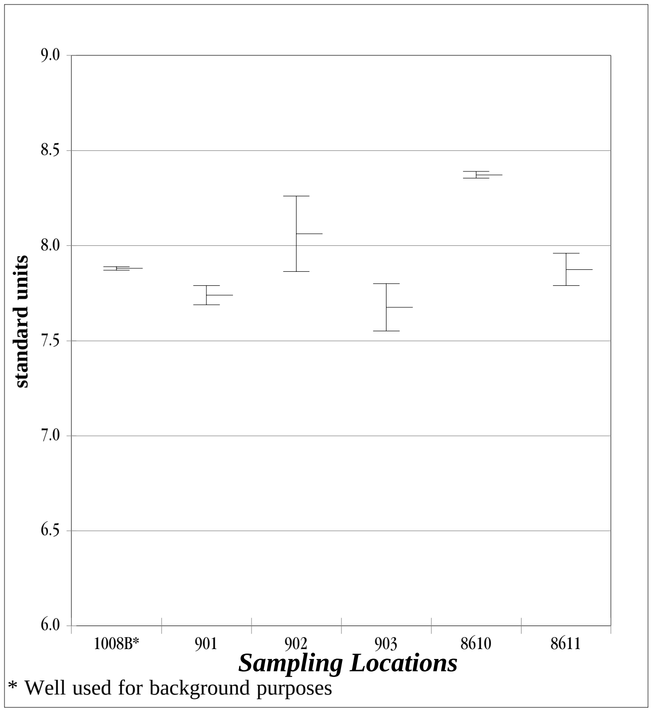


Figure 3-27. pH of Groundwater Samples from the Kent Recessional Sequence

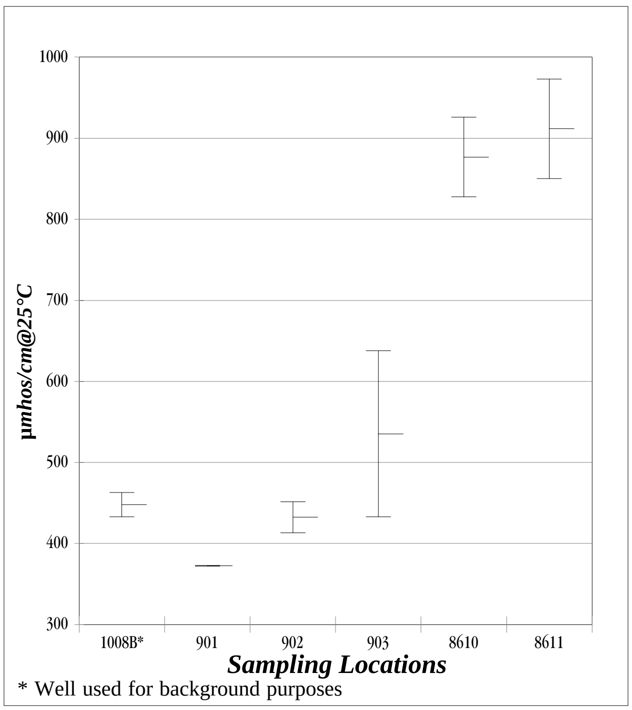


Figure 3-28. Conductivity of Groundwater Samples from the Kent Recessional Sequence

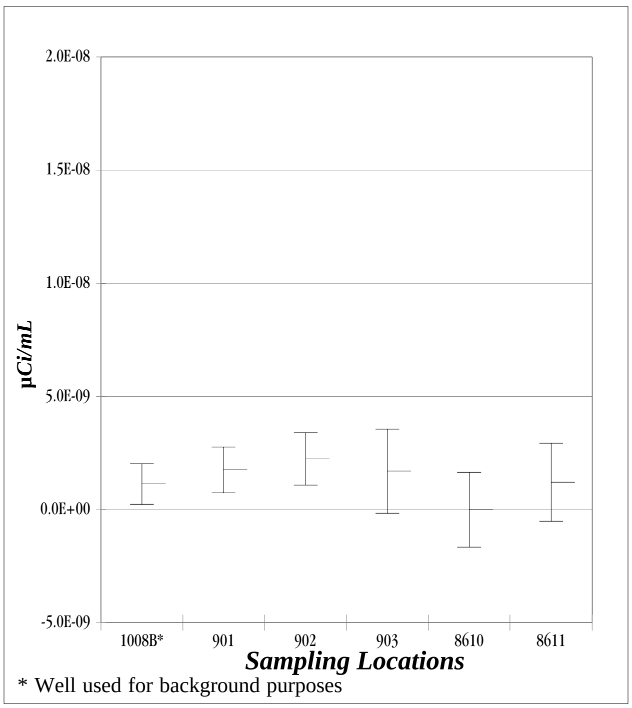


Figure 3-29. Gross Alpha in Groundwater Samples from the Kent Recessional Sequence

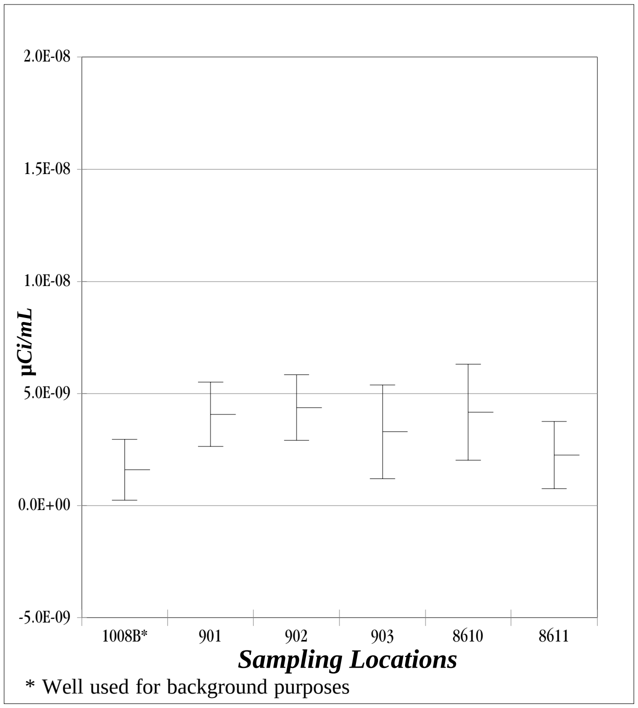


Figure 3-30. Gross Beta in Groundwater Samples from the Kent Recessional Sequence

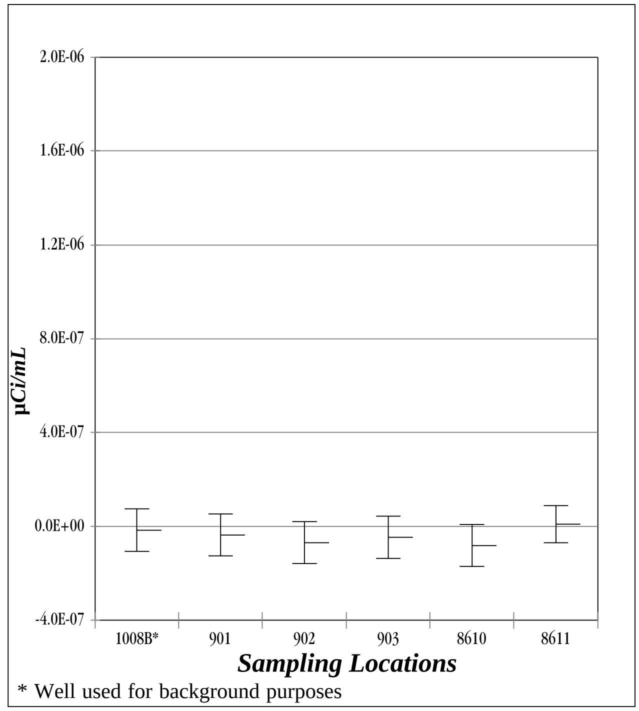


Figure 3-31. Tritium Activity in Groundwater Samples from the Kent Recessional Sequence

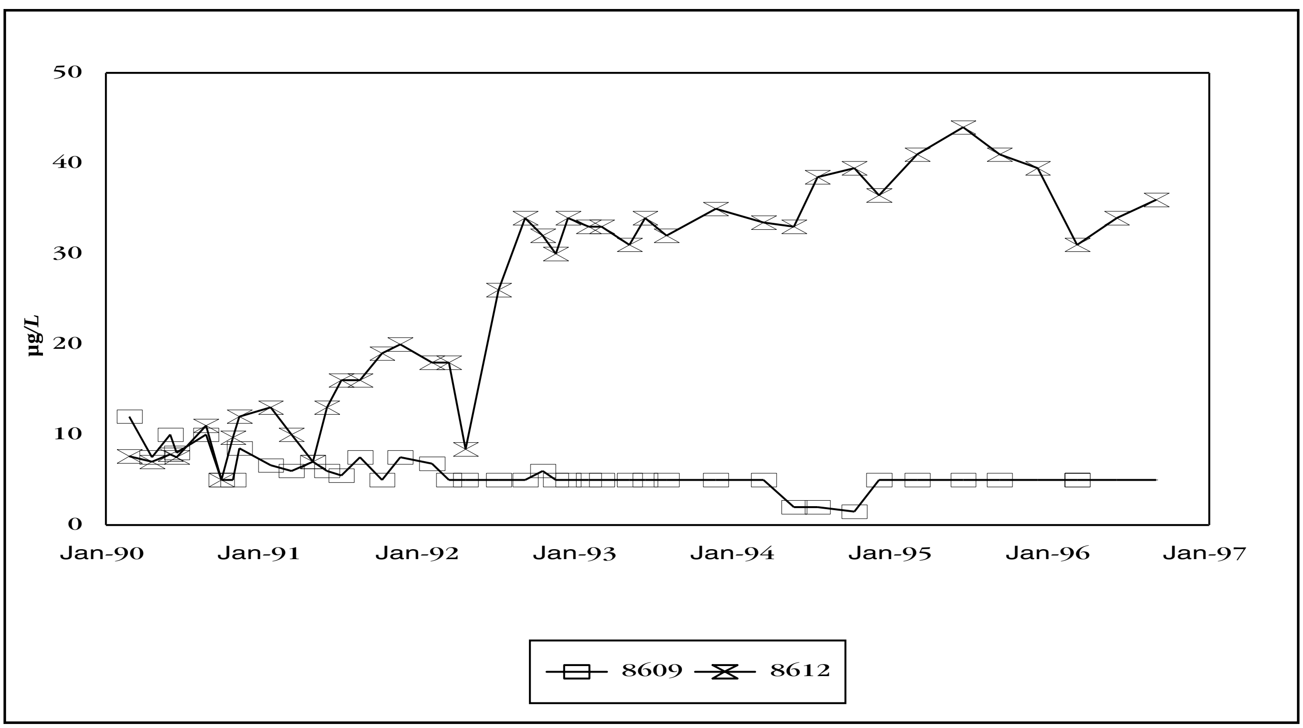


Figure 3-32. Seven-Year Trends (1990 through 1996) of 1,1-DCA at Selected Monitoring Locations

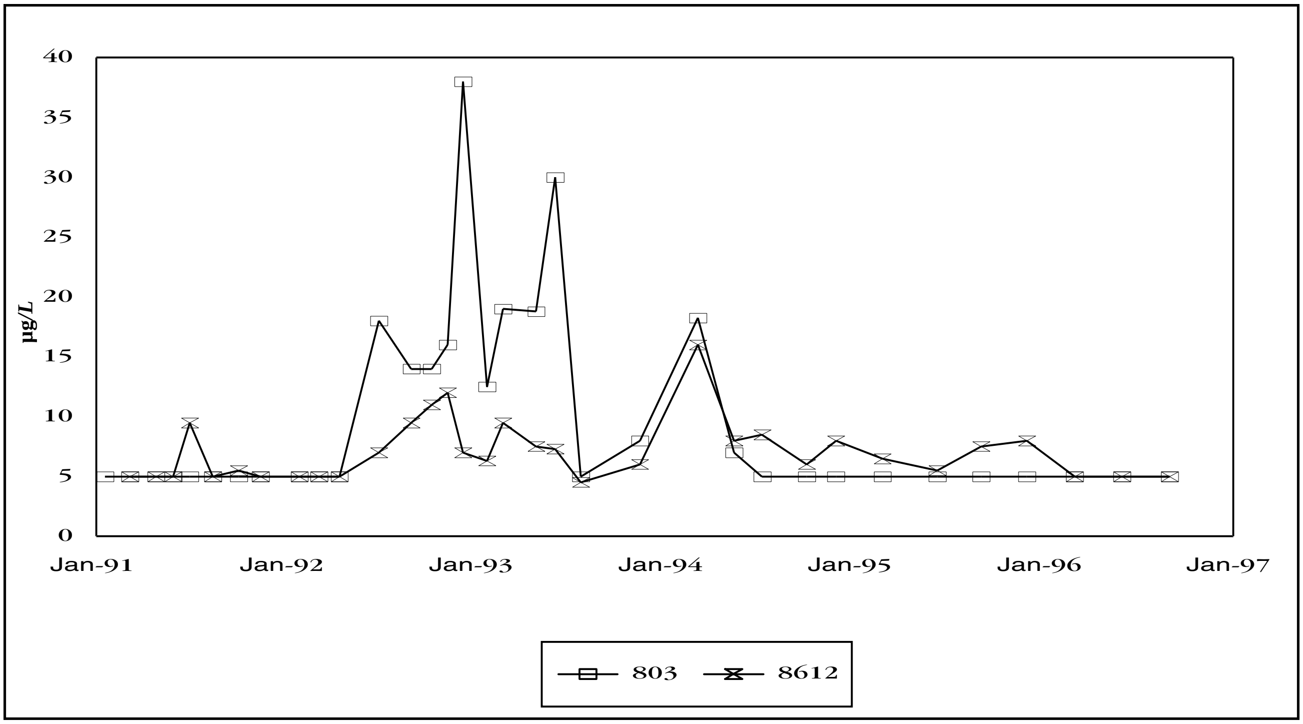


Figure 3-33. Six-Year Trends (1991 through 1996) of Dichlorodifluoromethane (DCDFMeth) at Selected Monitoring Locations

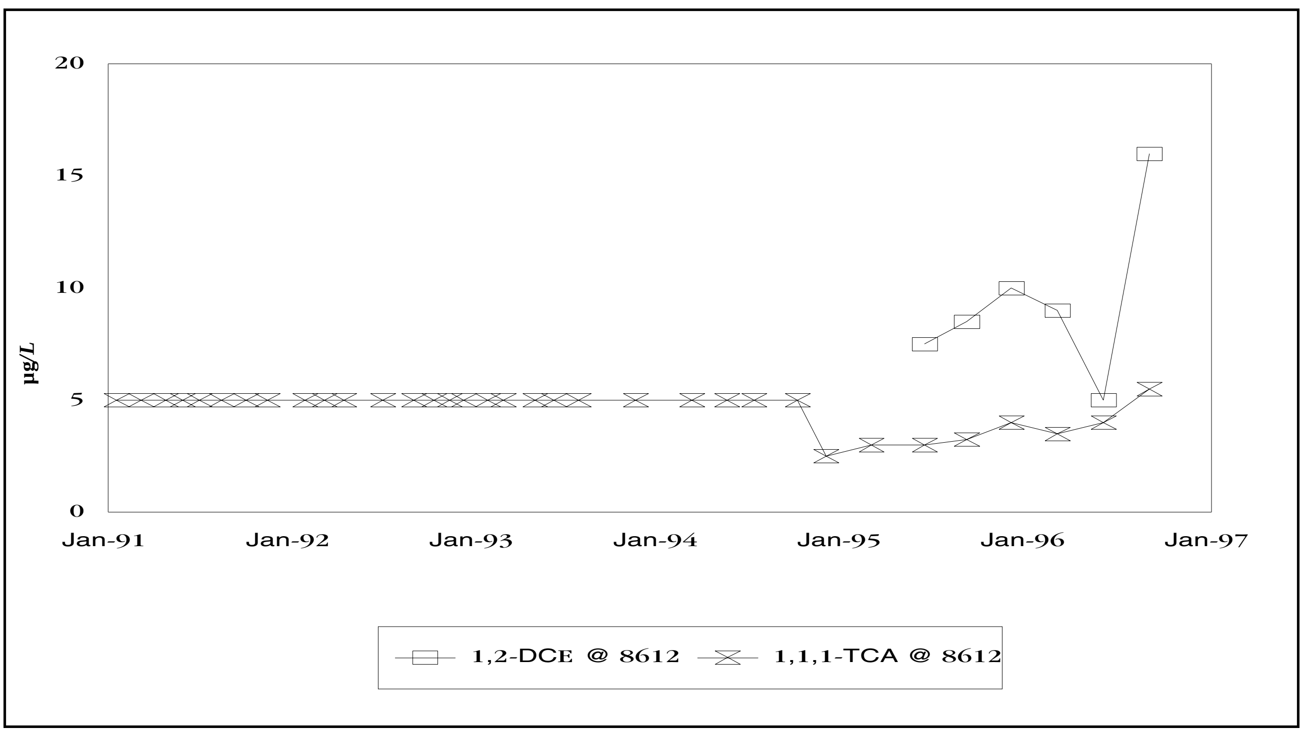


Figure 3-34. Six-Year Trends of 1,2-DCE and 1,1,1-TCA (1991 through 1996) at Selected Monitoring Locations

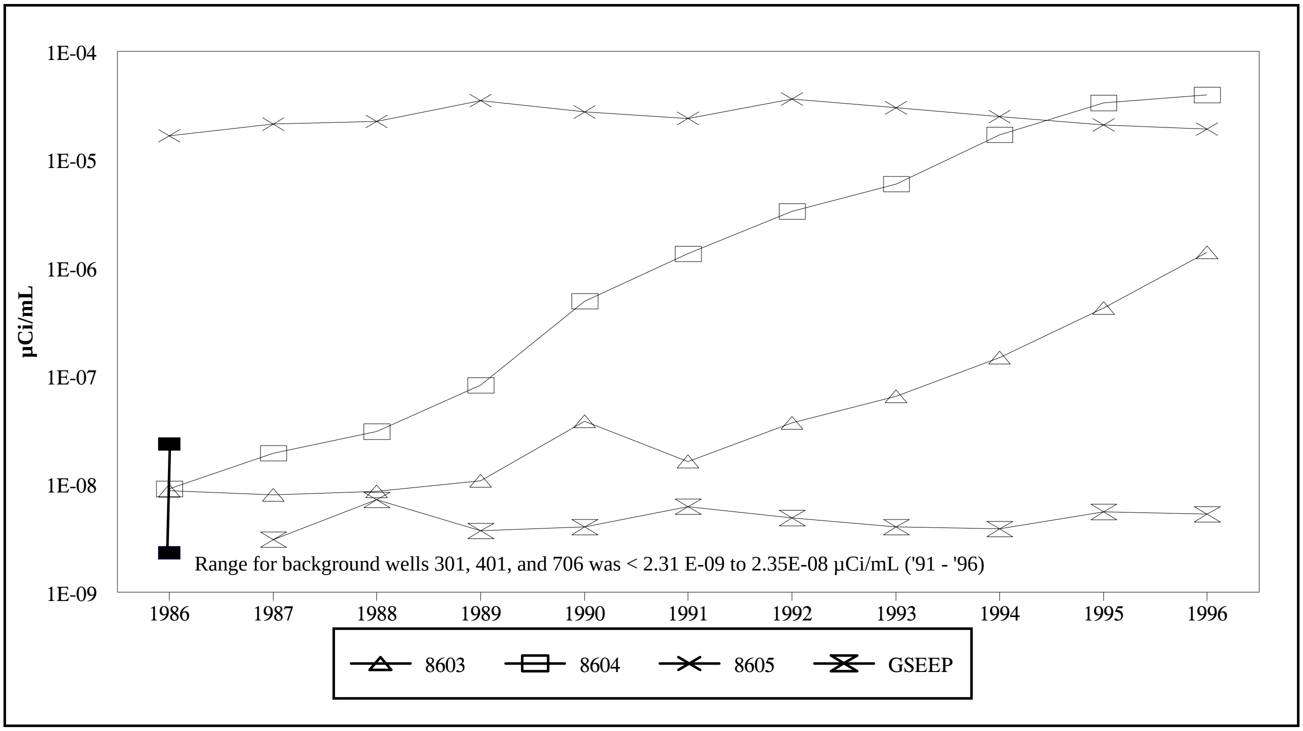


Figure 3-35. Eleven-Year Trends of Averaged Gross Beta Activity at Selected Locations in the Sand and Gravel Unit

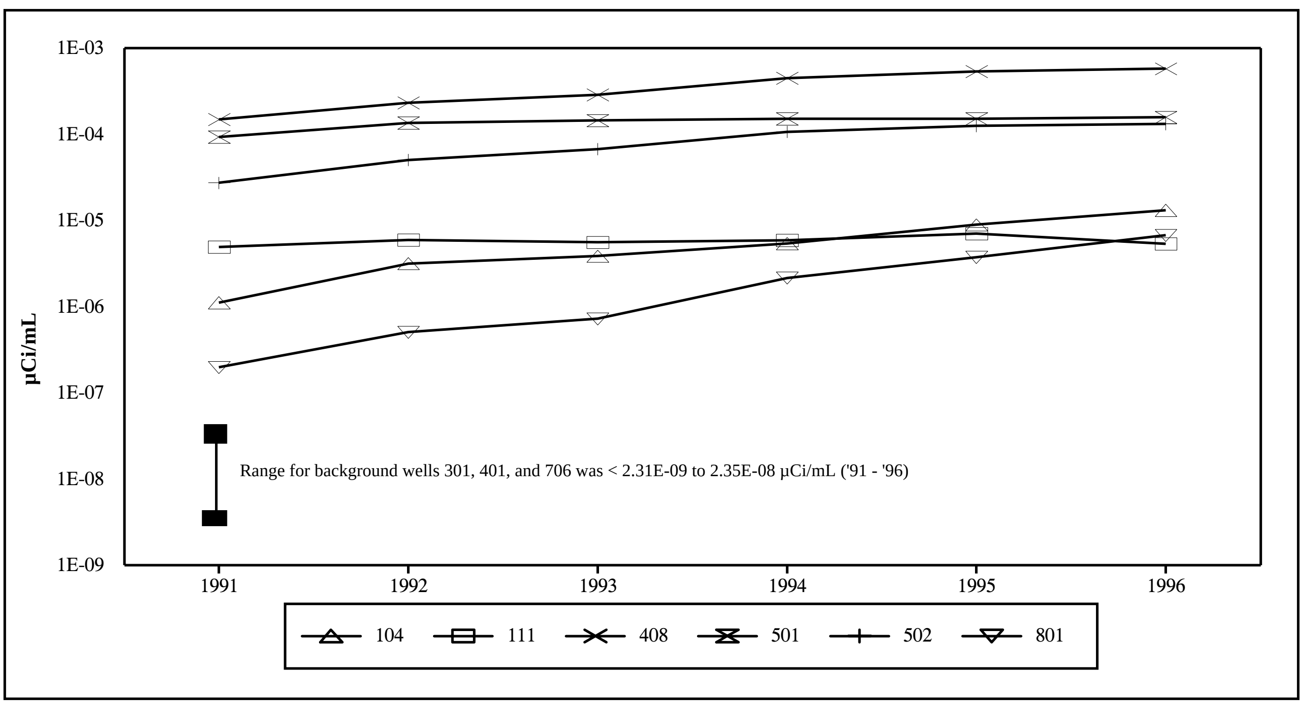


Figure 3-35a. Six-Year Trends of Averaged Gross Beta Activity at Selected Locations in the Sand and Gravel Unit

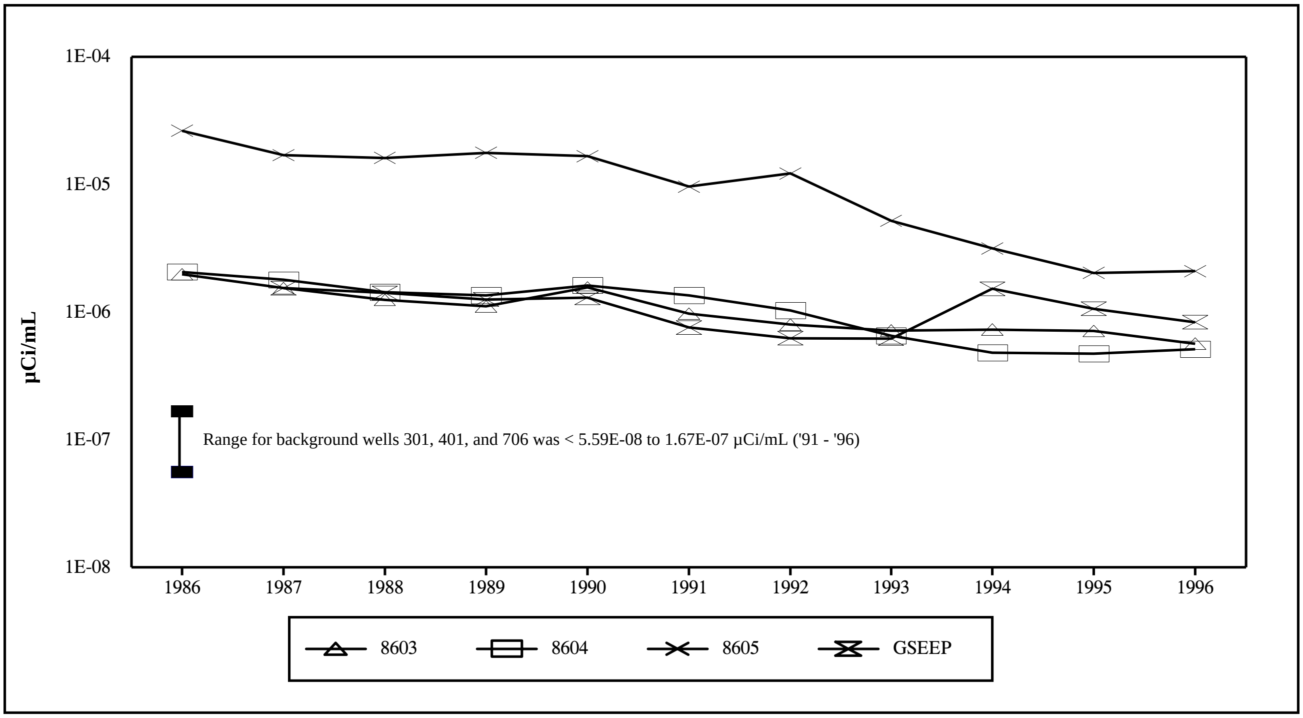


Figure 3-36. Eleven-Year Trends of Averaged Tritium Activity at Selected Locations in the Sand and Gravel Unit

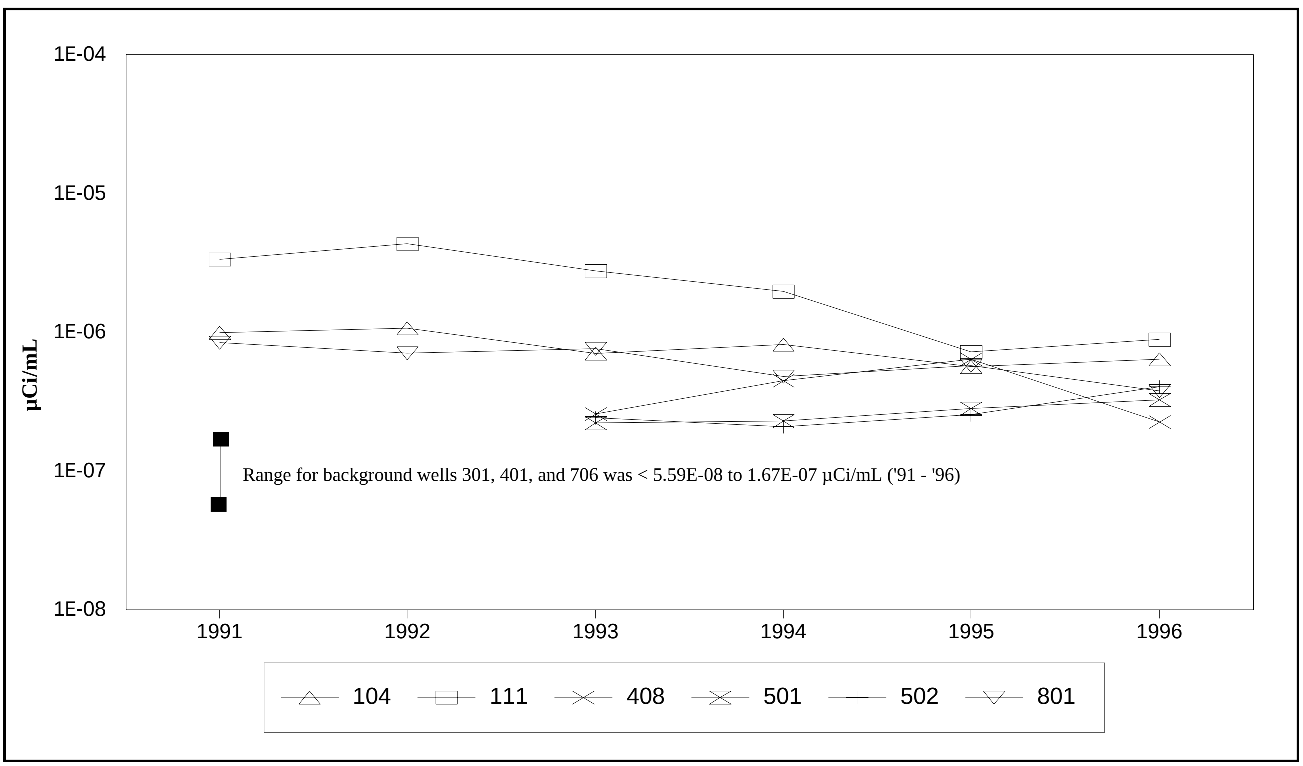


Figure 3-36a. Six-Year Trends of Averaged Tritium Activity at Selected Locations in the Sand and Gravel Unit

RADIOLOGICAL DOSE ASSESSMENT

Each year the potential radiological dose to the public that is attributable to operations and effluents from the West Valley Demonstration Project (the WVDP or Project) is assessed to verify that no individual could possibly have received a dose exceeding the limits established by the regulatory agencies. The results of these conservative dose calculations demonstrate that the potential maximum dose to an off-site resident was well below permissible standards and was consistent with the as-low-as-reasonably achievable (ALARA) philosophy of radiation protection.

Introduction

This chapter describes the methods used to estimate the dose to the general public resulting from exposure to radiation and radionuclides released by the Project to the surrounding environment during 1996.

Estimated doses are compared directly to current radiation standards established by the U.S. Department of Energy (DOE) and the U.S. Environmental Protection Agency (EPA) for protection of the public. The 1996 values are also compared to the annual dose the average resident of the U.S. receives from natural background radiation and to doses reported in previous years for the Project.

Radioactivity

Atoms that emit radiation are called radionuclides. Radionuclides are unstable isotopes that have the same number of protons as any other isotope of the element but different numbers of neutrons, resulting in different atomic masses. For example, the element hydrogen has two stable isotopes, H-1 and H-2 (deuterium), and one radioactive isotope, H-3 (tritium). The numbers following the element's symbol identify the atomic mass, which is the number of protons plus neutrons in the nucleus.

When radioactive atoms decay by emitting radiation, the daughter products that result may be either radioactive or stable. Generally, radionuclides with high atomic numbers, such as uranium-238 and plutonium-239, have many generations of radioactive progeny. For example, the radioactive decay of plutonium-239 creates uranium-235, thorium-231, protactinium-231, and so on through eleven progeny until only the stable isotope lead-207 remains.

Radionuclides with lower atomic numbers often have no more than one daughter. For example, strontium-90 has one radioactive daughter, yttrium-90, which finally decays into stable zirconium, whereas cobalt-60 decays directly to stable nickel with no intermediate nuclide.

The time required for half of the radioactivity of a radionuclide to decay is referred to as the radionuclide's half-life. Each radionuclide has a unique half-life; both strontium-90 and cesium-137 have half-lives of approximately 30 years while plutonium-239 has a half-life of 24,400 years. Knowledge of radionuclide half-lives is often used to estimate past and future inventories of radioactive material. For example, a 1.0-millicurie source of cesium-137 in 1996 would have measured 2.0 millicuries in 1966 and will be 0.5 millicuries in 2026.

Radiation emitted by radionuclides may consist of electromagnetic rays such as x-rays and gamma rays or charged particles such as alpha and beta particles. A radionuclide may emit one or more of these radiations at characteristic energies that can be used to identify them.

Radiation Dose

The energy released from a radionuclide is eventually deposited in matter encountered along the path of the radiation. The radiation energy absorbed by a unit mass of material is referred to as the absorbed dose. The absorbing material can be either inanimate matter or living tissue.

Alpha particles leave a dense track of ionization as they travel through tissue and thus deliver the most dose per unit-path length. However, alpha particles are not penetrating and must be taken into the body by inhalation or ingestion to cause harm. Beta and gamma radiation can penetrate the protective dead skin layer of the body from the outside, exposing the internal organs.

Because beta and gamma radiations deposit much less energy in tissue per unit-path length relative to alpha radiation, they produce fewer biological effects for the same absorbed dose. To allow for the different biological effects of different kinds of radiation, the absorbed dose is multiplied by a quality factor to yield a unit called the dose equivalent. A radiation dose expressed as a dose equivalent, rather than as an absorbed dose, permits the risks from different types of radiation exposure to be compared to each other (e.g., exposure to alpha radiation compared to exposure to gamma radiation). For this reason, regulatory agencies limit the dose to individuals in terms of total dose equivalent.

Units of Measurement

The unit for dose equivalent in common use in the U.S. is the rem, which stands for roentgen-equivalent-man. The international unit of dose equivalent is the sievert (Sv), which is equal to 100 rem. The millirem (mrem) and millisievert (mSv), used more frequently to report the low dose equivalents encountered in environmental exposures, are equal to one-thousandth of a rem or sievert.

The effective dose equivalent (EDE), also expressed in units of rem or sievert, provides a means of combining unequal organ and tissue doses into a single "effective" whole body dose that represents a comparable risk. The EDE is calculated by multiplying the organ dose equivalent by the organ-weighting factors developed by the International Commission on Radiological Protection (ICRP) in Publications 26 (1977) and 30 (1979). The weighting factor is a ratio of the risk from a specific organ or tissue dose to the total risk resulting from an equal whole body dose. All organ-weighted dose equivalents are then summed to obtain the EDE.

The dose from internally deposited radionuclides calculated for a fifty-year period following intake is called the fifty-year committed effective dose equivalent (CEDE). The CEDE sums the dose to an individual over fifty years to account for the biological retention of radionuclides in the body. The total EDE is calculated by adding the dose equivalent from external, penetrating radiation to the CEDE. Unless otherwise specified, all doses discussed here are EDE values, which include the CEDE for internal emitters.

A collective population dose is expressed in units of person-rem or person-sievert because the individual doses are summed over the entire potentially exposed population. The average individual dose can therefore be obtained by dividing the collective dose by the number in the population.

Sources of Radiation

Members of the public are routinely exposed to different sources of ionizing radiation from both natural and manmade sources. Figure 4-1 shows the relative contribution to the annual dose in millirem from these sources in comparison to the estimated 1996 maximum individual dose from the WVDP. The National Council on Radiation Protection and Measurements (NCRP) Report 93 (1987) estimates that the average annual effective dose equivalent received by an individual living in the U.S. is about 360 mrem (3.6 mSv) from both natural and manmade sources of radiation.

While most of the radiation dose received by the general public is natural background radiation, manmade sources of radiation also contribute to the average dose. Such sources include diagnostic and therapeutic x-rays, nuclear medicine, fallout from atmospheric nuclear weapons tests, effluents from nuclear fuel cycle facilities, and consumer products such as smoke detectors and cigarettes.

As can be seen in Figure 4-1, natural sources of radiation contribute 295 mrem (2.95 mSv) and manmade sources contribute 65 mrem (0.65 mSv) of the total annual U.S. average dose of 360 mrem. The WVDP contributes a very small amount (0.076 mrem [0.00076 mSv] per year) to the total annual manmade radiation dose to the maximally exposed individual residing near the WVDP. This is much less than the average dose received from using consumer products and is insignificant compared to the federal standard of 100 mrem

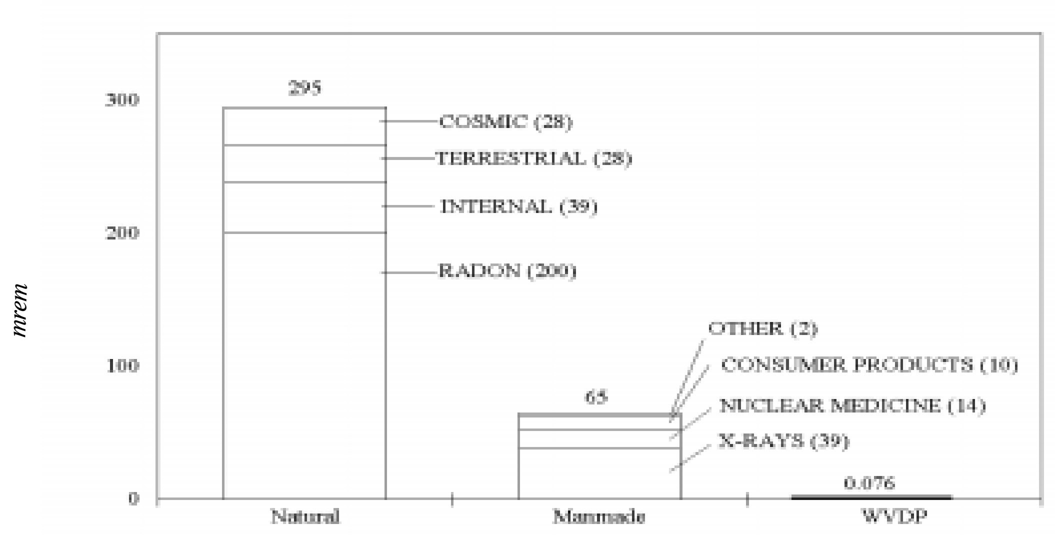


Figure 4-1. Comparison of Annual Background Radiation Dose to the Dose from 1996 WVDP Effluents

from manmade sources or the approximately 300 mrem received annually from natural sources.

Health Effects of Low-level Radiation

Radionuclides entering the body through air, water, or food are distributed in different organs of the body. For example, isotopes of iodine concentrate in the thyroid. Strontium, plutonium, and americium isotopes concentrate in the skeleton. When inhaled, uranium and plutonium isotopes remain in the lungs for a long period of time. Some radionuclides such as tritium, carbon-14, or cesium-137 are distributed uniformly throughout the body. Therefore, depending on the radionuclide, some organs may receive quite different doses. Moreover, at the same dose levels, certain organs (such as the breast) are more prone to developing a fatal cancer than other organs (such as the thyroid).

Because of the uncertainty and difficulty in measuring the incidence of increased cancer resulting from exposure to ionizing radiation, to be conservative, a linear model is used to predict health risk from low levels of radiation. This model assumes that there is a risk associated with all dose levels even though the body may effectively repair damage incurred from low levels of alpha, beta, and gamma radiations.

Exposure Pathways

The radionuclides present at the WVDP site are residues from the reprocessing of commercial nuclear fuel during the 1960s and early 1970s. A very small fraction of these radionuclides is released off-site during the year through ventilation systems and liquid discharges and makes a negligible contribution to the radiation dose to the surrounding population through a variety of exposure pathways.

An exposure pathway consists of a source of contamination or radiation that is transported by environmental media to a receptor where exposure to contaminants may occur. For example, a member of the public could be exposed to low levels of radioactive particulates carried by prevailing winds.

The potential pathways of exposure from Project emissions are inhalation of gases and particulates, ingestion of local food products, ingestion of fish, beef, and deer tissues, and exposure to external penetrating radiations emanating from contaminated materials. The drinking water pathway was excluded because surveys of drinking water usage by the local population surrounding and residing downstream of the WVDP site revealed no use by local residents. Table 4-1 summarizes the potential exposure pathways for the general off-site population.

1996 Land Use Survey

A 1996 survey of local residents collected information about local family sizes, sources of food, and gardening practices. The information was used to confirm the locations of the nearest residences and other population parameters. These parameters are required for computer models that are used for the annual dose assessments. See the discussion of **Predictive Computer Modeling** p. 4-6] for more information on the computer model used.

Radioactive Vitrification Operations

The start of radioactive vitrification operations in June/July 1996 resulted in an increase of radioactive emissions from the main plant stack. (See Table C-2.1, p. C2-3.) Specifically, the release rate of iodine-129 increased from a 1993-1995 average of 25 microcuries (μCi) per year to 1,200 μCi in 1996 as a result of the pretreatment of the

Table 4-1
Potential Off-Site Exposure Pathways Under Existing WVDP Conditions

Exposure Pathway and Transporting Medium	***Reason for Inclusion/Exclusion***
Inhalation: gases and particulates in air (included)	*Off-site transport of contaminants from WVDP stacks or resuspended particulates from soils*
Ingestion: cultivated crops (included)	*Local agricultural products irrigated with contaminated ground- or surface water; foliar deposition and uptake of airborne contaminants*
Ingestion: surface and groundwater (excluded)	*No documented use of local surface water and downgradient groundwater wells by local residents*
Ingestion: fish, beef, venison, and milk (included)	*Fish exposed to contaminants in water or sediments may be consumed; beef, venison, and milk consumption following deposition of transported airborne and surface water contaminants*
External exposure: radiation emanating from particulates and gases from air or surface water (included)	*Transport of air particulates and gases to off-site receptors; transport of contaminants in surface water and direct exposure during stream use and swimming*

high-level waste before it is vitrified. Overall, the total airborne release of fission products (with the exception of iodine) and actinides was lower in 1996 than in 1995.

Dose Assessment Methodology

The potential radiation dose to the general public from activities at the WVDP is evaluated by using a two-part methodology and following the requirements in DOE Order 5400.5. The first part uses the measurements of radionuclide concentrations in air and liquid discharges from the Project. (See *Appendices C-1* and *C-2*.) These data, together with meteorological and demographic information, are input to computer models that calculate the potential or estimated doses, rather than actual radiation doses, from all credible pathways to individuals and the local population. The second phase of the dose assessments is based on measurement of radioactivity in foodstuffs sampled in the vicinity of the WVDP and the comparison of these values with measurements of samples collected from locations well beyond the potential influence of site effluents. These measurements of environmental media show that the concentrations of radioactivity are small and usually are near the analytical detection limits, thereby providing additional assurance that operations at the WVDP are not adversely affecting the public.

Predictive Computer Modeling

Because of the difficulty of distinguishing the small amount of radioactivity emitted from the site from that which occurs naturally in the environment, computer codes were used to model the environmental dispersion of radionuclides emitted from on-site monitored ventilation stacks and liquid discharge points. The EDE to the maximally exposed off-site individual and the collective EDE to the population were calculated using models that have been approved by the DOE and the EPA to demonstrate compliance with radiation standards.

Radiological dose was evaluated for all major exposure pathways, including external irradiation, inhalation, and ingestion of local food products. The dose contributions from each radionuclide and pathway combination were then summed to obtain the total dose estimates reported in Table 4-2.

Separate dose calculations are performed if any of the near-site food samples contain radionuclide concentrations that are statistically higher than the concentrations in control samples. However, these calculated doses are not added to the estimates that are based on predictive computer modeling (Table 4-2) because the models already include contributions from all environmental pathways.

Environmental Media Concentrations

Near-site and control (background) samples of fish, milk, beef, venison, and local produce were collected and analyzed for various radionuclides, including tritium, cobalt-60, strontium-90, iodine-129, cesium-134, and cesium-137. The measured radionuclide concentrations reported in *Appendix C-3*, Tables C-3.1 through C-3.4 (pp. C3-3 through C3-8) are the basis for comparing near-site and background concentrations.

If differences were found between near-site and background sample concentrations, the amount by which the near-site sample concentration exceeded background was used to calculate a potential maximum individual dose for comparison with dose limits and the dose from background alone. If no differences in concentrations were found, then no further assessment was conducted.

The maximum potential dose to nearby residents from the consumption of foods with radionuclide concentrations above background was calculated by multiplying the excess concentrations by the maximum adult annual consumption rate for each type of food and the unit dose conversion factor for ingestion of the measured radionuclide. The

Table 4-2

Summary of Annual Effective Dose Equivalents to an Individual and Population from WVDP Releases in 1996

Exposure Pathways	*Annual Effective Dose Equivalent*	
	Maximally Exposed Off-Site Individual [1] *mrem (mSv)*	*Collective Effective Dose Equivalent* [2] *person-rem (person-Sv)*
Airborne Releases [3]	8.7E-03 (8.7E-05)	7.0E-02 (7.0E-04)
% EPA standard (10 mrem)	8.7E-02%	N/A
Waterborne Releases [4]		
Effluents only	4.3E-02 (4.3E-04)	1.7E-02 (1.7E-04)
Effluents plus north plateau drainage	6.7E-02 (6.7E-04)	8.4E-02 (8.4E-04)
Total from All Pathways	7.6E-02 (7.6E-04)	1.5E-01 (1.5E-03)
% DOE standard (100 mrem) — air and water combined	7.6E-02%	N/A
% natural background (300 mrem; 390,000 person-rem) — air and water combined	2.5E-02%	3.8E-05%

[1] Maximum exposure to air discharges occurs at a residence 1.9 kilometers north-northwest of the main plant.

[2] Population of 1.3 million within 80 kilometers of the site.

[3] From atmospheric release points. Calculated using CAP88-PC for individual and population.

[4] Calculated using methodology described in Radiological Parameters for Assessment of WVDP Activities (Faillace and Prowse 1990).

Exponents are expressed as "E" in this report; a value given as 1.2×10^{-4} in scientific notation is reported as 1.2E-04 in the text and tables.

N/A - Not applicable. Numerical regulatory standards are not set for the collective EDE to the population.

consumption rates are based on site-specific data and recommendations in NRC Regulatory Guide 1.109 for terrestrial food chain dose assessments (U.S. Nuclear Regulatory Commission October 1977). The internal dose conversion factors were obtained from Internal Dose Conversion Factors for Calculation of Dose to the Public (U.S. Department of Energy July 1988).

Airborne Releases

Releases of airborne radioactive materials from nominal 10-meter stacks and from the main 60-meter stack were modeled using the EPA-approved CAP88-PC computer code (U.S. Environmental Protection Agency March 1992). This air dispersion code estimates effective dose equivalents for the ingestion, inhalation, air immersion, and ground surface pathways. Site-specific data for radionuclide release rates in curies per year, wind data, and the current local population distribution were used as input parameters. Resulting output from the CAP88-PC code was then used to determine the total EDE to a maximally exposed individual and the collective dose to the population within an 80-kilometer (50-mi) radius of the WVDP.

As reported in *Chapter 2, Environmental Monitoring*, the main 60-meter stack and several shorter stacks were monitored for radioactive air emissions during 1996. The activity that was released to the atmosphere from these stacks is listed in Tables C-2.1 through C-2.10 (pp. C2-3 through C2-12) and Table C-2.14 and C-2.15 (p. C2-16) and was used as input to the CAP88-PC code.

Wind data collected from the on-site meteorological tower during 1996 were used as input to the CAP88-PC code. Data collected at the 60-meter and 10-meter heights were used in combination with the main plant stack and ground-level effluent release data, respectively.

Waterborne Releases

The EDE to the maximally exposed off-site individual and the collective EDE to the population due to routine waterborne releases and natural drainage are calculated using dose conversion factors as reported in Radiological Parameters for Assessment of WVDP Activities (Faillace and Prowse 1990).

Since the effluents eventually reach Cattaraugus Creek, which is not used as a source of drinking water, the most important individual exposure pathway is the consumption of fish by local sportsmen. It is assumed that a person may consume annually as much as 21 kilograms (46 lbs) of fish caught in the creek. Exposure to external radiation from shoreline or water contamination also is included in the model for estimating radiation dose. Population dose estimates assumed that radionuclides were further diluted in Lake Erie before reaching municipal drinking water supplies. The computer code LADTAP II (Simpson and McGill 1980) was used to calculate the dose conversion factors for routine waterborne releases and dispersion of these effluents. Input data included site-specific stream flow and dilution, drinking water usage, and stream usage factors. A detailed description of LADTAP II is given in Radiological Parameters for Assessment of WVDP Activities (Faillace and Prowse 1990).

Seven planned batch releases of liquid radioactive effluents from lagoon 3 occurred during 1996. The radioactivity that was discharged in these effluents is listed in *Appendix C-1*, Table C-1.1 (p. C1-3) and was used with the dose conversion factors to calculate the EDE to the maximally exposed off-site individual and the collective EDE to the population.

In addition to the batch releases from lagoon 3 (WNSP001), effluents from the sewage treatment facility (WNSP007) and the french drain (WNSP008) are routinely released. The activities measured from these release points were included in the EDE calculations. The measured radioactivity concentrations from the sewage treatment facility and french drain are presented in Tables C-1.5 and C-1.6 (p. C1-7).

In addition to the above discharges there are two natural drainage channels originating on the Project premises for which there are measurable amounts of radioactivity. These are drainages from the northeast swamp (WNSWAMP) and north swamp (WNSW74A). The measured radioactivity from these points is reported in Tables C-1.7 and C-1.8 (pp. C1-8 and C1-9). These release points are included in the EDE calculations for the maximally exposed off-site individual and the collective population.

Environmental Media Concentrations

Radionuclide concentrations in samples of fish, milk, beef, venison, and local crops were assessed to determine if near-site concentrations were statistically above concentrations for corresponding background (control) samples.

Fish

Samples of fish were collected from Cattaraugus Creek from June 1996 through November 1996. Twenty fish were collected both at background locations upstream of the site and at locations downstream of the site above the Springville dam. Ten fish were collected at points downstream of the site below the dam. Edible portions of all fish samples were analyzed for strontium-90 and gamma-emitting radionuclides, and the values were compared to background values. (See Table C-3.4 [pp. C3-6 through C3-8].)

Average values for strontium-90, cesium-134, and cesium-137 were below detection limits or were statistically the same as average background concentrations for all fish samples downstream of the site.

Strontium-90 and cesium-137 concentrations in fish collected downstream of the site were reported as being marginally higher in 1995 than concentrations in fish collected upstream. However, no difference was observed before 1995 or during 1996. This observation supports the conclusion that there is no long-term upward trend in strontium-90 or cesium-137 in fish flesh downstream of the site that is attributable to the Project.

Milk

Milk samples were collected from various nearby dairy farms throughout 1996. Control samples were collected from farms 25-30 kilometers (15-20 mi) to the south and north of the WVDP. Milk samples were measured for tritium, strontium-90, iodine-129, cesium-134, cesium-137, and potassium-40. (See Table C-3.1 [p. C3-3].) Ten near-site milk samples were collected and compared with eight background samples. The radionuclide concentrations in routine milk samples from near-site locations were below detection limits or statistically the same as background concentrations.

Beef

Near-site and control samples of locally raised beef were collected in 1996. These samples were measured for tritium, strontium-90, and gamma-emitting radionuclides such as cesium-134 and cesium-137. Two samples of beef muscle tissue were collected from background locations and two from near-site locations.

Individual concentrations of strontium-90, cesium-137, and cesium-134 in near-site samples were either below detection limits or not statistically different than concentrations at control locations. (See Table C-3.2 [p. C3-4].) The tritium concentration in one near-site beef sample was higher than the control concentration. The hypothetical maximum dose to an individual from consuming 110 kilograms (243 lbs) of beef from this location is 1.2E-03 mrem (1.2E-05 mSv). This annual dose is roughly equivalent to the dose received every two minutes from natural background radiation.

Venison

Meat samples from three near-site and three control deer were collected in 1996. (See Table C-3.2 [p. C3-4].) These samples were measured for tritium, strontium-90, cesium-134, cesium-137, and other gamma-emitting radionuclides. Individual concentrations of cesium-134 and cesium-137 in near-site venison samples were either below detection limits or not statistically different than concentrations at control locations. The tritium concentrations in all three near-site venison samples were slightly higher than the concentrations in the control samples. In addition, one venison sample contained higher strontium-90 concentrations than the controls. The calculated maximum dose to an individual from consuming 45 kilograms (100 lbs) of near-site venison is 3.0E-02 mrem (3.0E-04 mSv). This annual dose is roughly equivalent to the dose received every hour from natural background radiation.

Produce (corn, beans, and apples)

Near-site and background samples of corn, beans, and apples were collected during 1996 and analyzed for tritium, cobalt-60, strontium-90, potassium-40, and cesium-137. (See Table C-3.3 [p. C3-5].)

Individual concentrations of tritium, cobalt-60, and cesium-137 in near-site produce samples were either below detection limits or not statistically different than concentrations at control locations. Strontium-90 concentrations in annual near-site corn and apple samples were slightly above the control concentrations. The hypothetical maximum dose to an individual from consuming 52 kilograms (115 lbs) of near-site apples and corn is 6.2E-02 mrem (6.2E-04 mSv). This annual dose is roughly equivalent to the dose received every two hours from natural background radiation.

See *Appendix A* (pp. A-37 through A-40) for the locations from which background biological samples are collected.

Predicted Dose from Airborne Emissions

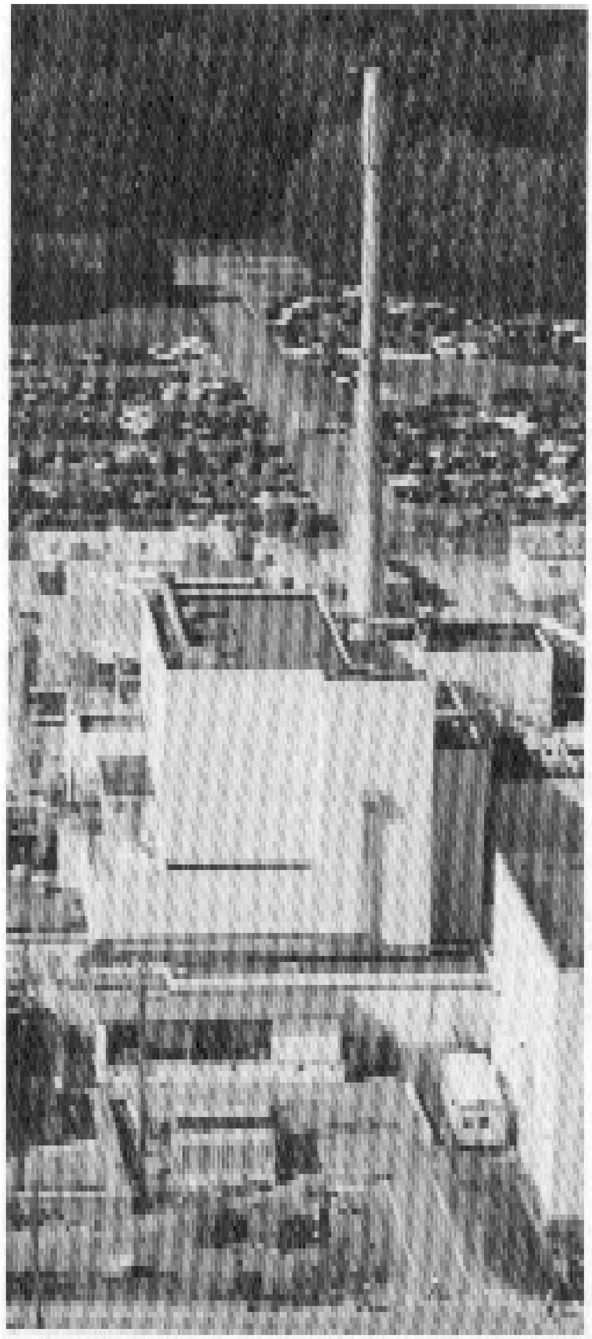
Applicable Standards

Airborne emissions of radionuclides are regulated by the EPA under the Clean Air Act and its implementing regulations. DOE facilities are subject to 40 CFR 61, Subpart H, National Emissions Standards for Hazardous Air Pollutants (NESHAP). The applicable standard for radionuclides is a maximum of 10 mrem (0.1 mSv) EDE to any member of the public in any year.

Maximum Dose to an Off-site Individual

Based on the airborne radioactivity released from the permitted point sources at the site during 1996, it was estimated that a person living in the vicinity of the WVDP could have received a total EDE of 8.7E-03 mrem (8.7E-05 mSv). This maximally exposed off-site individual is located at 1.9 kilometers north-northwest of the site and is assumed to eat only locally produced foods. Approximately 99% of the dose is from iodine-129, emitted from the main stack.

The maximum total EDE of 8.7E-03 mrem (8.7E-05 mSv) from the permitted stacks and



The Main Plant Ventilation Stack at the West Valley Demonstration Project

vents is far below levels that could be measured at the exposed individual's residence. This dose is comparable to about one-quarter hour of natural background radiation received by an average member of the U.S. population and is well below the 10 mrem (0.1 mSv) NESHAP limit promulgated by the EPA and required by DOE Order 5400.5.

Collective Population Dose

The CAP88-PC version of AIRDOS-EPA was used to estimate the collective EDE to the population. The population data that were used for the 1996 assessment are from the most recent census projection, which is for 1995. In this projection, 1.3 million people are estimated to reside within 80 kilometers (50 mi) of the WVDP. This population received an estimated 7.0E-02 person-rem (7.0E-04 person-Sv) total EDE from radioactive airborne effluents released from the permitted WVDP point sources during 1996. The resulting average EDE per individual was 5.4E-05 mrem (5.4E-07 mSv).

Predicted Dose from Waterborne Releases

Applicable Standards

Currently there are no EPA standards establishing limits on the radiation dose to members of the public from liquid effluents except as applied in 40 CFR 141 and 40 CFR 143, Drinking Water Guidelines (U.S. Environmental Protection Agency 1984a; 1984b). The potable water wells sampled for radionuclides are upgradient of the WVDP and therefore are not a potential source of exposure to radiation from Project activities. Since Cattaraugus Creek is not used as a drinking water supply, a comparison of the predicted concentrations and doses to the EPA drinking water limits established in 40 CFR 141 and 40 CFR 143 is not truly appropriate (although the values in creek samples are well below the EPA drinking water limits). The estimated radiation dose was compared with the applicable guidelines provided in DOE Order 5400.5.

Maximum Dose to an Off-site Individual

Based on the radioactivity in effluents released from the WVDP (lagoon 3, sewage treatment plant, and french drain) during 1996, an off-site individual could have received a maximum EDE of 4.3E-02 mrem (4.3E-04 mSv). Approximately 94% of this dose would be from cesium-137 and 4% from strontium-90. This dose of 0.043 mrem (0.00043 mSv) is negligible in comparison to the 300 mrem (3 mSv) that an average member of the U.S. population receives in one year from natural background radiation.

The maximum off-site individual EDE due to drainage from the north plateau (north swamp and northeast swamp) is 2.4E-02 mrem (2.4E-04 mSv). (See Tables C-1.7 and C-1.8 [pp. C1-8 and C1-9].) The combined EDE to the maximally exposed individual from liquid effluents and drainage is 6.7E-02 mrem (6.7E-04 mSv). This annual dose of 0.067 mrem (0.00067 mSv) is negligible in comparison to the 300 mrem (3 mSv) that an average member of the U.S. population receives in one year from natural background radiation.

Collective Dose to the Population

As a result of radioactivity released in liquid effluents from the WVDP (lagoon 3, sewage treatment plant, and french drain) during 1996, the population living within 80 kilometers (50 mi) of the site received a collective EDE of 1.7E-02 person-rem (1.7E-04 person-Sv). The collective dose to the population from the north plateau drainage is 6.6E-02 person-rem (6.6E-04 person-Sv). This estimate is based on a population of 1.3 million living within the 80-kilometer radius. The resulting average EDE from lagoon 3, the sewage treatment plant, the french drain, and north plateau drainage (north swamp and northeast swamp) per individual is 6.4E-05 mrem (6.4E-07 mSv). This dose of 0.000064 mrem (0.00000064 mSv) is an inconsequential addition to the dose that an average person receives in one year from natural background radiation.

Predicted Dose from All Pathways

The potential dose to the public from both airborne and liquid effluents released from the

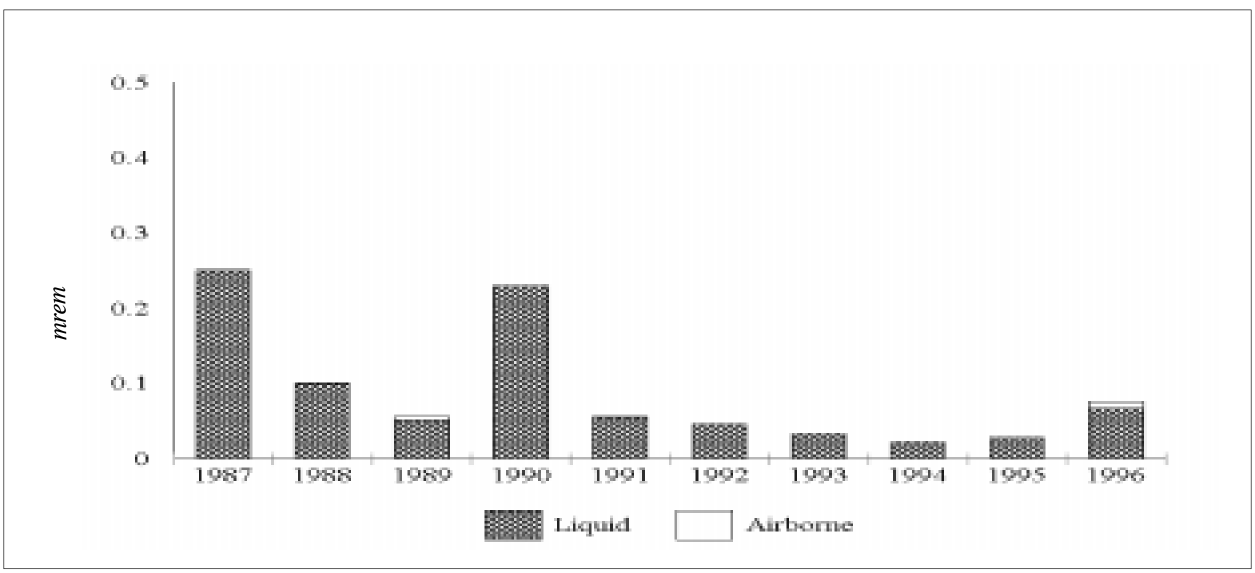


Figure 4-2. Effective Dose Equivalent from Liquid and Airborne Effluents to a Maximally Exposed Individual Residing near the WVDP

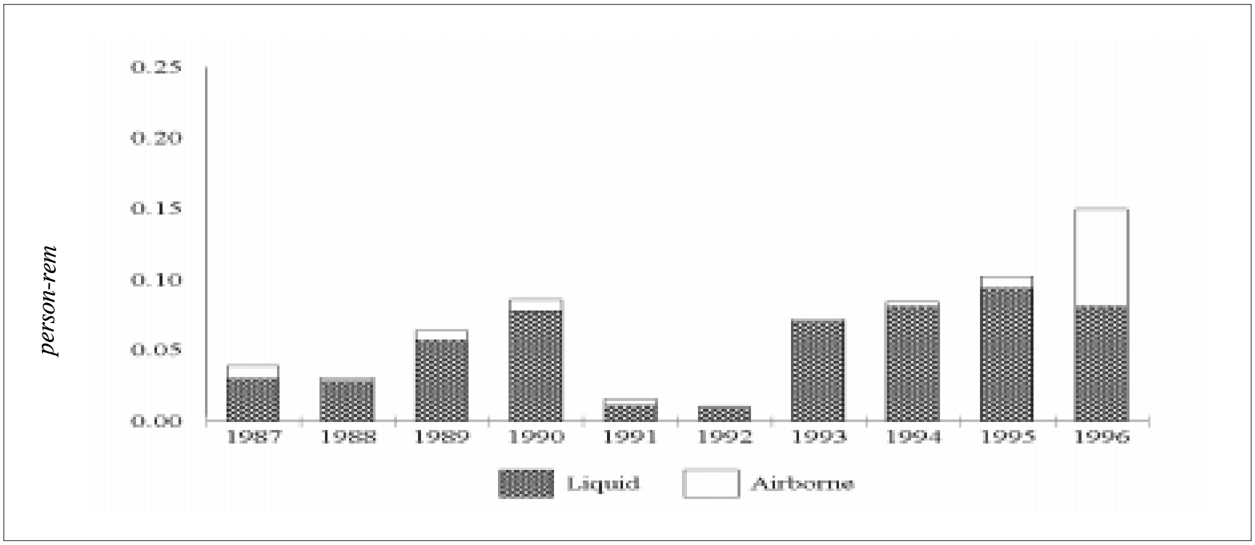


Figure 4-3. Collective Effective Dose Equivalent to the Population Residing within 80 Kilometers of the WVDP from Liquid and Airborne Effluents

Project during 1996 is the sum of the individual dose contributions. The calculated maximum EDE from all pathways to a nearby resident was 7.6E-02 mrem (7.6E-04 mSv). This dose is 0.08% of the 100 mrem (1 mSv) annual limit in DOE Order 5400.5.

The total collective EDE to the population within 80 kilometers (50 mi) of the site was 1.5E-01 person-rem (1.5E-03 person-Sv), with an average EDE of 1.2E-04 mrem (1.2E-06 mSv) per individual.

Table 4-2 (p. 4-7) summarizes the dose contributions from all pathways and compares the individual doses to the applicable standards.

Figure 4-2 shows the calculated annual dose to the hypothetical maximally exposed individual over the last ten years. The estimated dose for 1996 is higher than annual doses reported from 1991 through 1995, principally because of higher cesium-137 concentrations in the liquid discharges.

Figure 4-3 shows the collective dose to the population over the last ten years. The upward trend results from both the increased Project liquid releases over the past several years and an increase in iodine-129 emissions from the main plant stack after the start of radioactive vitrification operations in June/July 1996.

These data confirm the continued inconsequential addition to the natural background radiation dose that the individuals and population around the WVDP receive from Project activities.

Unplanned Releases

There were no off-site unplanned releases (as defined by DOE Order 5400.1) of air or liquid effluent identified or reported in 1996.

Risk Assessment

Estimates of cancer risk from ionizing radiation have been presented by the International Commission on Radiological Protection (1990), the National Council on Radiation Protection and Measurement (1987), and the National Research Council Committee on Biological Effects of Ionizing Radiation (1990). These reports estimate that the probability of fatal cancer induction to the public averaged over all ages ranges from 1.0E-04 to 5.0E-04 cancer fatalities/rem. The most recent risk coefficient of 5.0E-04 (International Commission on Radiological Protection 1990) was used to estimate risk to a maximally exposed off-site individual. The resulting risk to this hypothetical individual from airborne and waterborne releases was a 3.8E-08 probability of a cancer fatality (1 chance in 26 million). This risk is well below the range of 1E-06 to 1E-05 per year considered acceptable by the International Commission on Radiological Protection Report 26 (1977) for any individual member of the public.

Summary

Predictive computer modeling was performed for airborne and waterborne releases. This analysis resulted in estimated doses to the hypothetical maximally exposed individual that were orders of magnitude below all applicable EPA standards and DOE Orders, which place limitations on the release of radioactive materials and dose to individual members of the public. The collective population dose was also assessed and found to be orders of magnitude below natural background radiation doses. Based on the dose assessment, the WVDP was found to be in compliance with all applicable effluent radiological guidelines and standards during 1996.

QUALITY ASSURANCE

The quality assurance (QA) program at the West Valley Demonstration Project (WVDP) provides for and documents consistency, precision, and accuracy in collecting and analyzing environmental samples and in interpreting and reporting environmental monitoring data.

Organizational Responsibilities

Managers of programs, projects, and tasks are responsible for determining and documenting the applicability of quality assurance requirements to their activities and for implementing those requirements. For example, Environmental Laboratory management and staff are directly responsible for carrying out sampling and analytical activities in a manner consistent with good quality assurance practices and for following approved procedures.

Program Design

The quality assurance rule 10 CFR Part 830.120, Quality Assurance, and DOE Order 5700.6C, Quality Assurance (U.S. Department of Energy 1991) provide the quality assurance program policies and requirements applicable to activities at the WVDP. The integrated quality assurance program applicable to environmental monitoring at the WVDP also incorporates requirements from Quality Assurance Program Requirements for Nuclear Facilities (American Society of Mechanical Engineers 1989) and Quality Systems Requirements for Environmental Programs (American National Standards Institute and American Society for Quality Control 1994).

The quality assurance program focuses upon assigning responsibilities and upon thorough planning, specification, control, and documentation of all aspects of an activity in order to ensure the quality of both radiological and nonradiological monitoring data. The quality assurance program includes requirements in the following areas:

√ *Responsibility*. Responsibilities involved in overseeing, managing, and conducting an activity must be clearly defined. Personnel who check and verify that the activity has been completed correctly must be independent of those who performed it.

√ *Planning*. An activity must be planned beforehand and the plan followed. All activities must be documented. Similarly, purchases of any equipment or items must be planned, specified precisely, and verified for correctness upon receipt.

√ *Control of design, procedures, items, and documents*. Any activity, equipment, or construction must be clearly described or defined and tested, and changes in the design must be tested and documented. Procedures must clearly state how activities will be conducted. Only approved procedures may be used. Any equipment or particular items affecting the quality of environmental data must be identified, inspected, calibrated, and tested before use. Calibration status must be clearly indicated. Items that do not conform to requirements must be identified and separated from other items and the nonconformity documented.

√ *Documentation.* Records of all activities must be kept in order to verify what was done and by whom. Records must be clearly traceable to an item or activity.

√ *Corrective action.* If a problem should arise the cause of the problem must be identified, a corrective action planned, responsibility assigned, and the problem remedied.

√ *Audits.* Scheduled audits and assessments must be conducted to verify compliance with all aspects of the quality assurance program and determine its effectiveness.

Subcontractor laboratories providing analytical services for the environmental monitoring program are contractually required to maintain a quality assurance program consistent with WVNS requirements.

Procedures

Activities affecting the quality of environmental monitoring data are conducted according to approved procedures that clearly describe how the activity should be performed and what precautions are to be taken in connection with the activity. Any person performing an activity that could affect the quality of environmental monitoring data is trained in that procedure and must demonstrate proficiency.

New procedures are developed each time an activity is added to the monitoring program. Procedures are reviewed periodically and updated when necessary. Documents are controlled so that only current procedures are used.

Quality Control in the Field

Quality control (QC), an integral component of environmental monitoring quality assurance, is a way of verifying that samples are being collected and analyzed according to established quality assurance procedures: Quality control ensures that sample collection and analysis are consistent and repeatable; it is a means of tracking down possible sources of error. For example, sample locations are clearly marked in the field to ensure that future samples are collected in the same locations; collection equipment in place in the field is routinely inspected, calibrated, and maintained; and automated sampling stations are kept locked to prevent tampering and ensure sample integrity.

Samples are collected into certified pre-cleaned containers made of an appropriate material and capacity and are labeled immediately with the pertinent information. Date, time, person doing the collecting, and special field sampling conditions are recorded and kept as part of the record for that sample. If necessary, samples are preserved as soon as possible after collection.

In order to assess quality problems that might be introduced by the sampling process, duplicate field samples, field blank samples, and trip blank samples are collected. Background samples are collected for baseline environmental information.

Field Duplicates

Field duplicates are samples collected simultaneously for the same analyte at one location, after which they are treated as separate samples. If the sampling matrix is homogenous, field duplicates provide a means of assessing the precision of collection methods. Field duplicates are collected at a minimum rate of one per twenty analyses.

Field Blanks

A field blank is a sample of laboratory-distilled water that is put into a sample container at a field collection site and is processed from that point as a routine sample. Field blanks are used to detect contamination introduced by the sampling procedure. They are processed at a minimum rate of one per twenty analyses.

If the same collection equipment is used for more than one site, a special form of field blank known as an equipment blank may be collected by pouring laboratory-distilled water through cleaned collecting equipment and into a sample container. Equipment blanks are collected to detect any cross-contamination that may be passed from one sampling location to another by the equipment. Many wells and surface water collection stations have dedicated collecting equipment that remains at that location; equipment blanks are not necessary at these locations.

Trip Blanks

Trip blanks are prepared by pouring laboratory-distilled water into sample bottles in the laboratory. The bottles are then placed into sample coolers where they remain throughout the sampling event. Trip blanks are collected in order to detect any volatile organic contamination that may be introduced from handling during collection, storage, or shipping. Trip blanks are collected only when volatile organic samples are being collected.

Environmental Background Samples

To monitor each pathway for possible radiological contamination, samples of air, water, vegetation, meat, and milk are taken from locations remote from the site. Samples that are clearly outside site influence show natural radiological concentrations and serve as backgrounds or "controls," another form of field quality control sample. Background samples provide baseline information to compare with information from near-site or on-site samples so that any possible influence from the site can be determined.

Quality Control in the Laboratory

More than 11,000 samples were handled as part of site monitoring in 1996. Samples for routine radiological analysis were analyzed on-site, with the rest being sent to subcontract laboratories. Off-site laboratories must maintain a level of quality control as specified in contracts with WVNS. Subcontract laboratories are required to participate in all applicable crosscheck programs and to maintain all relevant certifications.

In order to monitor the accuracy and precision of data, laboratory quality control practices specific to each analytical method are clearly described in approved references or procedures. Examples of laboratory quality control activities include proper training of analysts, maintaining and calibrating measuring equipment and instrumentation, and processing samples in accordance with specific methods as a means of monitoring laboratory performance.

Analytical instruments and counting systems are calibrated at specified frequencies and logs of instrument calibration and maintenance are kept. Calibration methods for each instrument are specified in procedures or in manufacturers' directions. Standards traceable to the National Institute of Standards and Technology (NIST) are used to calibrate counting and test instrumentation.

Laboratory quality control samples consist of three general types: standards (including spikes), used to assess accuracy; blanks, to assess the possibility of contamination; and duplicates, to assess precision.

Standards

Laboratory standards are materials containing a known concentration of an analyte of interest such as a pH buffer or a plutonium-239 counting standard. Standards are either NIST-traceable or reference materials from other nationally recognized sources. At a minimum, one reference standard is analyzed for every twenty sample analyses. The results of the analyses are plotted on control charts, which specify acceptable limits. If the results lie within these limits, then analysis of actual environmental samples may proceed and the results deemed usable.

Laboratory Spikes

Another form of standard analysis is a laboratory spike. In a laboratory spike, a known amount of analyte is added to a sample or blank before the sample is analyzed. The percent recovery of the analyte indicates how much of the analyte of interest is being detected in the analysis of actual samples; hence, a spike also is an assessment of the accuracy of the method. Spike recoveries are recorded on control charts with documented acceptance limits.

Laboratory Blanks

Laboratory blanks are prepared from a matrix similar to that of the sample but known to contain none of the analyte of interest. For instance, distilled water, taken through the same preparatory procedure as a sample, may serve as a laboratory blank for both radiological and chemical analyses of water samples. A positive result for an analyte in a blank indicates that something is wrong with the analysis and that corrective action should be taken. In general, one laboratory blank is processed daily or with each batch of samples for a given analyte.

A special form of laboratory blank for radiological samples is an instrument background count, which is a count taken of a planchet or vial containing no sample. The count serves three purposes:

1) to determine if contamination is present in the counting instrument

2) to determine if the instrument is responding in an acceptable manner

3) to determine the background correction that should be applied when calculating radiological activity in certain samples.

An instrument background count is taken before each day's counting or with each batch of twenty samples. Background counts are recorded on control charts with defined acceptance limits. An unacceptable count requires corrective action before analyses can proceed.

Laboratory Duplicates

Duplicates are analyzed to assess precision in the analytical process. Laboratory duplicates are created by splitting existing samples before analysis; each split is treated as a separate sample. If the analytical process is in control, results for each split should be within documented acceptance criteria.

Crosschecks

WVNS participates in formal radiological crosscheck programs conducted by the U.S. Department of Energy (DOE) and the U.S. Environmental Protection Agency (EPA). The DOE requires all organizations performing effluent or environmental monitoring to participate in the semiannual Environmental Measurements Laboratory (EML) Quality Assessment Program (QAP), which is designed to test the quality of environmental measurements being reported to the DOE by its contractors. WVNS also participates in crosscheck programs from the EPA's National Exposure Research Laboratory, Characterization Research Division (NERL-CRD). Crosscheck samples for radiological analyses are analyzed by both the Environmental Laboratory on-site and by the subcontract laboratories.

Results from radiological crosschecks are summarized in *Appendix D*, Tables D-1 through D-3 (pp. D-1 through D-8). A total of 139 radiological crosscheck analyses were performed by or for WVNS and reported in 1996. One hundred and twenty-nine results (92.8%) were within control limits. Forty-six of the results were produced by the on-site Environmental Laboratory; 100% were within control limits. Out-of-control results were followed up through formal corrective action processes.

Results for nonradiological EPA crosschecks are summarized in Table D-5 (p. D-10). Twenty-one parameters were analyzed by Recra Environmental, Inc. and two by WVNS. All twenty-three results (100%) were within control limits.

By contract with WVNS, subcontract laboratories are required to perform satisfactorily on crosschecks, defined as 80% of results falling within control limits. Crosscheck results that fall outside control limits are addressed by formal corrective actions in order to determine any conditions that could adversely affect sample data and to ensure that actual sample results are reliable.

Table D-4 (p. D-9) summarizes environmental TLD results and the results from U.S. Nuclear Regulatory Commission (NRC) TLDs placed in the same locations but collected and analyzed by the NRC. Although not a formal crosscheck, the agreement of these sets of results demonstrates the precision of these measurements and substantiates confidence in results from the remainder of the environmental TLD locations.

Personnel Training

Anyone performing environmental monitoring program activities must be trained in the appropriate procedures and qualified accordingly before carrying out the activity as part of the site environmental monitoring program.

Record Keeping

Control of records is an integral part of the environmental monitoring program. Field data sheets, chain-of-custody forms, requests for analysis, sample-shipping documents, sample logs, bench logs, laboratory data sheets, equipment maintenance logs, calibration logs, training records, crosscheck performance records, data packages, and weather measurements, in addition to other records, are maintained as documentation of the environmental monitoring program. All records pertaining to the program are routinely reviewed and securely stored.

A Laboratory Information Management System (LIMS) is used to log samples, print labels, store and process data, track quality control samples, track samples, produce sampling and analytical worklists, and generate reports. Subcontract laboratories, where possible, provide data in electronic form for direct entry into the LIMS.

Chain-of-Custody Procedures

Chain-of-custody records begin with sample collection. Samples brought in from the field are transferred under signature from the sampler to the sample custodian and are logged at the sample receiving station, after which they are stored in a sample lock-up before analysis or shipping.

Samples sent off-site for analysis are accompanied by an additional chain-of-custody/analytical request form. Subcontract laboratories are required by contract to maintain internal chain-of-custody records and to store the samples under secure conditions.

Audits and Appraisals

The WVNS Quality Assurance Department assesses compliance with and the effectiveness of WVNS programs by performing audits, assessments, surveillances, and/or inspections of processes.

In 1996 WVNS Quality Assurance (QA) conducted several surveillances of various aspects of specific environmental programs at the WVDP. Topics addressed were shipping hazardous and radioactive materials, measuring air emission and liquid effluent discharge concentrations, calibrating and operating the meteorological system, sampling groundwater monitoring wells that contain radioactive contamination, calibrating and operating main stack air monitoring and sampling equipment, packaging and shipping crosscheck samples, inspecting groundwater monitoring well screens, collecting liquid effluent samples for analysis and comparison with the SPDES permit, collecting ambient air samples, and calibrating equipment for collecting routine air samples.

Activities were assessed against applicable regulations, safety requirements, or procedures. Results of all surveillances were satisfactory.

No formal audits of the environmental monitoring program by either WVNS Quality Assurance or by external agencies were conducted in 1996. (For more information on site audits and assessments see the *Environmental Compliance Summary: Calendar Year 1996* [p. lix]).

Self-Assessments

One self-assessment of the environmental monitoring program was conducted in 1996. The focus of this self-assessment was the adequacy of environmental monitoring program components that address new systems and processes associated with the start-up of vitrification.

Areas of inquiry were:

- liquid effluent monitoring
- airborne effluent monitoring
- meteorological monitoring
- environmental surveillance
- laboratory procedures
- data analysis and statistical treatment of data
- dose assessment
- records and reports
- quality assurance.

One finding and seven observations were noted. Deficiencies were addressed through formal corrective action procedures. In addition, several comments regarding possible program improvements were noted and commendable practices identified.

Nothing was found during the course of the self-assessment that would compromise the data in this report or in the program in general.

Data Management and Data Validation

Information on environmental monitoring program samples is maintained and tracked in the LIMS and includes date and time of collection, chain-of-custody transfer, shipping information, analytical results, and final validation status.

All analytical data produced in the Environmental Laboratory at the bench level must be reviewed and signed off by a qualified person other than the one who performed the analysis. A similar in-house review is contractually required from subcontractor laboratories.

All software used to generate data is subjected to verification and validation before use.

Analytical data from both on- and off-site laboratories are formally validated by the data validation group. As part of the validation procedure, quality control samples analyzed in conjunction with a batch of samples are checked for acceptability. After validation is complete and transcription between hard copy and the LIMS is verified, the sample result is formally approved and released for use in reports.

The data are then evaluated and reports are prepared. Before each technical report can be issued it must undergo a peer review in which the document, including the data, is comprehensively reviewed by one or more persons who are knowledgeable in the necessary technical aspects of the field of work.

While evaluating 1996 data it was found that some values for iodine-129 in effluent air were not correct. The vendor laboratory corrected the procedures that had caused the problem and a different method was used to calculate the iodine-129 values that had been reported during the time that the incorrect analyses had occurred.

The multiple levels of scrutiny built into data generation, validation, and reporting ensure that reliable and accurate data are reported from the environmental monitoring program.

Data Reporting

There is inherent uncertainty associated with all environmental radioactivity measurements. The uncertainty that is associated with individual measurements is expressed as a *confidence interval*, i.e., the range of measurement values above and below the test result within which the "true" value is expected to lie. This interval is derived mathematically using statistical concepts. The width of the interval is based primarily on a predetermined level of confidence that the "true" value lies within the interval. This *confidence level* is expressed in terms of a probability that the confidence interval actually encompasses the "true" value. For example, the WVDP environmental monitoring program uses a 95% confidence level for all radioactivity measurements and calculates confidence intervals accordingly.

Radiological measurements require that analytical or instrumental background counts be subtracted from sample measurement values to obtain net values. If background values are equal to or greater than the gross sample measurement value, then the net sample measurement value can be zero or negative. Although a negative value does not represent a physical reality, a reliable long-term average of many measurements can be obtained only if the very small and negative values are included in the calculations.

Averages of radioactivity measurements from a particular sampling location are calculated by taking a simple arithmetic mean. What is not so clear, even as a professional consensus, is how to represent the confidence interval that is associated with an average of many measurements.

One method in use by other facilities is to represent an average of a set of samples by using an arithmetic mean of the values and then using the standard error of the mean to represent the confidence interval. This method does not consider the value of the confidence interval for each of the individual measurements. Thus, in situations where the measurements are near the minimum detectable concentration and may all include zero within their confidence interval, the confidence interval for the average may not include zero; therefore, even though it is doubtful that any individual sample contained detectable radioactivity the confidence interval for the average may not include zero.

For this reason, in this report we have opted to express the confidence interval of the average of repeated measurements of independent samples by pooling the confidence intervals from the individual measurements. In this manner, we are expressing a reasonable and representative estimate of the confidence interval for the average as follows:

$$e_m = \frac{\sqrt{e_1^2 + e_2^2 + \ldots + e_n^2}}{\sqrt{n}}$$

where e_1 through e_n represent the confidence intervals for each of *n* measurements, and e_m equals the confidence interval for the mean.

Up until 1992, samples for which the confidence interval included zero were reported as "less than" values. Since then, to allow readers to perform similar calculations with data groups, as has been the past practice of the report preparers, the actual calculated value, whether positive, negative, or zero, is being reported. The pooled confidence interval will be expressed as e_m, above.

Appendix A

1996 Environmental Monitoring Program

The WVDP Supports a Bluebird and Wood Duck Nesting-box Program Sponsored by the Springville Field and Stream Club

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1996 Environmental Monitoring Program

The following schedule represents the West Valley Demonstration Project (WVDP) routine environmental monitoring program for 1996. This schedule met or exceeded the minimum program specifications needed to satisfy the requirements of DOE Order 5400.1. It also met requirements of DOE 5400.5 and DOE/EH-0173T. Specific methods and recommended monitoring program elements are found in DOE/EP-0096, *Effluent Monitoring*, and DOE/EP-0023, *Environmental Surveillance*, which were the bases for selecting most of the schedule specifics. Additional monitoring was mandated by operational safety requirements (OSRs) and air and water discharge permits (40 CFR 61 and SPDES), which also required formal reports. (OSRs applicable to the monitoring program were cancelled in March 1996.) Specifics are identified in the schedule under Monitoring/Reporting Requirements.

Results from all locations except groundwater monitoring points are summarized in Quarterly Environmental Monitoring Data Reports (QEMDRs). Groundwater monitoring data are summarized in quarterly groundwater monitoring reports. A computerized environmental data-screening system identifies analytical data that exceed pre-set limits. All locations are checked monthly for trends or noticeable results in accordance with criteria established in Documentation and Reporting of Environmental Monitoring Data (West Valley Nuclear Services Co., Inc. April 13, 1995). Reportable results are then described in the Monthly Trend Analysis Report (MTAR) together with possible causes and corrective actions, if indicated. A WVDP Effluent Summary Report (ESR) is transmitted with each MTAR.

Schedule of Environmental Sampling

The following table is a schedule of environmental sampling at the WVDP. Locations of the sampling points are shown in Figures A-1 through A-9. The index on pp. A-v through A-vii is a list of the codes for various sample locations. Table headings in the schedule are as follows:

- ***Sample Location Code.*** Describes the physical location where the sample is collected. The code consists of seven or eight characters: The first character identifies the sample medium as **A**ir, **W**ater, **S**oil/Sediment, **B**iological, or **D**irect Measurement. The second character specifics o**N**-site or o**F**f-site. The remaining characters describe the specific location (e.g., **AFGRVAL** is **A**ir o**F**f-site at **GR**eat **VAL**ley).

- ***Monitoring/Reporting Requirements.*** Notes the bases for monitoring that location, any additional references to permits or OSRs, and the reports generated from sample data. Routine reports cited in Appendix A are the Effluent Summary Report (ESR), the Monthly Trend Analysis Report (MTAR), the Quarterly Environmental Monitoring Data Report (QEMDR), the On-site Discharge Information System (ODIS) report, the Air Emissions Report (NESHAP), and the annual Site Environmental Report (SER).

- ***Sampling Type/Medium.*** Describes the collection method and the physical characteristics of the medium.

- ***Collection Frequency.*** Indicates how often the samples are collected or retrieved.

- ***Total Annual Sample Collections.*** Specifies the number of discrete physical samples collected annually for each group of analytes.

- ***Analyses Performed/Composite Frequency.*** Notes the type of analyses of the samples taken at each collection, the frequency of composite, and the analytes determined for the composite samples.

Summary of Monitoring Program Changes for 1996

Location Code	*Description of Changes*
Groundwater Monitoring Points	Program reviewed and sampling frequency and analytes tailored to address site-wide monitoring parameters as well as constituents of concern specific to SSWMUs. Number of monitoring points reduced; parameter lists at remaining wells streamlined.
ANVITSK **ANSEISK**	Vitrification heating, ventilation, and air conditioning stack sampler and seismic sampler brought on-line November 1995. The vitrification system began radioactive operations with the first transfer of high-level waste in June 1996 followed by the beginning of vitrification in July 1996.
ANCSPFK	Air sampler added at container sorting and packaging facility ventilation point.

Index of Environmental Monitoring Program Sample Points

Air Effluent and On-site Ambient Air (Fig. A-1)

Liquid Effluent and On-site Water (Fig. A-2)

** Not detailed on map*

Index of Environmental Monitoring Program Sample Points
(continued)

On-site Groundwater and Seeps (Fig. A-3)

Off-site Surface Water (Fig. A-4)

Off-site Drinking Water (Figs. A-5 and A-9)

Off-site Ambient Air (Figs. A-6 and A-9)

* *Not detailed on map*

Index of Environmental Monitoring Program Sample Points
(concluded)

Fallout, Sediment, and Soil (Figs. A-2, A-4, A-6, and A-9)

Off-site Biological (Figs. A-5 and A-9)

Direct Measurement Dosimetry (Figs. A-7, A-8, and A-9)

1996 Monitoring Program
On-site Effluent Monitoring:

Air Effluents

Sample Location Code	Monitoring/Reporting Requirements	Sampling Type/Medium	Collection Frequency	Total Annual Sample Collections	Analyses Performed/ Composite Frequency
ANSTACK Main Plant Ventilation Exhaust Stack **ANSTSTK** Supernatant Treatment System (STS) Ventilation Exhaust **ANCSSTK** 01-14 Building Ventilation Exhaust **ANCSRFK** Contact Size-reduction Facility Exhaust **ANCSPFK** Container Sorting and Packaging Facility **ANVITSK** Vitrification HVAC Exhaust	Airborne radioactive effluent points including LWTS and vitrification off-gas <u>Required by</u>: • OSR-GP-1 • 40 CFR 61 <u>Reported in</u>: • ESR • MTAR • QEMDR • ODIS • SER • Air Emissions Annual Report (NESHAP)	Continuous off-line air particulate monitors	→ Continuous measurement of fixed filter, replaced weekly	→ N/A	→ Real-time alpha and beta monitoring
		Continuous off-line air particulate filters	→ Weekly	→ 52 each location	→ Gross alpha/beta, gamma isotopic*
				Weekly filters composited to 4 each location	→ Quarterly composite for Sr-90, Pu/U isotopic, total U, Am-241, gamma isotopic
		Continuous off-line desiccant columns for water vapor collection	→ Weekly	→ 52 each of two locations	→ H-3 (**ANSTACK** and **ANSTSTK** only)
		Continuous off-line charcoal cartridges	→ Weekly	→ Weekly cartridges composited to 4 each location	→ Quarterly composite for I-129
ANSEISK Seismic Sampler, Vitrification Backup	Airborne radioactive effluent point <u>Required by</u>: • OSR-GP-1 • 40 CFR 61 <u>Reported in</u>: • ESR • MTAR • QEMDR • ODIS • SER • Air Emissions Annual Report (NESHAP)	Continuous off-line air particulate filter	→ Weekly	→ 52	→ Filters for gross alpha/beta, gamma isotopic* upon collection

* Weekly gamma isotopic only if gross activity rises significantly.

Sampling Rationale

ANSTACK DOE/EH-0173T, 3.0; OSR-GP-1, 1.A, 2.B; and DOE/EP-0096, 3.3.

Monitors and samples HEPA-filtered ventilation from most process areas, including cell ventilation, vessel off-gas, FRS and head end ventilation, analytical area. Requires continuous effluent monitoring per Subpart H, Section 61.93(b) because potential emissions may exceed 0.1 mrem limit.

ANSTSTK DOE/EH-0173T, 3.0; OSR-GP-1, 1.B, 2.B; and DOE/EP-0096, 3.3.

Monitors and samples HEPA-filtered ventilation from building areas involved in treatment of high-level waste supernatant. Requires continuous effluent monitoring per Subpart H, Section 61.93(b) because potential emissions may exceed 0.1 mrem limit.

ANCSSTK DOE/EH-0173T, 3.0; OSR-GP-1, 1.B, 2.B; and DOE/EP-0096, 3.3.

Monitors and samples HEPA-filtered ventilation from 01-14 building, which houses equipment used to treat ceramic melter off-gas. Requires continuous effluent monitoring per Subpart H, Section 61.93(b) because potential emissions may exceed 0.1 mrem limit.

ANCSRFK DOE/EH-0173T, 3.0; OSR-GP-1, 1.B, 2.B; and DOE/EP-0096, 3.3.

Monitors and samples HEPA-filtered ventilation from process area where radioactive tanks, pipes, and other equipment are reduced in volume by cutting with a plasma torch.

ANCSPFK DOE/EH-0173T, 3.0; DOE/EP-0096, 3.3.

Monitors and samples ventilation from lag storage area 4, the container sorting and packaging facility.

ANVITSK DOE/EH-0173T, 3.0; OSR-GP-1; DOE/EP-0096, 3.3.

Vitrification facility heating, ventilation, and air conditioning effluent exhaust stack. Sampler brought on-line in late 1995 when nonradioactive operations began. Radioactive operation began with first high-level waste transfer in June 1996 and vitrification startup in July 1996. Interim approval; permit pending.

ANSEISK DOE/EH-0173T, 3.0; OSR-GP-1; and DOE/EP-0096, 3.3.

Vitrification system back-up filter for catastrophic event monitoring in case of primary vitrification HVAC stack failure.

- Sampling locations are shown on Figure A-1 (p. A-45).

1996 Monitoring Program
On-site Effluent Monitoring:

Air Effluents

Sample Location Code	Monitoring/Reporting Requirements	Sampling Type/Medium	Collection Frequency	Total Annual Sample Collections	Analyses Performed/ Composite Frequency
ANSUPCV Supercompactor Exhaust	Airborne radioactive effluent point Required by: • OSR-GP-1 • 40 CFR 61 Reported in: • ESR • MTAR • QEMDR • ODIS • SER • Air Emissions Annual Report (NESHAP)	Continuous off-line air particulate monitor during operation →	Continuous measurement of fixed filter →	N/A →	Real-time beta monitoring
		Continuous off-line air particulate filter →	Weekly (when operating) →	52 maximum →	Filters for gross alpha/beta, gamma isotopic* upon collection
				Collected filters composited to 4 →	Quarterly composites for Sr-90, Pu/U isotopic, total U, Am-241, gamma isotopic
OVEs/PVUs Outdoor Ventilated Enclosures/ Portable Ventilation Units	Airborne radioactive effluent points Required by: • OSR-GP-1 • 40 CFR 61 Reported in: • ESR • MTAR • QEMDR • ODIS • Air Emissions Annual Report (NESHAP)	Continuous off-line air particulate filter →	As required →	1 each location →	Filters for gross alpha/beta, gamma isotopic* upon collection
				Collected filters** composited to 4 →	Quarterly composites for Sr-90, Pu/U isotopic, total U, Am-241, gamma isotopic

* Gamma isotopic only if gross activity rises significantly.

** If gross determination of individual filter is significantly higher than background, individual sample would be submitted immediately for isotopic analysis.

Sampling Rationale

ANSUPCV	DOE/EH-0173T, 3.0; OSR-GP-1, 1.B, 2.B; and DOE/EP-0096, 3.3. Monitors and samples HEPA-filtered ventilation from area where low-level radioactive waste volume is reduced by compaction.
OVEs/PVUs	DOE/EH-0173T, 3.0; OSR-GP-1, 1.B, 2.B; and DOE/EP-0096, 3.3. Outdoor ventilated enclosures; portable ventilation units used for handling of radioactive materials or for decontamination in areas without containment ventilation.

- Sampling locations are shown on Figure A-1 (p. A-45).

1996 Monitoring Program
Environmental Surveillance:

Air Effluents and On-site Ambient Air

Sample Location Code	Monitoring/Reporting Requirements	Sampling Type/Medium	Collection Frequency	Total Annual Sample Collections	Analyses Performed/ Composite Frequency
ANLLWTVC Low-level Waste Treatment and Ventilation, "cold" side **ANLLWTVH** Low-level Waste Treatment and Ventilation, "hot" side **ANLAUNV** Laundry Change Room Ventilation	Airborne radioactive effluent point Required by: • 40 CFR 61 Reported in: • ESR • MTAR • QEMDR • ODIS • SER • Air Emissions Annual Report (NESHAP)	Continuous off-line air particulate filter	→ Weekly (monthly at ANLAUNV)	→ 52 each location (12 at ANLAUNV)	→ Gross alpha/beta, gamma isotopic* upon collection
ANLAGAM Lag Storage Area Ambient Air **ANNDAAM** NDA Area Ambient Air	Ambient "diffuse source" air emissions Reported in: • MTAR • QEMDR • SER	Continuous air particulate filter	→ Weekly	→ 52 each location Weekly filter composited to 4 each location	→ Gross alpha/beta → Quarterly composite for Sr-90, gamma isotopic, Pu/U isotopic, total U, Am-241
ANSDAT9** SDA Trench 9 Ambient Air	Ambient "diffuse source" air emissions Reported in: • Quarterly reports to NYSDEC • MTAR • QEMDR • SER	Continuous air particulate filter	→ Weekly	→ 52 Weekly filter composited to 4	→ Gross alpha/beta → Quarterly composite for gamma isotopic
		Continuous off-line desiccant columns for water vapor collection	→ Weekly	→ 52	→ H-3
		Continuous off-line charcoal cartridges	→ Monthly	→ Monthly cartridges composited to 4	→ Quarterly composite for I-129

* Gamma isotopic only if gross activity rises significantly.
** Sampling frequency and analytical parameters as directed by NYSERDA.

Sampling Rationale

ANLLWTVC DOE/EH-0173T, 3.0; and DOE/EP-0096, 3.3.
ANLLWTVH

Samples nonradioaactive and radioactive sides of ventilation exhaust from low-level waste treatment facility.

ANLAUNV DOE/EH-0173T, 3.0; and DOE/EP-0096, 3.3.

Samples ventilation from contaminated clothing laundry.

ANLAGAM DOE/EH-0173T, 3.3.2.

Monitors ambient air in the lag storage area, a possible "diffuse source" of air emissions.

ANNDAAM DOE/EH-0173T, 3.3.2.

Monitors ambient air in NDA area, a possible "diffuse source" of air emissions.

ANSDAT9 DOE/EH-0173T, 3.3.2.

Monitors ambient air by SDA trench 9, a possible "diffuse source" of air emissions. WVDP support of NYSERDA.

- Sampling locations are shown on Figure A-1 (p. A-45).

1996 Monitoring Program
On-site Effluent Monitoring:

Liquid Effluents

Sample Location Code	Monitoring/Reporting Requirements	Sampling Type/Medium	Collection Frequency	Total Annual Sample Collections	Analyses Performed/ Composite Frequency
WNSP001 Lagoon 3 Discharge Weir	Primary point of liquid effluent batch release Required by: • OSR-GP-2 • SPDES Permit Reported in: • Monthly SPDES DMR • ESR • MTAR • QEMDR • ODIS • SER	Grab liquid →	Daily, during lagoon 3 discharge* →	40-80 →	Daily for gross beta, conductivity, flow
				7-12 →	Every 6 days a sample is analyzed for gross alpha/beta, H-3, Sr-90, gamma isotopic
				Composite of daily samples for each discharge, 4-8 →	Weighted composite for gross alpha/beta, H-3, C-14, Tc-99, Sr-90, I-129, gamma isotopic, Pu/U isotopic, total U, Am-241 for each month of discharge
		Composite liquid →	Twice during discharge, near start and near end →	8-16 →	Two 24-hour composites for BOD-5, suspended solids, SO_4, NO_3, NO_2, NH_3, total Al, Fe, and Mn, total recoverable Cd, Cr, Cu, Ni, Pb and Zn, dissolved As and Cu, dissolved sulfide
		Grab liquid →	Twice during discharge, near start and near end →	8-16 →	Settleable solids, total dissolved solids, pH, cyanide amenable to chlorination, oil & grease, surfactant (as LAS), total recoverable Co, Cr^{+6}, Se, and V, dichlorodifluoromethane, trichlorofluoromethane, 3,3-dichlorobenzidine, tributyl phosphate, hexachlorobenzene, alpha-BHC, heptachlor, xylene, 2-butanone
		Composite liquid →	Semiannual →	2 →	A 24-hour composite for titanium
		Composite liquid →	Annual →	1 →	A 24-hour composite for Ba and Sb
		Grab liquid →	Semiannual →	2 →	Bis(2-ethylhexyl) phthalate, 4-dodecene
		Grab liquid →	Annual →	1 →	Chloroform

* Lagoon 3 is discharged between four and eight times per year, as necessary, averaging ten days per discharge.

Sampling Rationale

WNSP001 DOE 5400.5 and DOE/EH-0173T, 2.3.3.

By DOE Order all liquid effluent streams from DOE facilities shall be evaluated and their potential for release of radionuclides addressed.

New York State SPDES permit no. NY0000973.

These regulations are met for radiological parameters by daily grab sampling during periods of lagoon 3 discharge. Sampling for chemical constituents is performed near the beginning and end of each discharge period to meet the site SPDES permit. Both grab samples and 24-hour composite samples are collected.

- Sampling location is shown on Figure A-2 (p. A-46).

1996 Monitoring Program
On-site Effluent Monitoring:

Liquid Effluents

Sample Location Code	Monitoring/Reporting Requirements	Sampling Type/Medium	Collection Frequency	Total Annual Sample Collections	Analyses Performed/ Composite Frequency
WNSP006 Frank's Creek at Security Fence	Combined facility liquid discharge Required by: • OSR-GP-2 Reported in: • MTAR • QEMDR • SER	Timed continuous composite liquid	→ Weekly	→ 52	→ Gross alpha/beta, H-3, pH, conductivity
				Weekly samples composited to 12	→ Monthly composite for gamma isotopic and Sr-90 (monthly composite shared with NYSDOH)
				Weekly samples composited to 4	→ Quarterly composite for C-14, I-129, Pu/U isotopic, total U, Am-241, Tc-99
		Grab liquid	→ Semiannual	→ 2	→ NPOC, TOX, Ca, Mg, Na, K, Ba, Mn, Fe, Cl, SO_4, NO_3+NO_2-N, F, HCO_3, CO_3
WNSP007 Sanitary Waste Discharge	Liquid effluent point for sanitary and utility plant combined discharge Required by: • SPDES Permit Reported in: • Monthly SPDES DMR • ESR • MTAR • QEMDR • ODIS • SER	24-hour composite liquid	→ 3 each month	→ 36	→ Gross alpha/beta, H-3, pH, suspended solids, NH_3, NO_2-N, BOD-5, total Fe
				Monthly samples composited to 4 quarterly samples	→ Gamma isotopic
		Grab liquid	→ 3 each month	→ 36	→ Oil & grease
		Grab liquid	→ Weekly	→ 52	→ pH, settleable solids, total residual chlorine
		Grab liquid	→ Annual	→ 1	→ Chloroform
WNSDADR SDA Run-off	Surface water run-off from south portion of SDA Required by: • Interim Measures Compliance Reported in: • Quarterly reports to NYSDEC • MTAR • QEMDR • SER	Grab liquid	→ Monthly	→ 12	→ pH, total suspended solids, oil & grease, flow, gross alpha/beta, H-3, gamma isotopic

Sampling Rationale

WNSP006 DOE/EH-0173T, 5.10.1.1.

By DOE Order all liquid effluent streams from DOE facilities shall be evaluated and their potential for release of radionuclides addressed.

In accordance with WVDP SPDES permit no. NY0000973, outfall 116 (pseudo-monitoring point) uses flow data from WNSP006. Flow augmentation parameters (flow and total dissolved solids [TDS] are monitored at location WNSP006; calculated TDS and flow data related to sample point WNSP006 are reported for pseudo-monitoring point 116 in the monthly SPDES Discharge Monitoring Report (DMR).

WNSP007 DOE 5400.5 and DOE/EH-0173T, 2.3.3.

Sampling rationale is based on New York State SPDES permit no. NY0000973 and DOE 5400.5 criteria for discharge of radioactivity to and from the sewage treatment plant.

WNSDADR NYSERDA interim measures compliance.

WVDP support of NYSERDA.

Grab sample monitoring surface water runoff from south portion of SDA.

- Sampling locations are shown on Figure A-2 (p. A-46).

1996 Monitoring Program
Environmental Surveillance:

On-site Surface Water

Sample Location Code	Monitoring/Reporting Requirements	Sampling Type/Medium	Collection Frequency	Total Annual Sample Collections	Analyses Performed/ Composite Frequency
WNSWAMP NE Swamp Drainage	Site surface drainage Reported in: • ESR • MTAR • QEMDR • ODIS • SER	Timed continuous composite liquid	→ Weekly	→ 52	→ Gross alpha/beta, H-3, pH, conductivity
				Weekly samples composited to 12	→ Monthly composite for gamma isotopic and Sr-90 (monthly composite shared with NYSDOH)
				Weekly samples composited to 4	→ Quarterly composite for C-14, I-129, Pu/U isotopic, total U, Am-241
		Grab liquid	→ Semiannual	→ 2	→ NPOC, TOX, Ca, Mg, Na, K, Ba, Mn, Fe, Cl, SO_4, NO_3+NO_2-N, F, HCO_3, CO_3
WNSW74A North Swamp Drainage	Site surface drainage Reported in: • ESR • MTAR • QEMDR • ODIS • SER	Timed continuous composite liquid	→ Weekly	→ 52	→ Gross alpha/beta, H-3, pH, conductivity
				Weekly samples composited to 12	→ Monthly composite for gamma isotopic, Sr-90
				Weekly samples composited to 4	→ Quarterly composite for C-14, I-129, Pu/U isotopic, total U, Am-241
		Grab liquid	→ Semiannual	→ 2	→ NPOC, TOX, Ca, Mg, Na, K, Ba, Mn, Fe, Cl, SO_4, NO_3+NO_2-N, F, HCO_3, CO_3
WN8D1DR High-level Waste Farm Underdrain	Drains subsurface water from HLW storage tank area Reported in: • MTAR	Grab liquid	→ Weekly	→ 52	→ Gross alpha/beta, H-3, pH
				Weekly samples composited to 12	→ Monthly composite for gamma isotopic, Sr-90

Sampling Rationale

WNSWAMP DOE/EH-0173T, 5.10.1.1.

NE site surface water drainage; provides for the sampling of this discrete drainage path for uncontrolled surface waters just before they leave the site's controlled boundary. Waters represent surface and subsurface drainages from the construction and demolition debris landfill (CDDL), old hardstand areas, and other possible north plateau sources of radiological or nonradiological contamination.

WNSW74A DOE/EH-0173T, 5.10.1.1.

N site surface water drainage; provides for the sampling of this discrete drainage path for uncontrolled surface waters just before they leave the site's controlled boundary. Waters represent surface and subsurface drainages from lag storage areas and other possible north plateau sources of radiological or nonradiological contamination.

WN8D1DR DOE/EH-0173T, 5.10.1.3.

Monitors the potential influence on subsurface drainage surrounding the high-level waste tank farm.

- Sampling locations are shown on Figure A-2 (p. A-46).

1996 Monitoring Program
Environmental Surveillance:

On-site Surface Water

Sample Location Code	Monitoring/Reporting Requirements	Sampling Type/Medium	Collection Frequency	Total Annual Sample Collections	Analyses Performed/ Composite Frequency
WNSP008 French Drain	Drains subsurface water from LLWTF lagoon area Required by: • SPDES Permit Reported in: • Monthly SPDES DMR • ESR • MTAR • QEMDR • ODIS • SER	Grab liquid	→ Monthly	→ 12	→ Gross alpha/beta, H-3
		Grab liquid	→ 3 each month	→ 36	→ Conductivity, pH, BOD-5, total Fe, total recoverable Cd and Pb
		Grab liquid	→ Annual	→ 1	→ As, Cr, total Ag and Zn
WNSP005 Facility Yard Drainage	Combined drainage from facility yard area Reported in: • MTAR • QEMDR • SER	Grab liquid	→ Monthly	→ 12	→ Gross alpha/beta, H-3, pH
WNCOOLW Cooling Tower Basin	Cools plant utility steam system water Reported in: • MTAR • QEMDR • SER	Grab liquid	→ Monthly	→ 12	→ Gross alpha/beta, H-3, pH
				Monthly samples composited to 4	→ Quarterly composite for gamma isotopic

Sampling Rationale

WNSP008 DOE/EH-0173T, 5.10.1.3.

French drain of subsurface water from lagoon (LLWTF) area. NYSDEC SPDES permit no. NY0000973 also provides for the sampling of this discrete drainage path for uncontrolled subsurface waters before they flow into Erdman Brook. Waters represent subsurface drainages from downward infiltration around the LLWTF and lagoon systems. This point would also monitor any subsurface spillover from the overfilling of lagoons 2 and 3. Sampling of significance for both radiological and nonradiological contamination.

This site is also monitored as part of the groundwater program. (See SSWMU #1.)

WNSP005 Facility yard surface water drainage; generally in accordance with DOE/EH-0173T, 5.10.1.1. Previously in accordance with NYSDEC SPDES permit no. NY0000973.

Provides for the sampling of this discrete drainage path for uncontrolled surface waters just after outfall 007 discharge into the drainage and before they flow to Erdman Brook. Waters represent surface and subsurface drainages primarily from the main plant yard area. Historically this point was used to monitor sludge pond(s) and utility room discharges to the drainage. These two sources have been rerouted. Migration of residual site contamination around the main plant dictates surveillance of this point primarily for radiological parameters.

WNCOOLW Facility cooling tower circulation water; generally in accordance with DOE/EH-0173T, 5.10.1.1.

Operational sampling carried out to confirm no migration of radiological contamination into the primary coolant loop of the HLWTF and/or plant utility steam systems. Migration from either source might indicate radiological control failure.

- Sampling locations are shown on Figure A-2 (p. A-46).

1996 Monitoring Program
Environmental Surveillance:

On-site Surface Water

Sample Location Code	Monitoring/Reporting Requirements	Sampling Type/Medium	Collection Frequency	Total Annual Sample Collections	Analyses Performed/ Composite Frequency
WNFRC67* Frank's Creek E of SDA	Drains NYS Low-level Waste Disposal Area Reported in: • Reported to NYSERDA • MTAR • QEMDR • SER	Grab liquid	→ Monthly	→ 12	→ Gross alpha/beta, H-3, pH
WNERB53* Erdman Brook N of Disposal Areas	Drains NYS and WVDP disposal areas Reported in: • Reported to NYSERDA • MTAR • QEMDR • SER	Grab liquid	→ Weekly	→ 52	→ Gross alpha/beta, H-3, pH
WNNDADR Drainage between NDA and SDA	Drains WVDP disposal and storage area Reported in: • MTAR • QEMDR • SER	Timed continuous composite liquid	→ Weekly	→ 52	→ pH
				Weekly samples composited to 12	→ Monthly composite for gross alpha/beta, gamma isotopic, H-3
				Weekly samples composited to 4	→ Quarterly composite for Sr-90, I-129
		Grab liquid	→ Semiannual	→ 2	→ NPOC, TOX
WNDCELD Drainage S of Drum Cell	Drains WVDP storage area Reported in: • MTAR • QEMDR • SER	Grab liquid	→ Monthly	→ 12	→ pH, gross alpha/beta
				Monthly samples composited to 4	→ Quarterly composite for Sr-90, I-129, gamma isotopic, H-3
WNNDATR** NDA Trench Interceptor Project	On-site groundwater interception Reported in: • MTAR • QEMDR • SER	Grab liquid	→ Monthly	→ 12	→ Gross alpha/beta, H-3, gamma isotopic, NPOC, TOX
				Monthly samples composited to 4	→ Quarterly composite for I-129

* Monthly sample collected by NYSDOH
** Coordinated with Waste Management Operations

Sampling Rationale

WNFRC67 DOE/EH-0173T, 5.10.1.1.

Monitors the potential influence of both the SDA and drum cell drainage into Frank's Creek east of the SDA and upstream of the confluence with Erdman Brook.

WNERB53 DOE/EH-0173T, 5.10.1.1.

Monitors the potential influence of the drainages from the SDA and the WVDP disposal area into Erdman Brook upstream of the confluence with Frank's Creek.

WNNDADR DOE/EH-0173T, 5.10.1.1.

Monitors the potential influence of the WVDP storage and disposal area drainage into Lagoon Road Creek upstream from confluence with Erdman Brook.

WNDCELD DOE/EH-0173T, 5.10.1.1.

Monitors potential influence of drum cell drainage into Frank's Creek south of the SDA and upstream of WNFRC67.

WNNDATR DOE Order 5400.1, IV.9.

Monitors groundwater in vicinity of the NDA interceptor trench project. The grab sample is taken directly from the trench collection system.

- Sampling locations are shown on Figure A-2 (p. A-46).

1996 Monitoring Program
Environmental Surveillance:

On-site Surface Water

Sample Location Code	Monitoring/Reporting Requirements	Sampling Type/Medium	Collection Frequency	Total Annual Sample Collections	Analyses Performed/ Composite Frequency
WNSTAW Series On-site standing water ponds not receiving effluent include: **WNSTAW4** Border pond SW of AFRT240 **WNSTAW5** Border pond SW of DFTLD13 **WNSTAW6** Borrow pit NE of Project facilities **WNSTAW9** North reservoir near intake **WNSTAWB** Background pond at Sprague Brook maintenance building	Water within vicinity of plant airborne or water effluent Reported in: • MTAR • QEMDR • SER	Grab liquid →	Annual →	1 each location* →	Gross alpha/beta, H-3, pH, conductivity, Cl, Fe, Mn, Na, NO_3+NO_2-N, SO_4

* Sampling depends upon on-site ponding conditions during the year.

Sampling Rationale

WNSTAW Series DOE/EH-0173T, 5.10.1.1.

Monitoring of on- and off-site standing waters at locations listed below. Although none receive effluent directly, the potential for contamination is present except at the background location. Former collecting sites 1, 2, 3, 7, and 8 were deleted from the monitoring program because they were built over or are now dry.

WNSTAW4 Border pond located south of AFRT240. Chosen to be a location for obtaining high potential concentration, based on meteorological data. Perimeter location adjacent to a working farm. Drainage extends through private property and is accessible to public.

WNSTAW5 Border pond located west of Project facilities near the perimeter fence and DFTLD13. Chosen to be a location for obtaining high potential concentration, based on meteorological data. Location is adjacent to private residence and potentially accessible by the general public.

WNSTAW6 Borrow pit northeast of Project facilities just outside of inner security fence. Considered to be the closest standing water to the main plant and high-level waste facilities (in lieu of the availability of WNSTAW1).

WNSTAW9 North reservoir near intake. Chosen to provide data in the event of potentially contaminated site potable water supply. Location is south of main plant facilities.

WNSTAWB Pond located near the Sprague Brook maintenance building. Considered a background location; approximately 14 kilometers north of the WVDP.

- Sampling locations are shown on Figures A-2, A-4, and A-9 (pp. A-46, A-48, and A-53, respectively).

1996 Monitoring Program
Environmental Surveillance:

On-site Potable Water

Sample Location Code	Monitoring/Reporting Requirements	Sampling Type/Medium	Collection Frequency	Total Annual Sample Collections	Analyses Performed/ Composite Frequency
WNDNK Series Site Potable Water includes: **WNDNKMS** Maintenance Shop Drinking Water **WNDNKMP** Main Plant Drinking Water **WNDNKEL** Environmental Laboratory Drinking Water **WNDNKUR** Utility Room (EP-1) Potable Water Storage Tank	Sources of potable water within site perimeter Reported in: • MTAR • QEMDR • SER • also reported to Cattaraugus County	Grab liquid	→ Monthly	→ 12 per location	→ Gross alpha/beta, H-3, pH, conductivity
		Grab liquid	→ Annual*	→ 1	→ As, Ba, Cd, Cr, Hg, Se, fluoride, NO_3

* **WNDNKUR** only. Sample for NO_3 to be collected in March. Pb and Cu also will be sampled at this site based upon Cattaraugus County Health Department guidance.

Sampling Rationale

WNDNK Series Site drinking water; generally according to DOE/EH-0173T, 5.10.1.2.

Potable water sampling carried out to confirm no migration of radiological and/or nonradiological contamination into the site's drinking water supply.

WNDNKMS Site drinking water; generally according to DOE/EH-0173T, 5.10.1.2.

Potable water sampled at the maintenance shop in order to monitor a point that is at an intermediate distance from the point of potable water generation and that is used heavily by site personnel.

WNDNKMP Site drinking water; generally according to DOE/EH-0173T, 5.10.1.2.

Same rationale as WNDNKMS but sampled at the main plant water fountain.

WNDNKEL Site drinking water; generally according to DOE/EH-0173T, 5.10.1.2.

Potable water sampled at the Environmental Laboratory in order to monitor the point farthest away from the point of potable water generation.

WNDNKUR Site drinking water; generally according to DOE/EH-0173T, 5.10.1.2.

Sampled at the utility room potable water storage tank before the site drinking water distribution system. Sample location is entry point EP-1.

- Sampling points are within site facilities and are not detailed on figures.

1996 Monitoring Program
Environmental Surveillance:

On-site Groundwater

Sample Location Code	Monitoring/Reporting Requirements	Sampling Type/Medium	Collection Frequency	Total Annual Sample Collections	Analyses Performed/ Composite Frequency
North Plateau background well (not in a SSWMU) **NB1S** Low-level Waste Treatment Facilities (SSWMU #1) **103** **104 C** **105 C** **106** **107** **108** **110** **111** **116 C** **8604 C** **8605** **SP008** Miscellaneous Small Units (SSWMU #2) **201 U** **205** **206 C** **208** **8605** Liquid Waste Treatment System (SSWMU #3) **103** **204** **301 U** **302 U** **401 U** **408** **8609**	Groundwater monitoring points around site super solid waste management units (SSWMUs) Reported in: • SER • Quarterly Groundwater Reports	Grab liquid →	Four times per year (generally)* →	4 each well (generally)* →	Gross alpha, gross beta, tritium*
		Direct field measurement of sample discharge water →	Each sampling event* →	Twice each sampling event →	Conductivity, pH

NOTE: "U" designates upgradient, "B" designates background, and "C" designates crossgradient wells; the remainder are downgradient.
* Sampling frequency and analytes vary from point to point. See Table 3-1 for a summary sampling schedule and a listing of analytes and Table 3-2 for a listing of analytes monitored at each location. See Appendix E for a listing of results from each location.

Sampling Rationale

On-site Groundwater	DOE Order 5400.1, IV.9; DOE/EH-0173T, 5.10.1.3; 40 CFR Parts 264 and 265, Subpart F. The on-site WVDP groundwater monitoring program focuses on radiological and chemical surveillance of both active and inactive super solid waste management units (SSWMUs). The program allows for the determination of water quality. In addition, using wells situated hydraulically upgradient (background) and downgradient of SSWMUs allows for both detection of groundwater contamination and evaluation of the effects associated with the individual SSWMUs. Groundwater protection is addressed in the Groundwater Protection Management Program, WVDP-091. Groundwater monitoring is detailed in the Groundwater Monitoring Plan, WVDP 239.
SSWMU #1	Low-level waste treatment facilities, including four active lagoons, lagoons 2, 3, 4 and 5, and an inactive, filled-in lagoon, lagoon 1.
SSWMU #2	Miscellaneous small units, including the sludge pond, the solvent dike, the paper incinerator, the equalization basin, and the kerosene tank.
SSWMU #3	Liquid waste treatment system containing effluent from the supernatant treatment system.

■ Sampling locations are shown on Figure A-3 (p. A-47).

1996 Monitoring Program
Environmental Surveillance:

On-site Groundwater

Sample Location Code	Monitoring/Reporting Requirements	Sampling Type/Medium	Collection Frequency	Total Annual Sample Collections	Analyses Performed/ Composite Frequency
HLW Storage and Processing Tank (SSWMU #4) **401 U** **402 U** **403 U** **405 C** **406** **408** **409** **8607** **8609** Maintenance Shop Leach Field (SSWMU #5) **501 U** **502** Low-level Waste Storage Area (SSWMU #6) **406 U** **602** **604** **605** **801** **8607 U** **8609 U** Chemical Process Cell Waste Storage Area (SSWMU #7) **704** **706 U** **707 C**	Groundwater monitoring points around site super solid waste management units (SSWMUs) <u>Reported in</u>: • SER • Quarterly Groundwater Reports	Grab liquid Direct field measurement of sample discharge water	→ Four times per year (generally)* → Each sampling event*	→ 4 each well (generally)* → Twice each sampling event	→ Gross alpha, gross beta, tritium* → Conductivity, pH

NOTE: "U" designates upgradient, "B" designates background, and "C" designates crossgradient wells; the remainder are downgradient.

* Sampling frequency and analytes vary from point to point. See Table 3-1 for a summary sampling schedule and a listing of analytes and Table 3-2 for a listing of analytes monitored at each location. See Appendix E for a listing of results from each location.

Sampling Rationale

On-site Groundwater	DOE Order 5400.1, IV.9; DOE/EH-0173T, 5.10.1.3; 40 CFR Parts 264 and 265, Subpart F. The on-site WVDP groundwater monitoring program focuses on radiological and chemical surveillance of both active and inactive super solid waste management units (SSWMUs). The program allows for the determination of water quality. In addition, using wells situated hydraulically upgradient (background) and downgradient of SSWMUs allows for both detection of groundwater contamination and evaluation of the effects associated with the individual SSWMUs. Groundwater protection is addressed in the Groundwater Protection Management Program, WVDP-091. Groundwater monitoring is covered in the Groundwater Monitoring Plan, WVDP-239.
SSWMU #4	High-level waste storage and processing area, including the high-level radioactive waste tanks, the supernatant treatment system, and the vitrification facility.
SSWMU #5	Maintenance shop sanitary leach field, formerly used by NFS and WVNS to process domestic sewage generated by the maintenance shop.
SSWMU #6	Low-level waste storage area includes metal and fabric structures housing low-level radioactive wastes being stored for future disposal.
SSWMU #7	Chemical process cell (CPC) waste storage area contains packages of pipes, vessels, and debris from decontamination and cleanup of chemical process cell in the former reprocessing plant.

■ Sampling locations are shown on Figure A-3 (p. A-47).

1996 Monitoring Program
Environmental Surveillance:

On-site Groundwater

Sample Location Code	Monitoring/Reporting Requirements	Sampling Type/Medium	Collection Frequency	Total Annual Sample Collections	Analyses Performed/ Composite Frequency
Construction and Demolition Debris Landfill (CDDL) (SSWMU #8) **116 U** **801 U** **802** **803** **804** **8603 U** **8612** **GSEEP** **SP12** NRC-licensed Disposal Area (NDA) (SSWMU #9) **901 U** **902 U** **903** **906** **908 U** **909** **910** **1005 C** **1006 C** **1008c U** **1109a**** **8610** **8611** **NDATR** IRTS Drum Cell (SSWMU #10) **1005 U** **1006** **1007** **1008b B** **1008c B**	Groundwater monitoring points around site super solid waste management units (SSWMUs) <u>Reported in</u>: • SER • Quarterly Groundwater Reports	Grab liquid Direct field measurement of sample discharge water	→ Four times per year (generally)* → Each sampling event*	→ 4 each well (generally)* → Twice each sampling event	→ Gross alpha, gross beta, tritium* → Conductivity, pH

NOTE: "U" designates upgradient, "B" designates background, and "C" designates crossgradient wells; the remainder are downgradient.

* Sampling frequency and analytes vary from point to point. See Table 3-1 for a summary sampling schedule and a listing of analytes and Table 3-2 for a listing of analytes monitored at each location. See Appendix E for a listing of results from each location.

** Sampled by NYSERDA.

Sampling Rationale

On-site Groundwater	DOE Order 5400.1, IV.9; DOE/EH-0173T, 5.10.1.3; 40 CFR Parts 264 and 265, Subpart F. The on-site WVDP groundwater monitoring program focuses on radiological and chemical surveillance of both active and inactive super solid waste management units (SSWMUs). The program allows for the determination of water quality. In addition, using wells situated hydraulically upgradient (background) and downgradient of SSWMUs allows for both detection of groundwater contamination and evaluation of the effects associated with the individual SSWMUs. Groundwater protection is addressed in WVDP-091, the Groundwater Protection Management Program. Groundwater monitoring is covered in WVDP-239, the Groundwater Monitoring Plan.
SSWMU #8	The construction and demolition debris landfill (CDDL), used by NFS and the WVDP to dispose of nonhazardous and nonradioactive materials.
SSWMU #9	The NRC-licensed disposal area (NDA) contains radioactive wastes generated by NFS and the WVDP.
SSWMU #10	The integrated radioactive waste system (IRTS) treatment drum cell stores cement-stabilized low-level radioactive waste.

■ Sampling locations are shown on Figure A-3 (p. A-47).

1996 Monitoring Program
Environmental Surveillance:

On-site Groundwater

Sample Location Code	Monitoring/Reporting Requirements	Sampling Type/Medium	Collection Frequency	Total Annual Sample Collections	Analyses Performed/ Composite Frequency
State-licensed Disposal Area (SSWMU #11)* **1101a U** **1101b U** **1101c U** **1102a** **1102b** **1103a** **1103b** **1103c** **1104a** **1104b** **1104c** **1105a** **1105b** **1106a U** **1106b U** **1107a** **1108a U** **1109a U** **1109b U** **1110a** **1111a**	Groundwater monitoring points around site super solid waste management units (SSWMUs) Reported in: • SER	Grab liquid	Per NYSERDA	Per NYSERDA	Per NYSERDA
Well Points (Not in a SSWMU) **WP-A** **WP-C** **WP-D** **WP-E** **WP-F** **WP-G** **WP-H**	Well points downgradient of Main Plant Reported in: • SER	Grab liquid	→ Annual	→ 1 each well	→ Gross alpha/beta, H-3, gamma isotopic
North Plateau Seeps **SP02** **SP04** **SP05** **SP06** **SP11** **SP12** **SP18** **SP23**	Reported in: • SER	Grab liquid	→ Quarterly	→ 4 each seep	→ Gross alpha/beta, H-3

NOTE: "U" designates upgradient, "B" designates background and "C" designates crossgradient wells; the remainder are downgradient.
* SSWMU #11 is sampled by NYSERDA under a separate program.

Sampling Rationale

On-site Groundwater	DOE Order 5400.1, IV.9; DOE/EH-0173T, 5.10.1.3; 40 CFR Parts 264 and 265, Subpart F. The on-site WVDP groundwater monitoring program focuses on radiological and chemical surveillance of both active and inactive super solid waste management units (SSWMUs). The program allows for the determination of water quality. In addition, using wells situated hydraulically upgradient (background) and downgradient of SSWMUs allows for both detection of groundwater contamination and evaluation of the effects associated with the individual SSWMUs. Groundwater protection is addressed in the Groundwater Protection Management Program, WVDP-091. Groundwater monitoring is covered in the Groundwater Monitoring Plan, WVDP-239.
SSWMU #11	The state-licensed disposal area (SDA) was operated by NFS as a commercial low-level disposal facility and also received wastes from NFS reprocessing operations.
Well Points	Monitor groundwater of known subsurface contamination in the north plateau area. All well points are downgradient of the main plant.
North Plateau Seeps	Monitor groundwater emanating at the ground surface along the edge of the site's north plateau.

■ Sampling locations are shown on Figure A-3 (p. A-47).

1996 Monitoring Program
Environmental Surveillance:

Off-site Surface Water

Sample Location Code	Monitoring/Reporting Requirements	Sampling Type/Medium	Collection Frequency	Total Annual Sample Collections	Analyses Performed/ Composite Frequency
WFBCTCB Buttermilk Creek, upstream of Cattaraugus Creek confluence at Thomas Corners Road	Restricted surface waters receiving plant effluents Reported in: • MTAR • QEMDR • SER	Timed continuous composite liquid	→ Weekly	→ 52	→ pH, conductivity
				Weekly samples composited to 12	→ Monthly composite for gross alpha/beta, H-3
				Weekly samples composited to 4	→ Quarterly composite for gamma isotopic and Sr-90
WFFELBR Cattaraugus Creek at Felton Bridge	Unrestricted surface waters receiving plant effluents Reported in: • MTAR • QEMDR • SER	Timed continuous composite liquid	→ Weekly	→ 52	→ Gross alpha/beta, H-3, pH
				Weekly samples composited to 12	→ Flow-weighted monthly composite for gamma isotopic and Sr-90, gross alpha/beta, H-3
WFBCBKG Buttermilk Creek near Fox Valley (background)	Unrestricted surface water background Reported in: • MTAR • QEMDR • SER	Timed continuous composite liquid	→ Weekly	→ 52	→ pH, conductivity
				Weekly samples composited to 12	→ Monthly composite for gross alpha/beta, H-3
				Weekly samples composited to 4	→ Quarterly composite for gamma isotopic, Sr-90, C-14, I-129, Pu/U isotopic, total U, Am-241, Tc-99
		Grab liquid	→ Semiannual	→ 2	→ NPOC, TOX, Ca, Mg, Na, K, Ba, Mn, Fe, Cl, SO_4, NO_3-NO_2-N, F, HCO_3, CO_3
WFBIGBR Cattaraugus Creek at Bigelow Bridge (background)	Unrestricted surface water background Reported in: • MTAR • QEMDR • SER	Grab liquid	→ Monthly	→ 12	→ Gross alpha/beta, H-3, Sr-90, and gamma isotopic

Monthly composites at **WFBCTCB, WFBCBKG,** and **WFFELBR** are also sent to NYSDOH.

Sampling Rationale

WFBCTCB DOE/EH-0173T, 5.10.1.1.

Buttermilk Creek is the surface water receiving all WVDP effluents. **WFBCTCB** monitors the potential influence of WVDP drainage into Buttermilk Creek upstream of confluence with Cattaraugus Creek.

WFFELBR DOE/EH-0173T, 5.10.1.1.

Because Buttermilk Creek is the surface water that receives all WVDP effluents and empties into Cattaraugus Creek, **WFFELBR** monitors the potential influence of WVDP drainage into Cattaraugus Creek directly downstream of the Cattaraugus Creek confluence with Buttermilk Creek.

WFBCBKG DOE/EH-0173T, 5.10.1.1.

Monitors background conditions of Buttermilk Creek upstream of the WVDP. Allows for comparison to downstream conditions.

WFBIGBR DOE/EH-0173T, 5.10.1.1.

Monitors background conditions of Cattaraugus Creek at Bigelow Bridge, upstream of the WVDP. Allows for comparison to downstream conditions.

- Sampling locations are shown on Figure A-4 (p. A-48).

1996 Monitoring Program
Environmental Surveillance:

Off-site Drinking Water

Sample Location Code	Monitoring/Reporting Requirements	Sampling Type/Medium	Collection Frequency	Total Annual Sample Collections	Analyses Performed/ Composite Frequency
WFWEL series wells near WVDP outside WNYNSC perimeter **WFWEL01** 3.0 km WNW **WFWEL02** 1.5 km NW **WFWEL03** 3.5 km NW **WFWEL04** 3.0 km NW **WFWEL05** 2.5 km SW **WFWEL06** (background) 29 km S **WFWEL07** 4.4 km NNE **WFWEL08** 2.5 km ENE **WFWEL09** 3.0 km SE **WFWEL10** 7.0 km N	Drinking water supply; groundwater near facility* <u>Reported in</u>: • MTAR • QEMDR • SER	→ Grab liquid	→ Annual	→ 1 each location	→ Gross alpha/beta, H-3, gamma isotopic, pH, conductivity

* No drinking water wells are located in hydrogeological units affected by site activity.

Sampling Rationale

Off-site Drinking Water **WFWEL** Series	DOE 5400.1, IV.9; DOE/EH-0173T, 5.10.1.2. Eight of the ten listed off-site private residential drinking water wells represent the nearest unrestricted uses of groundwater close to the WVDP. The ninth sample (**WFWEL10**) is from a public water supply from deep wells. The tenth drinking water well, **WFWEL06**, is located 29 kilometers south of the Project and is considered a background drinking water source.

■ Sampling locations are shown on Figures A-5 and A-9 (pp. A-49 and A-53).

1996 Monitoring Program
Environmental Surveillance:

Off-site Air

Sample Location Code	Monitoring/Reporting Requirements	Sampling Type/Medium	Collection Frequency	Total Annual Sample Collections	Analyses Performed/ Composite Frequency
AFFXVRD 3.0 km SSE at Fox Valley **AFTCORD** 3.7 km NNW at Thomas Corners Road **AFRT240*** 2.0 km NE on Route 240 **AFSPRVL** 7 km N at Springville **AFWEVAL** 6 km SSE at West Valley **AFNASHV** 37 km W at Village of Nashville, town of Hanover (background) **AFBOEHN** 2.3 km SW on Dutch Hill Road **AFRSPRD** 1.5 km NW on Rock Springs Road **AFGRVAL** 29 km S at Great Valley (background) **AFBLKST** Bulk Storage Warehouse 2.2 km ESE at Buttermilk Road	Particulate air samples around WNYNSC perimeter Reported in: • MTAR • QEMDR • SER	Continuous air particulate filter	→ Weekly	→ 52 each location	→ Gross alpha/beta
				Weekly filters composited to 4 each location	→ Quarterly composite for Sr-90, gamma isotopic Total U, U/Pu isotopic, and Am-241 for **AFRSPRD** and **AFGRVAL** only
		Continuous desiccant column for water vapor collection	→ Weekly	→ 52 each location (**AFRSPRD** and **AFGRVAL** only)	→ H-3
		Continuous charcoal cartridge	→ Monthly	→ 12 composited to 4 each location (**AFRSPRD** and **AFGRVAL** only)	→ Quarterly composite for I-129

* Filter from duplicate sampler sent to NYSDOH.

Sampling Rationale

AFFXVRD DOE/EH-0173T, 5.7.4.
AFTCORD
AFRT240 Air samplers put into service by NFS as part of the site's original monitoring program. Perimeter locations chosen to obtain data from places most likely to provide highest concentrations, based on meteorological data.

AFSPRVL DOE/EH-0173T, 5.7.4; DOE/EP-0023, 4.2.3.

Off-site (remote) sampler located on private property in nearby community within 15 kilometers of the site (north).

AFWEVAL DOE/EH-0173T, 5.7.4; DOE/EP-0023, 4.2.3.

Off-site (remote) sampler located on private property in nearby community within 15 kilometers of the site (southeast).

AFNASHV DOE/EH-0173T, 5.7.4; DOE/EP-0023, 4.2.3.

Off-site (remote) sampler considered to be representative of natural background radiation. Located 37 kilometers west of the site (upwind) on privately owned property.

AFBOEHN DOE/EH-0173T, 5.7.4; DOE/EP-0023, 4.2.3.

Perimeter location chosen to obtain data from the place most likely to provide highest elevated release concentrations based on meteorological data. AFBOEHN is located on NYSERDA property at the perimeter.

AFRSPRD DOE/EH-0173T, 5.7.4.

Perimeter location chosen to obtain data from the place most likely to provide highest ground-level release concentrations, based on meteorological data. AFRSPRD is on WVDP property but outside the main plant operations fence line. I-129 and H-3 are sampled here because the sampling trains were easy to incorporate and the location was most likely to receive effluent releases.

AFGRVAL DOE/EH-0173T, 5.7.4; DOE/EP-0023, 4.2.3.

Off-site (remote) sampler considered to be representative of natural background radiation. Located on privately owned property 29 kilometers south of the site (typically upwind). I-129 and H-3 sampled here also.

AFBLKST DOE/EH-0173T, 5.7.4.

Off-site monitoring of bulk storage warehouse, near site perimeter.

■ Sampling locations are shown on Figures A-6 and A-9 (pp. A-50 and A-53).

1996 Monitoring Program Environmental Surveillance:

Fallout, Sediment, and Soil

Sample Location Code	Monitoring/Reporting Requirements	Sampling Type/Medium	Collection Frequency	Total Annual Sample Collections	Analyses Performed/ Composite Frequency
AFDHFOP 2.3 km SW **AFFXFOP** 3.0 km SSE **AFTCFOP** 3.7 km NNW **AF24FOP** 2.0 km NE **ANRGFOP** Met tower on-site	Collection of fallout particulate and precipitation around WNYNSC perimeter Reported in: • MTAR • QEMDR • SER	Integrated precipitation	→ Monthly	→ 12 each location	→ Gross alpha/beta, H-3, pH, gamma isotopic
SF Soil Series Surface soil (at each of ten air samplers)	Long-term fallout accumulation Reported in: • MTAR • QEMDR • SER	Surface plug composite soil	→ Annual	→ 1 each location	→ Gross alpha/beta, gamma isotopic, Sr-90, Pu-239, Am-241, plus U-isotopic and total U at **SFRSPRD, SFBOEHN,** and **SFGRVAL**
SFCCSED Cattaraugus Creek at Felton Bridge **SFSDSED** Cattaraugus Creek at Springville Dam **SFBISED** Cattaraugus Creek at Bigelow Bridge (background) **SFTCSED** Buttermilk Creek at Thomas Corners Road **SFBCSED** Buttermilk Creek at Fox Valley Road (background)	Deposition in sediment downstream of facility effluents Reported in: • MTAR • QEMDR • SER	Grab stream sediment	→ Annual (Split of **SFSDSED and SFBCSED** with **NYSDOH**)	→ 1 each location	→ Gross alpha/beta, gamma isotopic, Sr-90, U/Pu isotopic, total U, Am-241
SN On-site Soil Series: **SNSW74A** (Near WNSW74A) **SNSWAMP** (Near WNSWAMP) **SNSP006** (Near WNSP006)	Reported in: • MTAR • QEMDR • SER	Surface plug or grab	→ Annual	→ 1 each location	→ Gross alpha/beta, gamma isotopic, Sr-90, Pu-239, Am-241, U-isotopic, total U, Al, Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Hg, Ni, K, Se, Ag, Na, Tl, V, Zn

Sampling Rationale

AFDHFOP **AFFXFOP** **AFTCFOP** **AF24FOP**	DOE/EP-0023, 4.7. Collection of fallout particles and precipitation around the site perimeter at established air sampling locations: AFDHFOP (Dutch Hill at Boehn road), AFFXFOP (Fox Valley Road), AFTCFOP (Thomas Corners), AF24FOP (Route 240). Indicates short-term effects.
ANRGFOP	Collection of fallout particles and precipitation on-site at the meteorological tower. Indicates short-term effects.
SF Soil Series	DOE/EH-0173T, 5.9.1. Off-site soils collected at air sampling locations. **SFWEVAL** (West Valley), **SFFXVRD** (Fox Valley Road), **SFSPRVL** (Springville), **SFTCORD** (Thomas Corners), **SFRT240** (Route 240), **SFNASHV** (Nashville), **SFBOEHN** (Boehn Road-Dutch Hill), **SFGRVAL** (Great Valley), **SFRSPRD** (Rock Springs Road), **SFBLKST** (bulk storage warehouse): Collection of long-term fallout data at established air sampler locations via soil sampling.
SFTCSED	DOE/EH-0173T, 5.12.1. Sediment deposition at Thomas Corners in Buttermilk Creek immediately downstream of all facility liquid effluents.
SFBCSED	DOE/EH-0173T, 5.12.1. Sediment deposition in Buttermilk Creek upstream of facility effluents (background).
SFCCSED	DOE/EH-0173T, 5.12.1. Sediment deposition in Cattaraugus Creek at Felton Bridge. Location is first access point to Cattaraugus Creek downstream of the confluence with Buttermilk Creek.
SFSDSED	DOE/EH-0173T, 5.12.1. Sediment deposition in Cattaraugus Creek at Springville Dam. Reservoir provides ideal settling and collection location for sediments downstream of Buttermilk Creek confluence. Located downstream of **SFCCSED**.
SFBISED	DOE/EH-0173T, 5.12.1. Sediment deposition in Cattaraugus Creek at Bigelow Bridge. Location is upstream of the Buttermilk Creek confluence and serves as a Cattaraugus Creek background location.
SN Soil Series	DOE/EH-0173T, 5.9.1. On-site soil. (Samples may be partially composed of sediments.)
SNSW74A	Surface soil near **WNSW74A**. Location to be specifically defined by geographic coordinates. Corresponds to site drainage pattern flow (i.e., most likely area of radiological deposition/accumulation).
SNSWAMP	Surface soil near **WNSWAMP**. Location to be specifically defined by geographic coordinates. Corresponds to site drainage pattern flow (i.e., most likely area of radiological deposition/accumulation).
SNSP006	Surface soil near **WNSP006**. Location to be specifically defined by geographic coordinates. Corresponds to site drainage pattern flow (i.e., most likely area of radiological deposition/accumulation).

■ Sampling locations are shown on Figures A-2, A-4, A-6, and A-9 (pp. A-46, A-48, A-50, and A-53).

1996 Monitoring Program
Environmental Surveillance:

Off-site Biological

Sample Location Code	Monitoring/Reporting Requirements	Sampling Type/Medium	Collection Frequency	Total Annual Sample Collections	Analyses Performed/ Composite Frequency
BFFCATC Cattaraugus Creek downstream of its confluence with Buttermilk Creek **BFFCTRL** Control sample from nearby stream not affected by the WVDP (7 km or more upstream of site effluent point; background)	Fish in waters up- and downstream of facility effluents Reported in: • MTAR • QEMDR • SER	Individual collection, biological	Semiannual (samples at **BFFCATC** and **BFFCTRL** shared with NYSDOH) →	20 fish each location →	Gamma isotopic and Sr-90 in edible portions of each individual fish
BFFCATD Cattaraugus Creek downstream of Springville Dam			Annual (**BFFCATD** only) →	10 fish →	Gamma isotopic and Sr-90 in edible portions of each individual fish
BFMREED Dairy farm, 3.8 km NNW **BFMCOBO** Dairy farm, 1.9 km WNW **BFMCTLS** Control location 25 km S (background) **BFMCTLN** Control location 30 km N (background)	Milk from animals foraging around facility perimeter and at background sites Reported in: • MTAR • QEMDR • SER	Grab biological →	Monthly (**BFMREED, BFMCOBO, BFMCTLS, BFMCTLN.** Samples at **BFMREED** and **BFMCOBO** shared with NYSDOH) →	12 monthly samples composited to 4 each location →	Quarterly composite for gamma isotopic, Sr-90, H-3, and I-129
BFMWIDR Dairy farm, 3.0 km SE of site **BFMSCHT** Dairy farm 4.8 km S			Annual (**BFMWIDR, BFMSCHT**) →	1 each location →	Gamma isotopic, Sr-90, H-3, and I-129

Sampling Rationale

BFFCATC **BFFCATD**	DOE/EH-0173T, 5.11.1.1. Radioactivity may enter a food chain in which fish are a major component and are consumed by the local population.
BFFCTRL	Control fish sample to provide background data for comparison with data from fish caught downstream of facility effluents.
BFMREED **BFMCOBO** **BFMWIDR** **BFMSCHT**	DOE/EH-0173T, 5.8.2.1. Milk from animals foraging around facility perimeter. Milk is consumed by all age groups and is frequently the most important food that could contribute to the radiation dose. Dairy animals pastured near the site and at two background locations allow adequate monitoring.
BFMCTLS **BFMCTLN**	Control milk samples collected far from site to provide background data for comparison with data from near-site milk.

- Sampling locations are shown on Figures A-5 and A-9 (pp. A-49 and A-53).

1996 Monitoring Program
Environmental Surveillance:

Off-site Biological

Sample Location Code	Monitoring/Reporting Requirements	Sampling Type/Medium	Collection Frequency	Total Annual Sample Collections	Analyses Performed/ Composite Frequency
BFVNEAR* Nearby locations **BFVCTRL*** Remote locations (16 km or more from facility; background) **BFHNEAR** Beef cattle/milk cow forage from near-site location	Fruit and vegetables grown near facility perimeter, downwind if possible Reported in: • MTAR • QEMDR • SER	Grab biological (fruits and vegetables) →	Annual, at harvest (**BFVNEAR** and **BFVCTRL**) →	3 each (split with NYSDOH) →	Gamma isotopic and Sr-90 analysis of edible portions, H-3 in free moisture
BFHCTLS or **BFHCTLN** Beef cattle/milk cow forage from control location south or north (background)		Grab biological →	Annual (**BFHNEAR**, **BFHCTLS**, or **BFHCTLN**) →	1 each location →	Gamma isotopic, Sr-90
BFBNEAR Beef animal from nearby farm in downwind direction **BFBCTRL** Beef animal from control location 16 km or more from facility (background)	Meat (beef foraging near facility perimeter, downwind if possible) Reported in: • MTAR • QEMDR • SER	Grab biological →	Semiannual →	2 each location →	Gamma isotopic and Sr-90 analysis of meat, H-3 in free moisture
BFDNEAR Deer in vicinity of the site **BFDCTRL** Control deer 16 km or more from facility (background)	Meat (deer foraging near facility perimeter) Reported in: • MTAR • QEMDR • SER	Individual collection biological →	Annual, during hunting season (**BFDNEAR** sample split with NYSDOH) →	3 →	Gamma isotopic and Sr-90 analysis of meat, H-3 in free moisture
			During year as available (**BFDCTRL** sample split with NYSDOH) →	3 →	Gamma isotopic and Sr-90 analysis of meat, H-3 in free moisture

* Corn, apple, and bean samples are identified specifically as follows: corn = BFVNEAC and BFVCTRC; apples = BFVNEAA and BFCTRA; beans = BFVNEAB and BFVCTRB.

Sampling Rationale

BFVNEAR DOE/EH-0173T, 5.8.2.2.

Fruits and vegetables (corn, apples, and beans) collected from areas near the site. These samples are collected, if possible, from areas near the site predicted to have worst case downwind concentrations of radionuclides in air and soil. Sample analysis reflects steady state/chronic uptake or contamination of foodstuffs as a result of site activities. Possible pathway to humans or indirectly through animals.

BFVCTRL DOE/EH-0173T, 5.8.2.2.

Fruits and vegetables collected from area remote from the site. Background fruits and vegetables collected for comparison with near-site samples. Collected in area(s) of no possible site impact.

BFHNEAR DOE/EH-0173T, 5.8.2.2.

Hay collected from areas near the site. Same as for near-site fruits and vegetables (**BFVNEAR**). Indirect pathway to humans through animals. Collected with either beef or milk sample location.

BFHCTLS DOE/EH-0173T, 5.8.2.2.
BFHCTLN

Hay collected from areas remote from the site. Background hay collected for comparison with near-site samples. Collected in area(s) of no possible site impact.

BFBNEAR DOE/EH-0173T, 5.8.2.3.

Beef collected from animals raised near the site. Following the rationale for vegetable matter collected near site (**BFVNEAR** and **BFHNEAR**), edible flesh portion of beef animals is analyzed to determine possible radionuclide content passable directly to humans. For animals foraging downwind in areas of maximum probable site impact.

BFBCTRL DOE/EH-0173T, 5.8.2.3.

Beef collected from animals raised far from the site. Background beef collected for comparison with near-site samples. Collected in area(s) of no possible site impact.

BFDNEAR DOE/EH-0173T, 5.8.3.

Venison from deer herd found living near the site. Same as for beef **(BFBNEAR).**

BFDCTRL DOE/EH-0173T, 5.8.3.

Venison from deer herd living far from the site. Background deer meat collected for comparison with near-site samples. Collected in area(s) of no possible site impact.

- Sampling locations are shown on Figures A-5 and A-9 (pp. A-49 and A-53).

1996 Monitoring Program
Environmental Surveillance:

Off-site Direct Radiation

Sample Location Code	Monitoring/Reporting Requirements	Sampling Type/Medium	Collection Frequency	Total Annual Sample Collections	Analyses Performed/ Composite Frequency
DFTLD Series Thermoluminescent Dosimetry (TLD) Off-site: **#1-16** At each of 16 compass sectors at nearest accessible perimeter point **#17** "5 Points" landfill, 19 km SW (background) **#20** 1,500 m NW (downwind receptor) **#21** Springville 7 km N **#22** West Valley 6 km SSE **#23** Great Valley 29 km S (background) **#37** Nashville 37 km NW (background) **#41** Sardinia-Savage Road 24 km NE (background)	Direct radiation around facility Reported in: • QEMDR • SER	Integrating LiF TLD →	Quarterly →	5 TLDs at each of 23 locations collected 4 times per year →	Quarterly gamma radiation exposure

Sampling Rationale

DOSIMETRY Off-site	DOE/EH-0173T, 5.5 and DOE/EP-0023, 4.6.3. TLDs offer continuous integrated environmental gamma-ray monitoring and have been deployed systematically about the site. Off-site TLDs are used to verify that site activities have not adversely affected the surrounding environs. In addition to general NRC crosschecks at selected sites, a biennial HPIC gamma radiation measurement is completed at all TLD locations.

- Sampling locations are shown on Figures A-7 and A-9 (pp. A-51 and A-53).

1996 Monitoring Program
Environmental Surveillance:

On-site Direct Radiation

Sample Location Code	Monitoring/Reporting Requirements	Sampling Type/Medium	Collection Frequency	Total Annual Sample Collections	Analyses Performed/ Composite Frequency
DNTLD Series Thermoluminescent Dosimetry (TLD) On-site: **#18, #19, #33** At three corners of SDA **#24, #26-32, #34** (9) at security fence around site **#35, #36, #38-40** (5) On-site near operational areas **#25** Rock Springs Road 500 m NNW of plant **#42** SDA T-1 Building **#43** SDA West Perimeter Fence	Direct radiation on facility grounds Reported in: • QEMDR • SER	Integrating LiF TLD	→ Quarterly	→ 5 TLDs at each of 20 sites collected 4 times per year	→ Quarterly gamma radiation exposure

Sampling Rationale

DOSIMETRY On-site	DOE/EH-0173T, 5.4 and 5.5. On-site TLDs monitor waste management units and verify that the potential dose rate to the general public (i.e., at Rock Springs Road) is below 100 mr/annum (1 mSv/annum) from site activities. In addition to general NRC crosschecks at selected sites, a biennial HPIC gamma radiation measurement is completed at all locations. Potential TLD sampling locations are continually evaluated with respect to site activities.

■ Sampling locations are shown on Figure A-8 (p. A-52).

JEB: 97: W: \DWG\INACTIVE\SER\SER96\SR96A-1.DWG

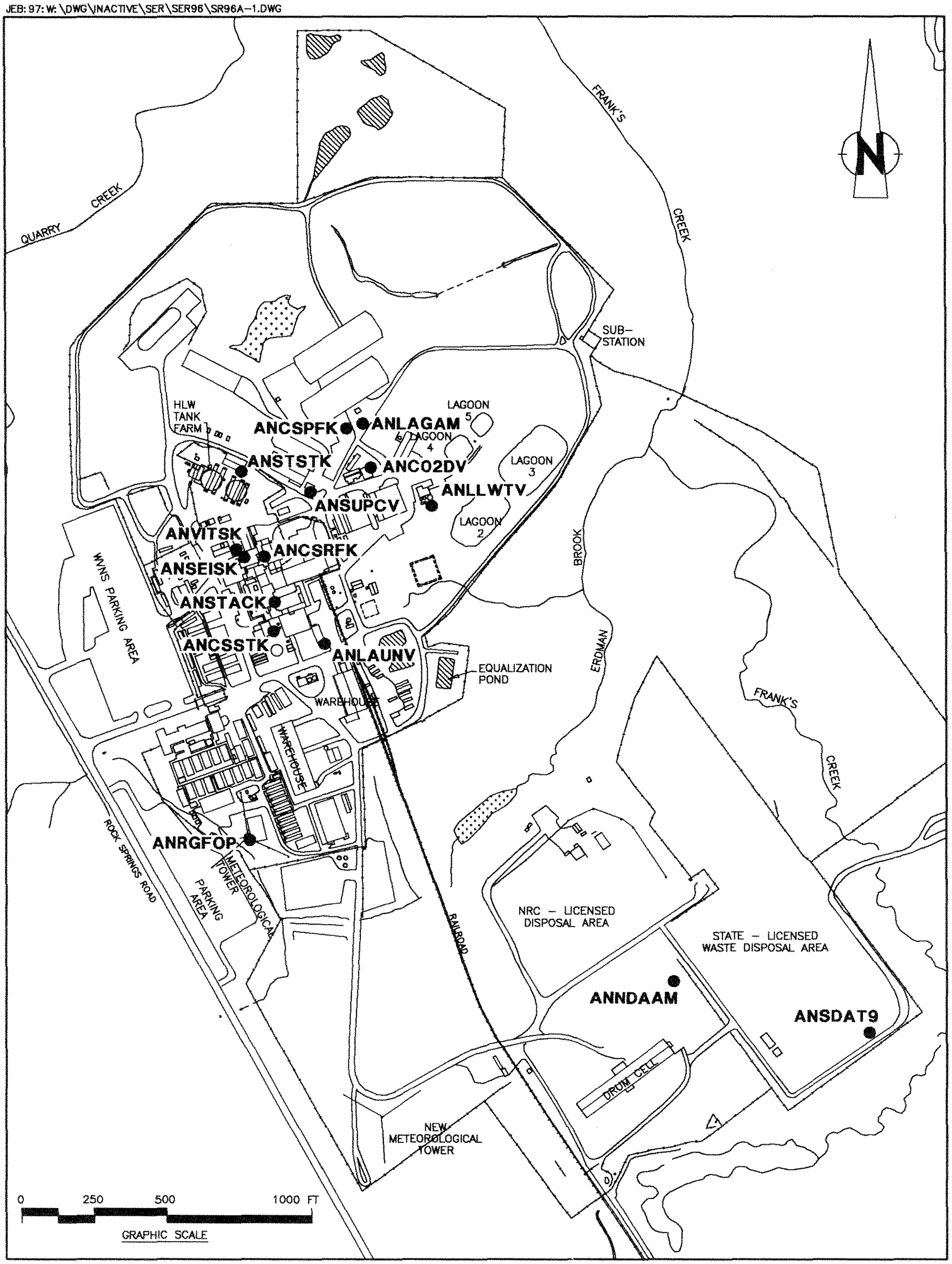

Figure A-1. On-site Air Monitoring and Sampling Points.

JEB: 97: W: \DWG\INACTIVE\SER\SER96\SR96A-2.DWG

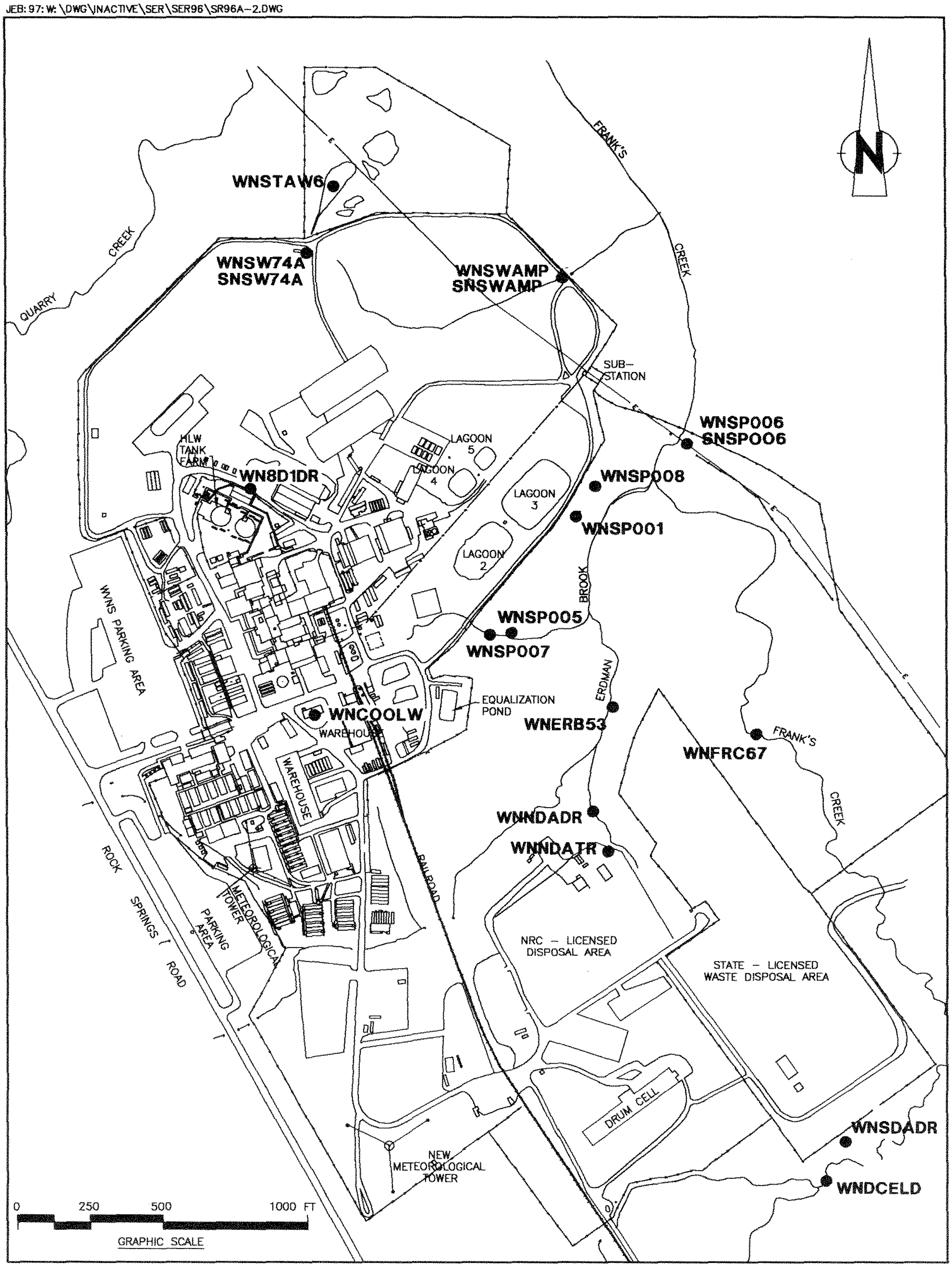

Figure A-2. On-site Surface Water and Soil Sampling Locations.

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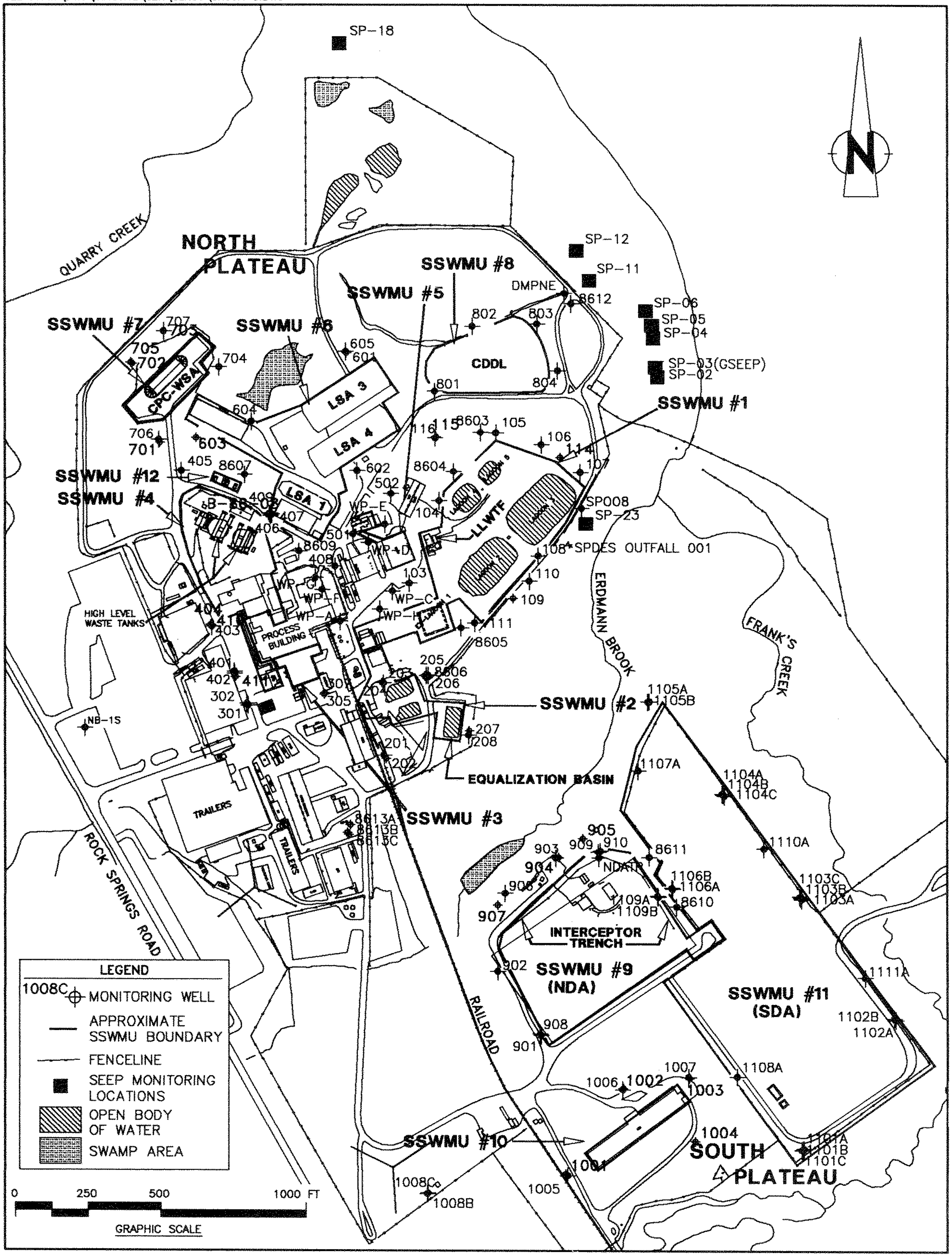


Figure A-3. On-Site Groundwater Monitoring Network (Includes wells not actively monitored following May 1995 but used for water level measurements).

JEB: 97: W: \DWG\INACTIVE\SER\SER96\SR96A-4.DWG

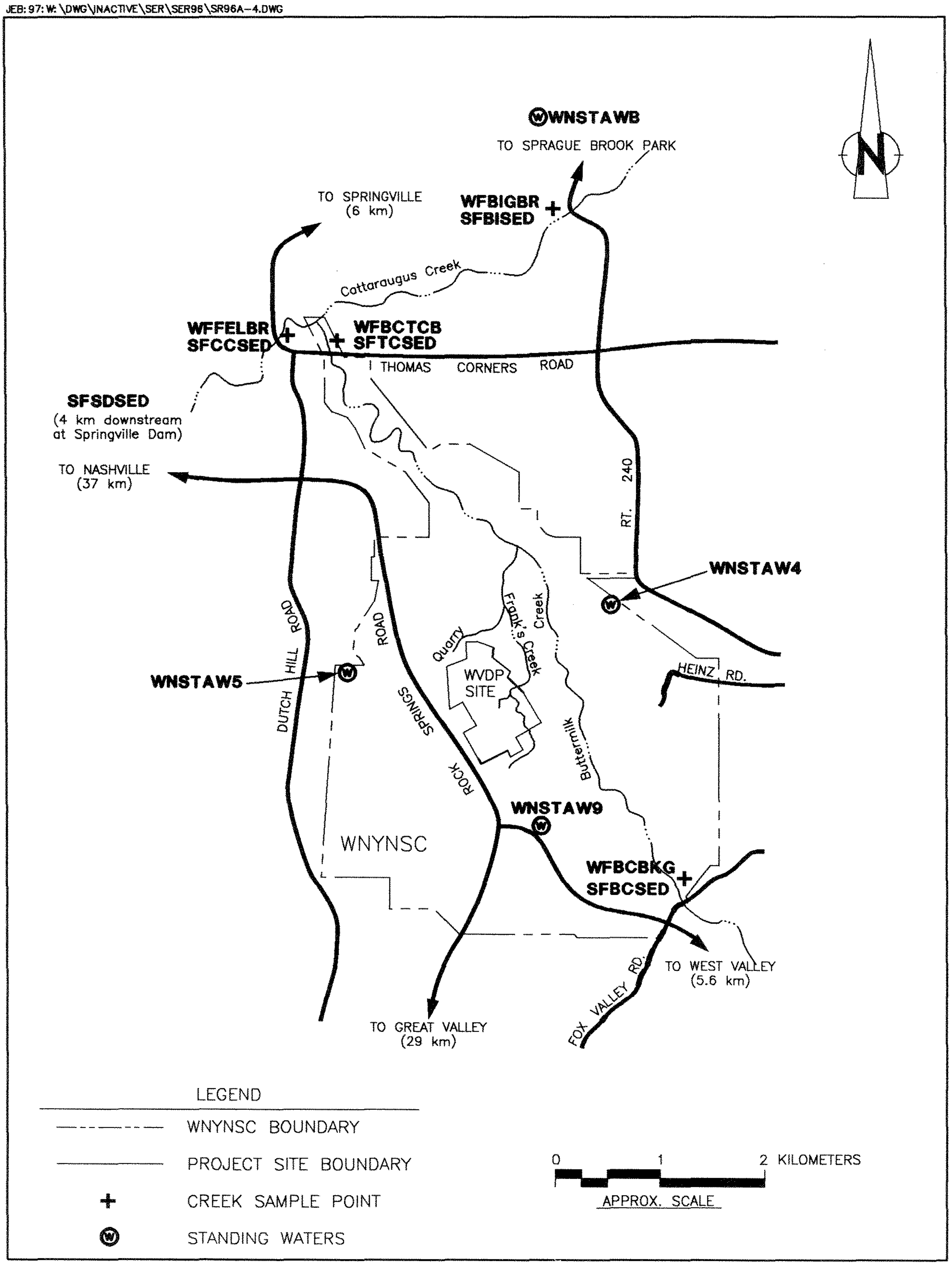


Figure A-4. Off-site Surface Water and Sediment Sampling Locations.

JEB: 97: W: \DWG\INACTIVE\SER\SER96\SR96A-5.DWG

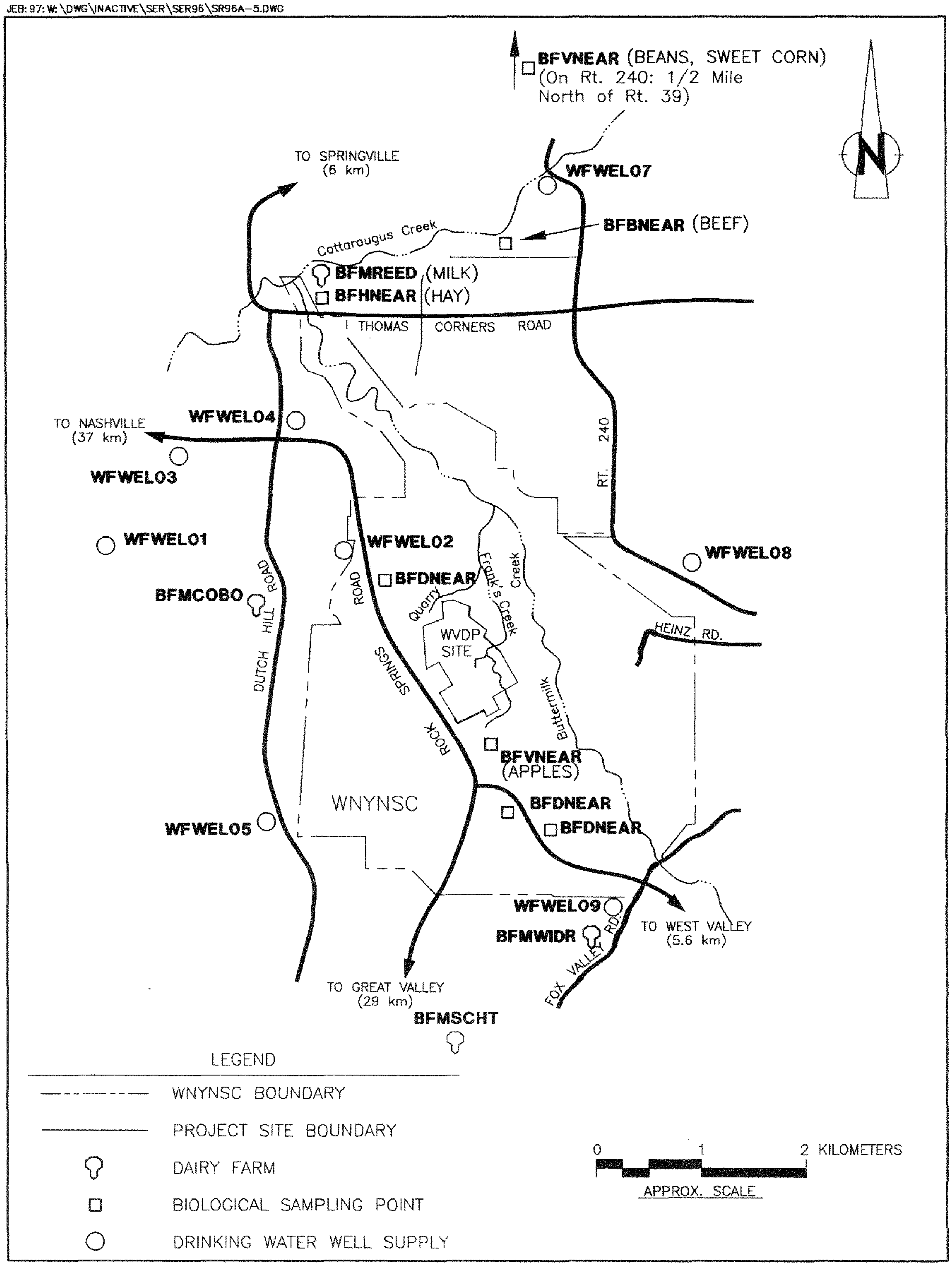


Figure A-5. Near-site Drinking Water and Biological Sample Points.

JEB: 97: W: \DWG\INACTIVE\SER\SER96\SR96A-6.DWG

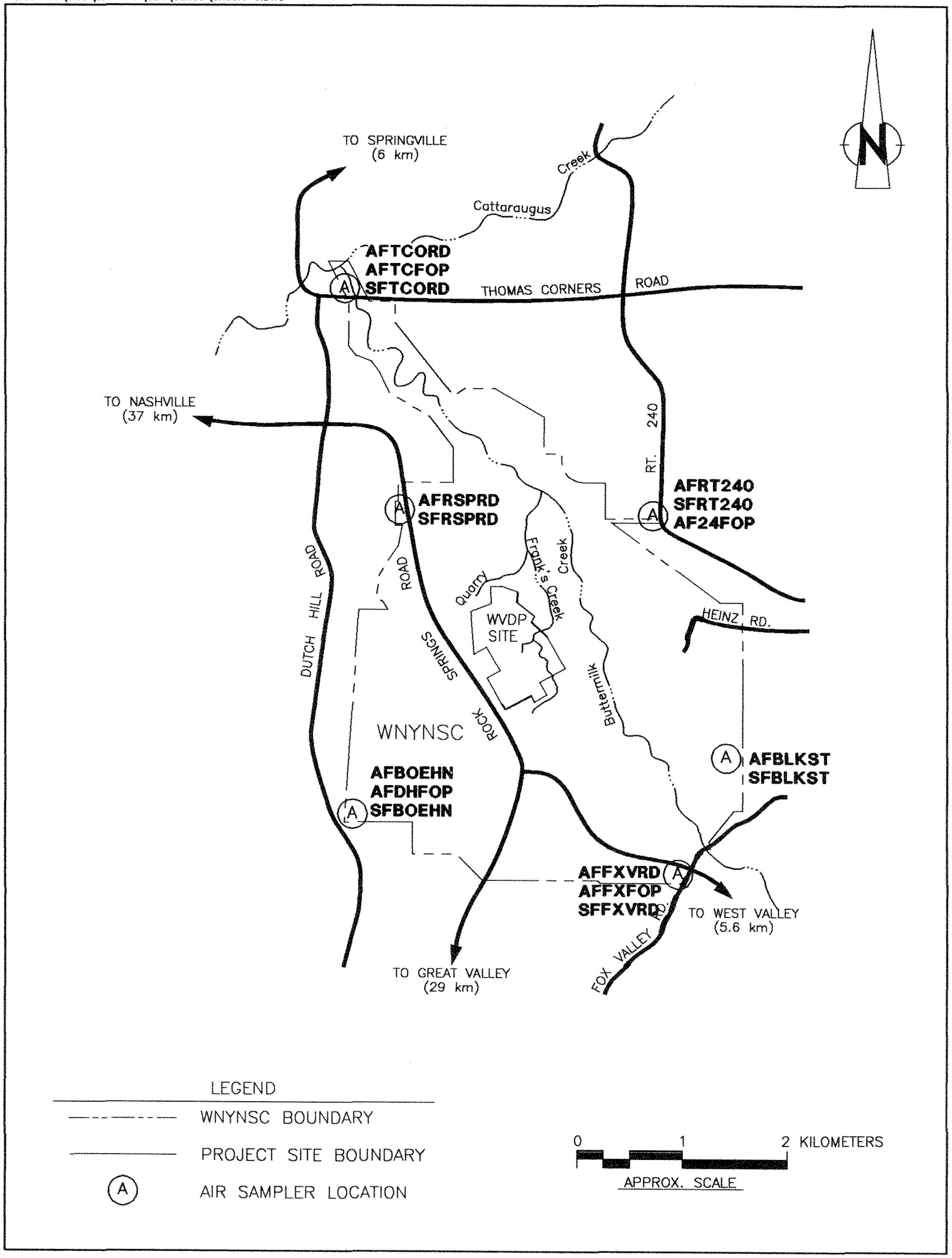


Figure A–6. Perimeter Air, Soil, and Fallout Sampling Point Locations.

JEB: 97: W: \DWG\INACTIVE\SER\SER96\SR96A-7.DWG

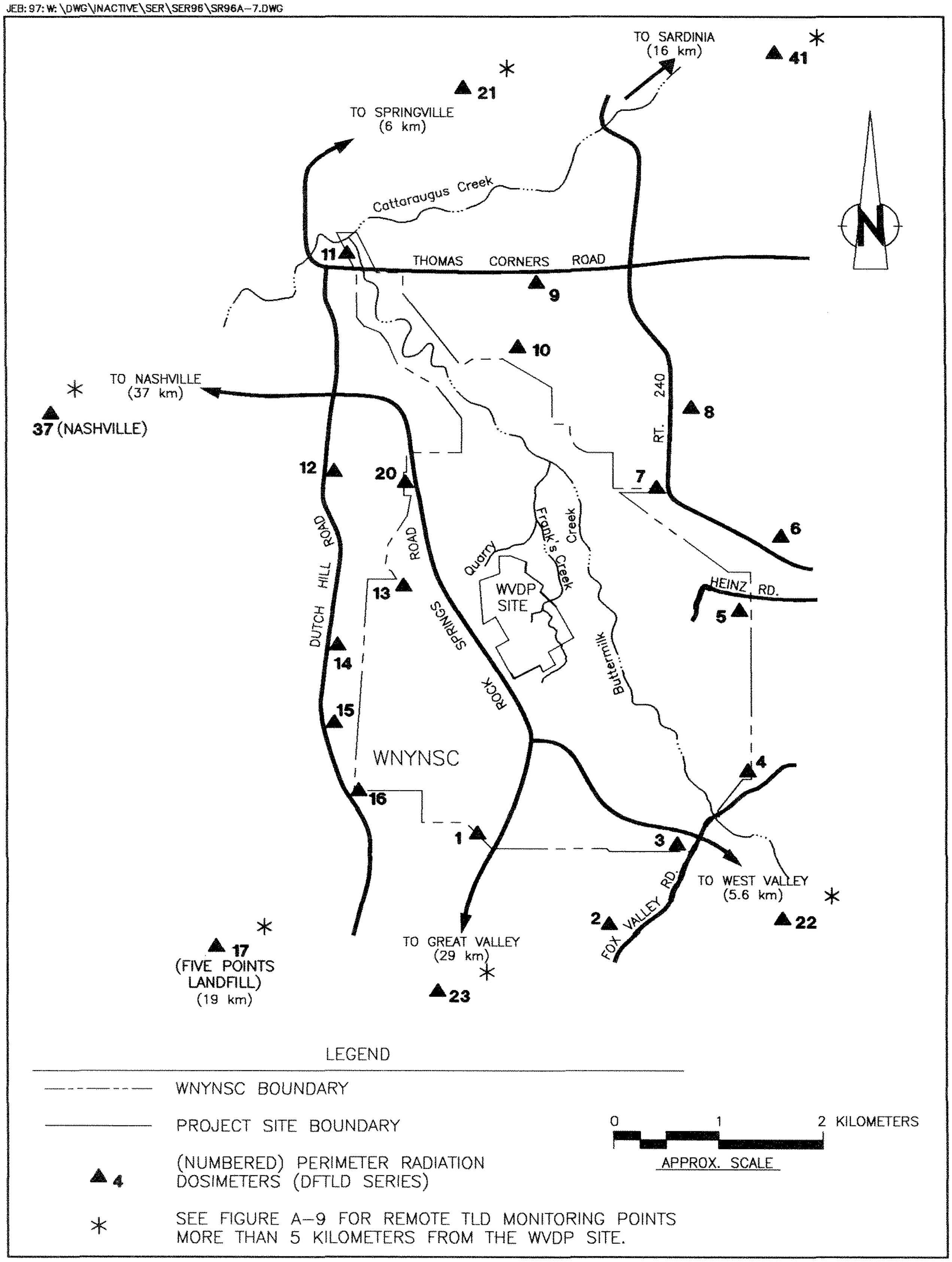


Figure A-7. Off-site Thermoluminescent Dosimeter (TLD) Locations.

JEB: 97: W: \DWG\INACTIVE\SER\SER96\SR96A-8.DWG

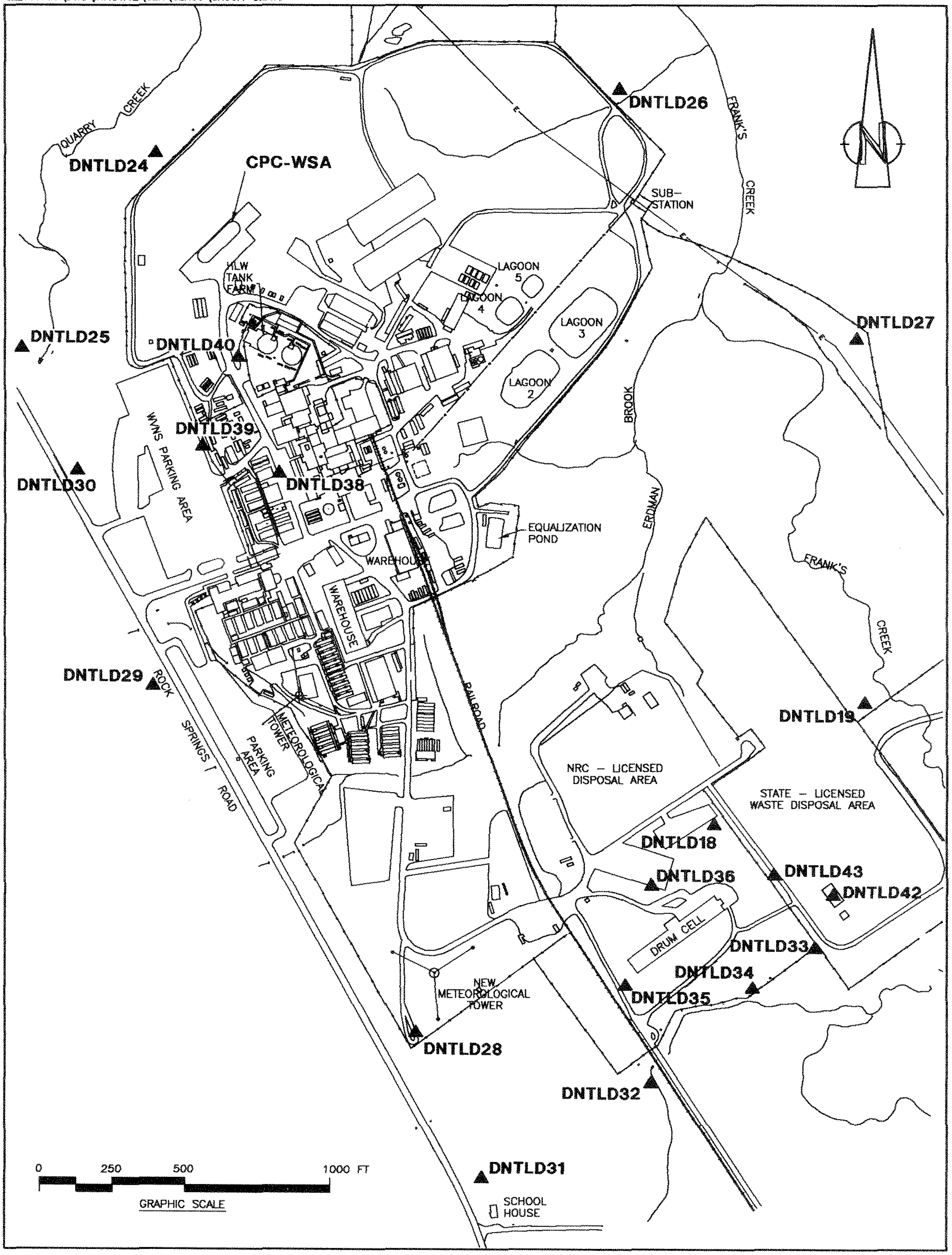
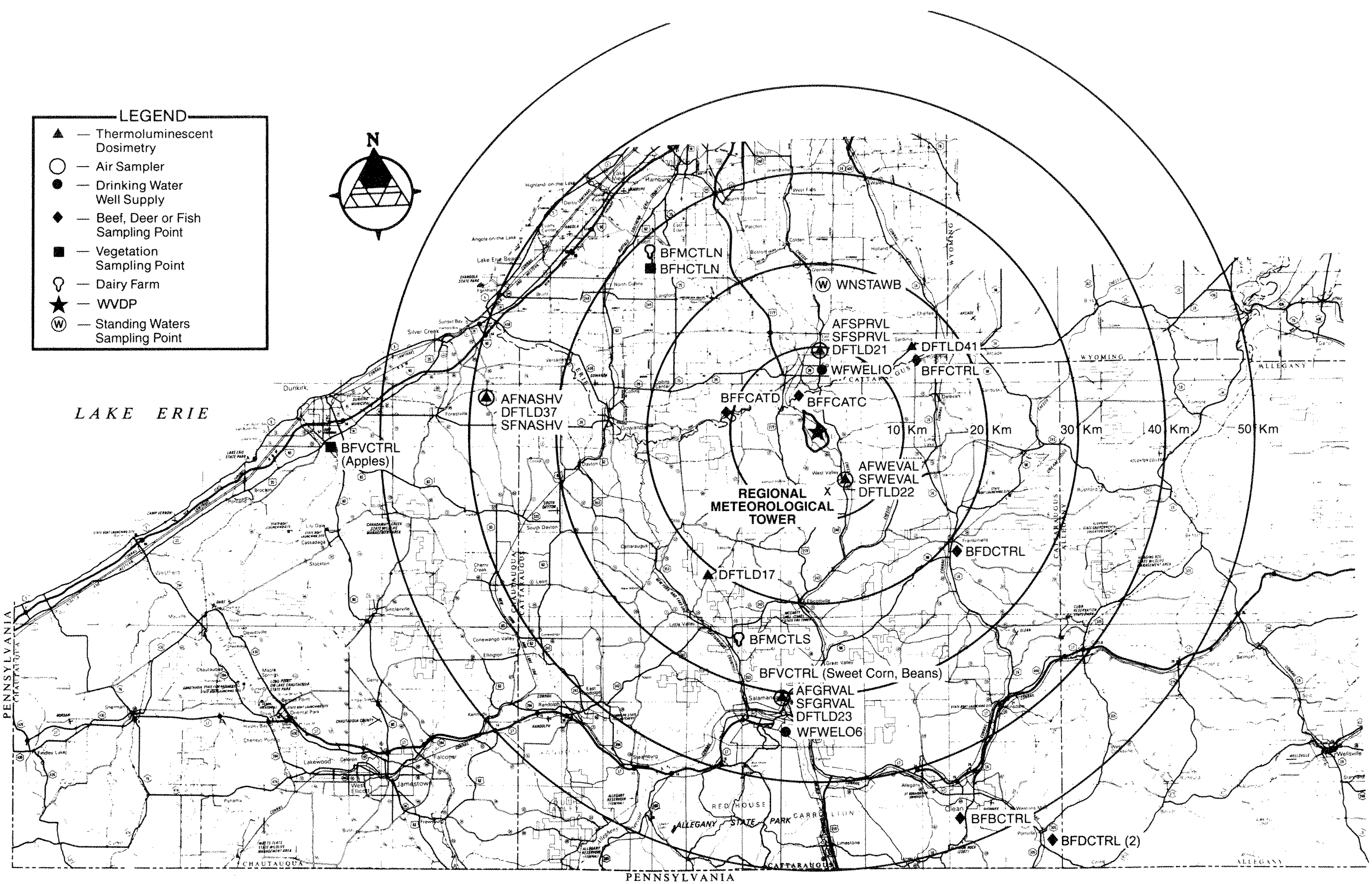


Figure A-8. On-site Thermoluminescent Dosimeters (TLD) Locations.

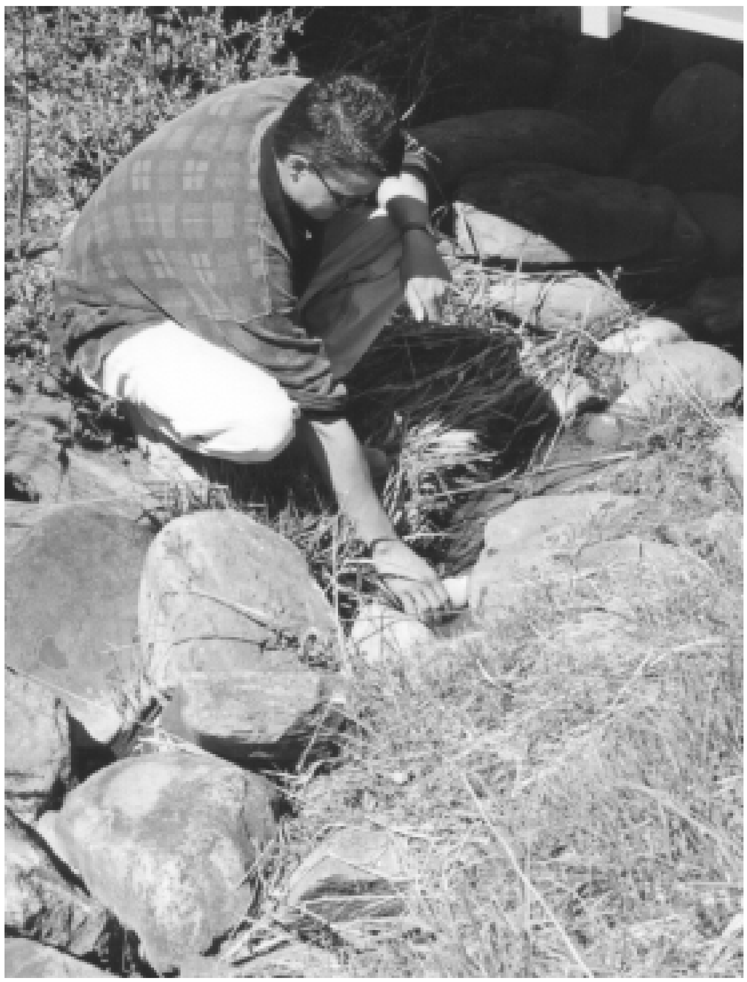


REF: NYSDOT, New York State Map — West Sheet, 1:250,000, Revised 1982

Figure A-9. Environmental Sample Points more than 5 kilometers from the WVDP Site.

Appendix C - 1

Summary of Water and Sediment Monitoring Data



Collecting a Sample at a WVDP Stream Sampling Location

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Table C - 1.1

Total Radioactivity of Liquid Effluents Released from Lagoon 3 (WNSP001) in 1997 (curies)

Isotope	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Annual Total
Alpha	-0.29±1.12E-04	5.90±9.73E-05	*NA*	1.23±1.49E-04	1.54±2.10E-04
Beta	2.82±0.20E-03	3.05±0.20E-03	*NA*	6.01±0.30E-03	1.19±0.04E-02
H-3	1.94±0.05E-01	1.46±0.04E-01	*NA*	1.14±0.03E-01	4.54±0.07E-01
C-14	1.41±0.49E-04	5.38±8.35E-05	*NA*	2.34±0.63E-04	4.29±1.16E-04
K-40	1.30±7.19E-04	0.26±6.68E-04	*NA*	2.09±8.11E-04	0.37±1.27E-03
Co-60	0.00±5.35E-05	0.00±5.06E-05	*NA*	0.00±7.06E-05	0.00±1.02E-04
Sr-90	5.69±0.40E-04	7.22±0.57E-04	*NA*	1.28±0.06E-03	2.57±0.09E-03
Tc-99	2.30±0.06E-03	2.88±0.11E-03	*NA*	7.32±0.14E-03	1.25±0.02E-02
I-129	3.23±1.19E-05	1.91±1.72E-05	*NA*	3.66±1.28E-05	8.80±2.45E-05
Cs-137	7.47±0.58E-04	4.08±0.46E-04	*NA*	2.00±0.51E-04	1.36±0.09E-03
U-232	4.85±0.55E-05	1.12±0.08E-04	*NA*	4.43±0.35E-04	6.04±0.36E-04
U-233/234	3.73±0.44E-05	7.01±0.54E-05	*NA*	1.35±0.11E-04	2.43±0.13E-04
U-235/236	1.87±1.03E-06	3.17±0.63E-06	*NA*	6.09±1.70E-06	1.11±0.21E-05
U-238	2.02±0.30E-05	4.25±0.39E-05	*NA*	6.65±0.66E-05	1.29±0.08E-04
Total U (g)	3.95±0.09E+01	1.18±0.03E+02	*NA*	1.41±0.04E+02	2.99±0.05E+02
Pu-238	2.33±1.48E-06	1.92±0.68E-06	*NA*	6.61±2.36E-06	1.09±0.29E-05
Pu-239/240	1.21±0.70E-06	1.37±0.48E-06	*NA*	3.64±1.52E-06	6.22±1.74E-06
Am-241	1.09±0.57E-06	5.24±5.40E-07	*NA*	1.54±1.99E-06	3.16±2.14E-06

NA- Not applicable. No lagoon 3 discharges in the 3rd quarter of 1997.

Table C - 1.2

Comparison of 1997 Lagoon 3 (WNSP001) Liquid Effluent Radioactivity Concentrations with Department of Energy Guidelines

Isotope	**Discharge Activity**[a] (Ci)	**Radioactivity** (Bequerels)	**Concentration** (µCi/mL)	**DCG** (µCi/mL)	**% of DCG**
Alpha	1.54±2.10E-04	5.69±7.77E+06	3.04±4.15E-09	*NA*[b]	*NA*
Beta	1.19±0.04E-02	4.40±0.15E+08	2.35±0.08E-07	*NA*[b]	*NA*
H-3	4.54±0.07E-01	1.68±0.02E+10	8.97±0.13E-06	2E-03	0.45
C-14	4.29±1.16E-04	1.59±0.43E+07	8.48±2.29E-09	7E-05	0.01
K-40	0.37±1.27E-03	1.35±4.71E+07	0.72±2.52E-08	*NA*[b]	*NA*
Co-60	0.00±1.02E-04	0.00±3.77E+06	0.00±2.02E-09	5E-06	<0.04
Sr-90	2.57±0.09E-03	9.51±0.33E+07	5.08±0.18E-08	1E-06	5.08
Tc-99	1.25±0.02E-02	4.62±0.07E+08	2.47±0.04E-07	1E-04	0.25
I-129	8.80±2.45E-05	3.26±0.91E+06	1.74±0.49E-09	5E-07	0.35
Cs-137	1.36±0.09E-03	5.01±0.33E+07	2.68±0.18E-08	3E-06	0.89
U-232[c]	6.04±0.36E-04	2.23±0.13E+07	1.19±0.07E-08	1E-07	11.9
U-233/234[c]	2.43±0.13E-04	8.99±0.49E+06	4.80±0.26E-09	5E-07	0.96
U-235/236[c]	1.11±0.21E-05	4.12±0.77E+05	2.20±0.41E-10	5E-07[d]	0.04
U-238[c]	1.29±0.08E-04	4.78±0.30E+06	2.55±0.16E-09	6E-07	0.43
Pu-238	1.09±0.29E-05	4.02±1.06E+05	2.48±0.65E-10	4E-08	0.62
Pu-239/240	6.22±1.74E-06	2.30±0.65E+05	1.23±0.35E-10	3E-08	0.41
Am-241	3.16±2.14E-06	1.17±0.79E+05	7.18±4.86E-11	3E-08	0.24
Total % of DCGs					**21.7**

[a] *Total volume released: 4.40E+10 mL.*
[b] *Derived concentration guides (DCGs) are not applicable (NA) to gross alpha, gross beta, or naturally occurring background potassium-40 activity.*
[c] *Total U (g) = 2.99±0.07E+02; average U (µg/mL) = 5.90±0.14E-03*
[d] *DCG for U-236 is used for this comparison*
Half-lives are listed in Table B-1.

Table C-1.3

1997 Radioactivity Concentrations (µCi/mL) and pH in Surface Water Facility Yard Drainage (WNSP005)

Month	Alpha	Beta	H-3	pH (standard units)
January	-0.42±2.66E-09	1.17±0.08E-07	1.31±0.79E-07	7.65
February	3.45±2.01E-09	7.27±0.61E-08	-2.75±7.98E-08	7.78
March	1.45±1.72E-09	1.96±0.08E-07	3.06±8.08E-08	7.70
April	1.94±3.34E-09	2.22±0.11E-07	8.84±8.32E-08	7.80
May	-3.53±2.57E-09	1.59±0.09E-07	5.30±8.16E-08	7.83
June	5.36±3.93E-09	7.31±0.70E-08	1.48±0.79E-07	6.88
July	-0.61±3.39E-09	8.83±0.75E-08	-6.49±7.99E-08	7.05
August	-0.97±3.78E-09	8.57±0.77E-08	-3.02±8.56E-08	7.31
September	2.90±2.95E-09	1.58±0.07E-07	-0.16±7.99E-08	7.06
October	3.45±9.71E-10	3.75±0.40E-08	0.28±8.20E-08	7.34
November	-0.02±2.45E-09	2.00±0.08E-07	-4.78±7.99E-08	7.64
December	1.36±1.03E-09	8.81±0.49E-08	2.29±8.10E-08	7.53

Table C - 1.4

1997 Radioactivity Concentrations (μCi/mL) in Surface Water Downstream of the WVDP at Frank's Creek (WNSP006)

Month	Alpha	Beta	H-3	Sr-90	Cs-137
January	6.13±9.08E-10	2.03±0.35E-08	1.12±0.78E-07	6.34±1.69E-09	0.00±1.44E-08
*February**	1.47±0.93E-09	3.80±0.38E-08	1.41±0.11E-06	1.42±0.25E-08	1.05±0.29E-08
*March**	0.30±1.29E-09	3.34±0.39E-08	4.14±0.89E-07	9.72±2.28E-09	0.00±1.55E-08
*April**	1.62±9.10E-10	1.95±0.33E-08	1.02±0.81E-07	7.61±2.66E-09	0.00±2.42E-08
May	0.74±1.23E-09	2.81±0.37E-08	7.77±1.04E-07	1.14±0.38E-08	0.00±1.99E-08
*June**	2.14±1.34E-09	4.80±0.44E-08	9.40±1.03E-07	1.20±0.34E-08	0.00±1.49E-08
July	0.61±1.49E-09	4.02±0.43E-08	-1.26±8.18E-08	1.79±0.35E-08	0.00±2.23E-08
August	1.16±1.79E-09	4.39±0.44E-08	9.14±7.68E-08	1.93±0.30E-08	0.00±1.89E-08
September	0.47±1.37E-09	3.85±0.39E-08	-0.28±8.12E-08	1.76±0.31E-08	0.00±1.38E-08
*October**	1.70±1.09E-09	4.36±0.40E-08	5.22±0.89E-07	1.52±0.27E-08	0.00±1.98E-08
November	2.67±8.66E-10	1.67±0.31E-08	6.33±8.19E-08	1.09±0.30E-08	0.00±1.16E-08
*December**	1.94±0.98E-09	3.68±0.40E-08	3.84±0.88E-07	1.23±0.30E-08	0.00±2.06E-08

Quarter	C-14	Tc-99	I-129	U-232	U-233/234
1st Quarter	1.97±4.44E-09	7.44±1.52E-09	6.56±5.88E-10	2.12±0.92E-10	2.05±0.66E-10
2nd Quarter	-1.24±1.27E-08	1.28±0.13E-08	7.29±8.38E-10	4.41±1.00E-10	3.73±0.82E-10
3rd Quarter	6.37±4.94E-09	0.60±1.90E-09	3.27±7.61E-10	8.14±6.20E-11	2.86±0.63E-10
4th Quarter	0.35±1.32E-08	1.48±0.23E-08	3.77±9.21E-10	5.04±1.08E-10	3.59±0.82E-10

	U-235/236	U-238	Total U (μg/mL)	Pu-238	Pu-239/240
1st Quarter	1.77±2.14E-11	1.66±0.62E-10	9.39±0.21E-04	1.39±4.45E-11	1.97±2.73E-11
2nd Quarter	3.34±2.45E-11	2.22±0.62E-10	7.62±0.36E-04	8.43±6.40E-11	4.80±4.05E-11
3rd Quarter	2.68±1.87E-11	2.06±0.53E-10	8.53±0.41E-04	-0.01±1.64E-10	3.85±7.74E-11
4th Quarter	2.44±2.56E-11	2.21±0.62E-10	6.84±0.15E-04	9.56±6.83E-11	2.65±4.33E-11

	Am-241
1st Quarter	0.86±4.02E-11
2nd Quarter	2.47±2.76E-11
3rd Quarter	1.19±0.46E-10
4th Quarter	4.61±6.26E-11

** Month of discharge from WNSP001. See Table C-1.27 for a summary of water quality data at WNSP006.*

Table C-1.5

1997 Radioactivity Concentrations (µCi/mL) in Surface Water Sewage Treatment Facility (WNSP007)

Month	Alpha	Beta	H-3	Cs-137
January	-0.97±2.70E-09	2.96±0.58E-08	4.78±7.25E-08	
February	1.92±3.00E-09	3.34±0.66E-08	3.14±7.42E-08	
March	-0.60±3.16E-09	4.43±0.67E-08	-2.02±8.00E-08	
1st Qtr				0.00±4.79E-09
April	0.94±3.32E-09	2.41±0.56E-08	5.09±8.27E-08	
May	-1.92±3.69E-09	2.24±0.57E-08	0.20±7.42E-08	
June	-0.41±3.18E-09	1.88±0.52E-08	0.77±7.96E-08	
2nd Qtr				0.00±2.14E-08
July	1.08±3.20E-09	1.68±0.55E-08	-2.76±8.42E-08	
August	0.34±3.84E-09	1.61±0.62E-08	-2.21±8.15E-08	
September	2.31±3.48E-09	2.07±0.56E-08	1.24±8.01E-08	
3rd Qtr				0.00±2.05E-08
October	0.25±2.14E-09	3.28±0.58E-08	-3.06±8.07E-08	
November	1.29±3.12E-09	2.23±0.60E-08	2.50±7.48E-08	
December	2.31±2.67E-09	2.73±0.67E-08	4.22±7.54E-08	
4th Qtr				0.00±4.38E-09

Table C - 1.6

1997 Radioactivity Concentrations (µCi/mL) in Surface Water French Drain (WNSP008)

Month	Alpha	Beta	H-3
January	-0.96±1.65E-09	3.60±0.42E-08	1.51±0.11E-06
February	1.21±1.42E-09	3.55±0.41E-08	2.10±0.12E-06
March	1.18±1.39E-09	2.63±0.36E-08	1.21±0.10E-06
April	0.40±1.69E-09	3.32±0.41E-08	2.16±0.13E-06
May	-1.59±1.46E-09	3.02±0.27E-08	2.20±0.13E-06
June	1.26±1.92E-09	2.86±0.38E-08	2.24±0.12E-06
July	1.11±2.21E-09	2.30±0.37E-08	1.57±0.11E-06
August	1.68±2.26E-09	2.81±0.40E-08	2.63±0.13E-06
September	1.12±1.29E-09	2.36±0.27E-08	2.56±0.13E-06
October	2.80±2.16E-09	2.29±0.36E-08	1.88±0.12E-06
November	0.70±1.68E-09	1.92±0.35E-08	2.18±0.13E-06
December	1.41±1.67E-09	2.70±0.47E-08	1.52±0.11E-06

Table C - 1.7
1997 Radioactivity Concentrations (µCi/mL) in Surface Water at the Northeast Swamp (WNSWAMP)

Month	Alpha	Beta	H-3	Sr-90	Cs-137
January	0.78±1.12E-09	1.49±0.02E-06	1.90±0.78E-07	6.82±0.20E-07	0.00±4.61E-09
February	0.46±1.15E-09	2.08±0.02E-06	2.01±0.81E-07	9.75±0.27E-07	0.00±6.88E-09
March	0.11±1.17E-09	1.53±0.02E-06	1.62±0.81E-07	7.34±0.23E-07	0.00±6.75E-09
April	0.64±1.40E-09	1.93±0.02E-06	1.43±0.83E-07	9.53±0.19E-07	0.00±4.51E-09
May	-0.17±1.38E-09	1.98±0.02E-06	1.78±0.81E-07	9.36±0.23E-07	0.00±4.61E-09
June	0.78±1.47E-09	2.18±0.03E-06	1.73±0.82E-07	1.03±0.03E-06	0.00±6.67E-09
July	0.64±1.72E-09	3.22±0.03E-06	2.18±0.83E-07	1.60±0.02E-06	0.00±7.03E-09
August	2.35±1.76E-09	3.16±0.03E-06	1.79±0.83E-07	1.55±0.02E-06	0.00±4.24E-09
September	0.25±1.43E-09	2.63±0.03E-06	1.57±0.82E-07	1.33±0.02E-06	0.00±4.54E-09
October	0.73±1.27E-09	2.27±0.03E-06	1.59±0.81E-07	1.08±0.03E-06	0.00±6.80E-09
November	1.08±1.23E-09	2.02±0.02E-06	2.23±0.82E-07	9.61±0.15E-07	0.00±2.12E-08
December	0.88±1.10E-09	2.02±0.02E-06	7.15±8.28E-08	9.76±0.22E-07	0.00±6.53E-09

Quarter	C-14	I-129	U-232	U-233/234	U-235/236
1st Quarter	-0.89±1.20E-08	0.00±1.08E-09	-1.98±6.09E-11	1.56±0.60E-10	0.64±1.76E-11
2nd Quarter	-1.10±5.58E-09	-0.07±1.23E-09	-0.62±8.69E-11	1.11±0.64E-10	1.97±3.47E-11
3rd Quarter	-0.16±6.71E-09	3.91±5.03E-10	0.70±3.72E-11	1.89±0.54E-10	0.63±1.27E-11
4th Quarter	0.27±5.48E-08	0.81±1.17E-09	1.41±0.80E-10	2.13±0.98E-10	1.00±4.08E-11

	U-238	Total U (µg/mL)	Pu-238	Pu-239/240	Am-241
1st Quarter	7.72±4.02E-11	6.96±0.10E-04	4.30±4.98E-11	1.66±2.45E-11	3.64±5.45E-11
2nd Quarter	1.15±0.63E-10	3.94±0.30E-04	6.16±4.20E-11	-0.82±2.52E-11	1.67±2.68E-11
3rd Quarter	1.17±0.42E-10	3.40±0.26E-04	1.07±0.64E-10	0.31±1.41E-11	6.05±4.00E-11
4th Quarter	1.02±0.67E-10	3.64±0.12E-04	6.36±1.69E-10	1.73±3.36E-11	9.28±8.33E-11

See Table C-1.27 for a summary of water quality data at WNSWAMP.

Table C - 1.8
1997 Radioactivity Concentrations (µCi/mL) in Surface Water
North Swamp (WNSW74A)

Month	Alpha	Beta	H-3	Sr-90	Cs-137
January	-0.32±1.13E-09	1.19±0.24E-08	4.78±7.31E-08	4.10±1.50E-09	0.00±1.48E-08
February	0.80±1.71E-09	1.26±0.27E-08	1.49±7.80E-08	6.79±1.94E-09	0.00±1.66E-08
March	-0.09±1.42E-09	1.39±0.25E-08	-0.56±7.98E-08	4.36±1.71E-09	0.00±1.60E-08
April	0.39±1.19E-09	1.17±0.25E-08	4.23±7.97E-08	3.25±1.52E-09	0.00±1.19E-08
May	-0.64±1.26E-09	9.04±2.33E-09	2.19±7.60E-08	4.57±3.29E-09	0.00±1.46E-08
June	0.54±1.32E-09	9.94±2.32E-09	9.02±7.96E-08	5.60±2.38E-09	0.00±1.47E-08
July	0.54±1.13E-09	6.98±2.14E-09	-5.86±7.45E-08	2.59±2.46E-09	0.00±1.15E-08
August	0.71±1.21E-09	8.24±2.31E-09	-2.67±7.85E-08	3.48±1.96E-09	0.00±1.38E-08
September	0.59±1.13E-09	8.69±2.30E-09	-8.62±6.85E-08	5.91±2.23E-09	0.00±1.84E-08
October	8.28±9.94E-10	9.95±2.29E-09	-3.51±8.08E-08	6.20±3.04E-09	0.00±1.00E-08
November	0.28±9.84E-10	8.29±2.31E-09	-0.77±7.53E-08	5.95±2.59E-09	0.00±1.77E-08
December	1.90±1.45E-09	6.81±2.65E-09	1.06±8.06E-08	3.61±2.30E-09	0.00±1.08E-08

Quarter	C-14	I-129	U-232	U-233/234	U-235/236
1st Quarter	-1.83±4.33E-09	1.90±5.72E-10	3.89±7.53E-11	1.21±0.58E-10	-0.82±2.12E-11
2nd Quarter	-0.83±1.27E-08	2.19±8.02E-10	0.06±4.47E-11	7.33±3.68E-11	0.81±1.15E-11
3rd Quarter	0.67±4.73E-09	1.69±2.43E-10	1.13±2.56E-11	6.38±3.01E-11	0.00±9.85E-12
4th Quarter	-0.19±1.30E-08	0.14±1.17E-09	2.52±3.46E-11	1.24±0.50E-10	1.40±0.48E-10

	U-238	Total U (µg/mL)	Pu-238	Pu-239/240	Am-241
1st Quarter	4.09±4.08E-11	2.32±0.03E-03	-0.15±2.96E-11	1.01±1.54E-11	-2.08±4.73E-11
2nd Quarter	5.73±3.46E-11	4.86±0.24E-04	-4.37±3.94E-11	-2.81±2.32E-11	1.35±4.37E-11
3rd Quarter	4.67±2.39E-11	1.64±0.10E-04	1.49±3.44E-11	2.23±1.94E-11	1.66±3.46E-11
4th Quarter	9.02±3.93E-11	1.77±0.05E-04	1.45±0.64E-10	1.15±3.83E-11	5.04±4.63E-11

See Table C-1.27 for a summary of water quality parameters at WNSW74A.

Table C - 1.9
1997 Radioactivity Concentrations (µCi/mL) and pH in Surface Water
Frank's Creek East of the SDA (WNFRC67)

Month	Alpha	Beta	H-3	pH (standard units)
January	-3.20±6.45E-10	-0.39±1.87E-09	-9.94±7.99E-08	7.86
February	5.60±5.52E-10	2.78±1.86E-09	-5.57±5.63E-08	7.64
March	-1.72±6.67E-10	3.99±1.86E-09	-2.57±8.03E-08	8.17
April	2.99±5.99E-10	2.07±1.88E-09	-1.04±0.80E-07	7.90
May	-1.91±7.71E-10	1.45±1.76E-09	0.33±8.14E-08	7.70
June	0.45±7.59E-10	2.66±1.87E-09	8.94±7.84E-08	6.78
July	4.23±7.32E-10	1.27±2.00E-09	-1.16±0.81E-07	6.47
August	0.05±1.06E-09	4.13±2.74E-09	5.16±7.96E-08	7.46
September	0.04±1.07E-09	2.78±2.39E-09	-2.48±8.01E-08	6.78
October	-1.72±7.86E-10	1.48±2.40E-09	7.63±8.20E-08	7.32
November	1.88±7.36E-10	1.47±2.51E-09	-0.28±8.00E-08	7.18
December	6.80±8.05E-10	2.38±2.72E-09	1.79±8.08E-08	7.96

Table C - 1.10
1997 Radioactivity Concentrations (µCi/mL) and pH in Surface Water Erdman Brook (WNERB53)

Month	Alpha	Beta	H-3	pH (standard units)
January	1.46±1.86E-09	1.40±0.33E-08	1.12±0.78E-07	7.47
February	3.58±8.58E-10	1.23±0.28E-08	5.12±7.92E-08	7.29
March	-0.22±1.01E-09	1.46±0.28E-08	3.86±8.01E-08	8.20
April	0.09±1.01E-09	1.21±0.29E-08	7.89±8.05E-08	7.41
May	-0.59±1.14E-09	1.20±0.30E-08	6.86±8.03E-08	7.68
June	0.42±1.23E-09	1.56±0.31E-08	1.07±0.80E-07	7.06
July	0.56±1.61E-09	1.46±0.33E-08	-1.94±8.03E-08	7.09
August	1.02±1.48E-09	1.42±0.30E-08	3.06±7.97E-08	7.50
September	0.55±1.38E-09	1.63±0.33E-08	-1.55±8.05E-08	7.35
October	0.78±1.05E-09	1.50±0.31E-08	3.50±7.71E-08	7.04
November	0.09±1.14E-09	1.66±0.33E-08	3.20±8.15E-08	7.69
December	1.09±0.93E-09	1.62±0.31E-08	1.24±0.81E-07	7.82

Table C - 1.11

1997 Radioactivity Concentrations (µCi/mL) and pH in Surface Water Cooling Tower Basin (WNCOOLW)

Month	Alpha	Beta	H-3	Cs-137	pH (standard units)
January	-1.20±1.56E-09	1.91±0.36E-08	4.75±8.09E-08		8.44
February	2.57±1.62E-09	2.18±0.35E-08	0.00±7.82E-08		8.72
March	0.55±1.33E-09	1.64±0.43E-08	1.12±7.89E-08		8.58
1st Qtr				0.00±1.44E-08	
April	0.74±1.27E-09	1.44±0.32E-08	6.38±7.84E-08		8.42
May	-1.80±1.92E-09	1.85±0.34E-08	-9.60±5.66E-08		8.39
June	0.35±1.44E-09	1.63±0.32E-08	6.81±7.78E-08		7.21
2nd Qtr				0.00±1.98E-08	
July	2.00±2.29E-09	1.76±0.37E-08	-5.03±5.64E-08		8.44
August	0.59±1.69E-09	2.23±0.27E-08	4.46±7.89E-08		7.86
September	1.17±2.72E-09	1.82±0.38E-08	-0.22±7.95E-08		8.58
3rd Qtr				0.00±1.73E-08	
October	-0.32±2.41E-09	2.70±0.39E-08	4.11±8.20E-08		8.16
November	1.10±1.90E-09	2.38±0.38E-08	6.16±8.08E-08		8.92
December	5.60±8.06E-10	1.16±0.32E-08	2.98±8.14E-08		8.22
4th Qtr				0.00±1.60E-08	

Table C - 1.12

1997 Radioactivity Concentrations (µCi/mL) and pH in Surface Water SDA Drainage (WNSDADR)

Month	Alpha	Beta	H-3	Cs-137	pH (standard units)
January	3.20±2.32E-10	2.25±0.88E-09	9.26±7.79E-08	0.00±1.55E-08	6.80
February	5.04±2.63E-10	3.50±0.92E-09	9.72±8.18E-08	0.00±1.21E-08	6.53
March	-0.63±2.43E-10	1.81±0.75E-09	2.69±0.81E-07	0.00±1.50E-08	8.99
April	-2.23±5.20E-10	0.91±1.28E-09	3.71±0.85E-07	0.00±9.93E-09	6.31
May	-0.44±4.24E-10	0.56±1.22E-09	6.01±8.16E-08	0.00±1.48E-08	6.59
June	9.48±6.36E-10	3.53±1.31E-09	1.32±0.82E-07	0.00±1.69E-08	6.21
July	5.46±2.72E-10	4.63±0.94E-09	0.57±8.06E-08	0.00±1.64E-08	5.88
August	7.24±3.18E-10	2.61±0.82E-09	2.32±0.57E-07	0.00±2.26E-08	7.90
September	4.86±2.66E-10	7.02±1.06E-09	2.74±0.83E-07	0.00±1.23E-08	6.03
October	1.23±0.32E-09	8.72±1.08E-09	1.68±0.82E-07	0.00±1.34E-08	6.86
November	2.56±2.28E-10	2.50±0.81E-09	2.39±0.83E-07	0.00±1.81E-08	7.37
December	3.74±2.15E-10	9.59±1.19E-09	-5.29±8.00E-08	0.00±1.39E-08	6.65

Table C - 1.13

1997 Radioactivity Concentrations (µCi/mL) and pH in Surface Water Waste Tank Farm Underdrain (WN8D1DR)

Month	Alpha	Beta	H-3	Sr-90	Cs-137	pH (standard units)
January	2.88±3.97E-09	1.86±0.53E-08	4.86±7.36E-08	6.57±1.92E-09	0.00±1.54E-08	7.57
February	7.19±5.30E-09	2.56±0.65E-08	0.31±8.23E-08	8.07±2.14E-09	0.00±2.03E-08	7.29
March	0.32±2.90E-09	1.09±0.52E-08	-5.14±7.59E-08	4.75±1.88E-09	0.00±2.09E-08	7.98
April	1.20±3.76E-09	5.03±0.55E-08	5.87±0.82E-07	2.30±0.37E-08	0.00±1.93E-08	7.54
May	-2.81±4.14E-09	1.47±0.58E-08	-0.52±8.02E-08	1.72±3.04E-09	0.00±1.72E-08	7.29
June	0.99±2.66E-09	9.38±4.86E-09	3.13±7.91E-08	6.55±3.01E-09	0.00±1.73E-08	7.08
July	0.11±2.53E-09	8.77±5.09E-09	-9.37±7.90E-08	6.06±2.11E-09	0.00±1.79E-08	7.23
August	0.37±2.61E-09	1.11±0.55E-08	-2.17±7.42E-08	4.00±1.82E-09	0.00±1.72E-08	7.29
September	1.12±3.42E-09	1.08±0.60E-08	-5.47±7.96E-08	4.52±2.50E-09	0.00±1.95E-08	7.14
October	0.53±2.56E-09	1.62±0.49E-08	7.24±8.11E-08	3.41±2.77E-09	0.00±1.56E-08	6.75
November	1.66±2.78E-09	1.42±0.55E-08	-0.93±8.10E-08	8.29±2.76E-09	0.00±1.88E-08	7.73
December	3.85±3.53E-09	1.28±0.57E-08	-2.58±8.14E-08	2.30±2.21E-09	0.00±1.91E-08	7.39

Table C - 1.14

1997 Radioactivity Concentrations (µCi/mL) in Surface Water Drum Cell Drainage (WNDCELD)

Month	Alpha	Beta	H-3	Sr-90	I-129	Cs-137
January	6.86±3.28E-10	1.23±0.84E-09				
February	2.83±4.32E-10	0.15±1.25E-09				
March	3.45±5.22E-10	2.64±1.31E-09				
1st Qtr			-5.53±8.01E-08	0.76±1.33E-09	-2.04±8.55E-10	0.00±1.22E-08
April	-2.05±4.78E-10	0.56±1.25E-09				
May	1.31±0.79E-09	0.76±1.26E-09				
June	0.92±6.05E-10	4.66±1.39E-09				
2nd Qtr			0.28±8.11E-08	0.59±1.22E-09	7.05±8.87E-10	0.00±2.60E-08
July	-0.24±7.20E-10	2.41±1.37E-09				
August	1.28±0.91E-09	3.19±1.34E-09				
September	7.62±5.92E-10	2.31±1.30E-09				
3rd Qtr			-8.95±7.67E-08	0.97±1.03E-09	2.91±7.52E-10	0.00±1.59E-08
October	4.35±4.40E-10	1.49±1.29E-09				
November	5.96±4.27E-10	2.92±1.29E-09				
December	5.12±4.32E-10	4.04±1.52E-09				
4th Qtr			3.41±8.15E-08	3.09±1.34E-09	0.37±1.00E-09	0.00±1.38E-08

Table C - 1.15

1997 Radioactivity Concentrations (µCi/mL), pH, and Conductivity Environmental Laboratory Potable Water Sampling Location (WNDNKEL)

Month	Alpha	Beta	H-3	pH (standard units)	Conductivity (µmhos/cm@25°C)
January	-1.85±2.64E-10	1.67±0.61E-09	-1.22±0.78E-07	7.86	187
February	5.31±3.65E-10	1.61±0.80E-09	-1.01±0.75E-07	8.35	203
March	0.82±2.62E-10	1.43±0.75E-09	-8.30±7.83E-08	8.36	166
April	1.28±3.10E-10	5.71±7.53E-10	-6.54±8.05E-08	8.27	159
May	-3.05±4.38E-10	1.11±0.76E-09	3.02±8.11E-08	8.65	188
June	-0.29±2.48E-10	1.42±0.55E-09	-0.65±7.52E-08	6.97	186
July	1.34±5.13E-10	1.82±0.86E-09	-2.99±7.96E-08	7.35	211
August	3.71±4.99E-10	1.97±0.89E-09	-2.34±7.71E-08	7.41	232
September	1.20±7.46E-10	2.04±0.94E-09	1.14±7.89E-08	8.20	242
October	2.18±2.84E-10	1.76±0.58E-09	0.38±5.65E-08	8.04	205
November	1.08±4.21E-10	0.23±7.68E-10	2.69±0.81E-07	7.82	210
December	4.25±3.28E-10	1.96±0.76E-09	-6.42±7.90E-08	7.78	182

Table C - 1.16

1997 Radioactivity Concentrations (µCi/mL), pH, and Conductivity Maintenance Shop Potable Water (WNDNKMS)

Month	Alpha	Beta	H-3	pH (standard units)	Conductivity (µmhos/cm@25°C)
January	-0.29±3.80E-10	2.98±7.94E-10	-1.20±0.78E-07	7.14	189
February	2.11±3.08E-10	1.38±0.78E-09	-1.26±0.76E-07	8.29	195
March	1.68±2.84E-10	1.32±0.75E-09	-1.38±5.51E-08	8.45	160
April	1.50±3.01E-10	0.23±7.18E-10	-7.02±5.70E-08	8.19	184
May	-5.30±4.13E-10	7.63±7.37E-10	-9.65±7.91E-08	8.61	196
June	-1.05±3.08E-10	9.20±7.51E-10	7.53±5.50E-08	7.10	170
July	-0.38±3.73E-10	2.41±0.94E-09	-2.09±7.98E-08	7.78	195
August	5.27±5.07E-10	1.73±0.87E-09	-3.74±7.77E-08	7.29	225
September	2.31±4.62E-10	1.78±0.87E-09	1.78±7.90E-08	7.21	250
October	-0.50±3.82E-10	1.24±0.79E-09	-0.22±8.00E-08	8.28	210
November	2.49±4.31E-10	1.65±0.86E-09	-9.44±7.93E-08	7.74	213
December	1.97±2.91E-10	5.18±0.71E-09	-8.03±7.99E-08	7.80	170

Table C - 1.17

1997 Radioactivity Concentrations (µCi/mL), pH, and Conductivity Main Plant Potable Water (WNDNKMP)

Month	Alpha	Beta	H-3	pH (standard units)	Conductivity (µmhos/cm@25°C)
January	-2.12±3.63E-10	1.84±7.90E-10	-5.70±7.91E-08	7.70	191
February	1.84±2.19E-10	1.31±0.55E-09	-1.22±0.76E-07	8.20	198
March	2.23±2.92E-10	1.27±0.75E-09	-1.07±0.78E-07	8.32	163
April	0.98±3.01E-10	4.11±7.43E-10	1.35±8.10E-08	8.18	162
May	-3.94±4.21E-10	1.43±0.77E-09	-3.72±7.98E-08	8.58	199
June	2.85±3.86E-10	1.11±0.77E-09	6.13±7.69E-08	6.95	183
July	2.33±4.65E-10	1.47±0.91E-09	1.92±8.05E-08	7.57	215
August	2.92±5.01E-10	1.48±0.86E-09	-2.70±5.45E-08	7.69	252
September	3.17±4.82E-10	7.53±8.12E-10	-2.86±5.56E-08	8.37	240
October	2.36±4.10E-10	1.33±0.80E-09	-3.22±7.93E-08	7.52	197
November	3.85±4.08E-10	1.45±0.84E-09	1.44±8.02E-08	7.84	211
December	0.30±2.61E-10	7.31±0.78E-09	8.14±8.09E-08	7.43	169

Table C - 1.18

1997 Radioactivity Concentrations (µCi/mL) and Water Quality Parameters Utility Room Potable Water (WNDNKUR)

Month	Alpha	Beta	H-3	pH (standard units)	Conductivity (µmhos/cm@25°C)
January	-1.22±3.77E-10	-0.23±7.78E-10	-1.64±5.50E-08	7.44	193
February	3.63±3.32E-10	1.01±0.76E-09	-7.96±7.60E-08	8.48	216
March	0.30±2.60E-10	1.16±0.74E-09	-1.29±0.78E-07	8.72	162
April	1.78±3.05E-10	6.60±7.56E-10	-0.81±8.04E-08	8.73	160
May	-2.41±4.44E-10	1.52±0.78E-09	-6.18±7.94E-08	7.61	190
June	0.21±3.43E-10	1.38±0.78E-09	6.92±7.73E-08	6.82	179
July	2.01±4.78E-10	1.38±0.90E-09	-2.55±8.00E-08	8.33	211
August	3.39±5.11E-10	1.25±0.84E-09	-6.80±7.64E-08	7.23	247
September	4.27±5.29E-10	1.06±0.83E-09	-1.46±7.88E-08	7.12	238
October	8.01±4.59E-10	1.46±0.80E-09	4.56±8.04E-08	7.22	199
November	-1.69±3.36E-10	1.41±0.84E-09	-8.19±7.87E-08	7.76	211
December	1.72±2.91E-10	5.80±0.73E-09	8.14±8.10E-08	7.60	173

Date	Nitrate-N (mg/L)	Arsenic Total (µg/L)	Cadmium Total (µg/L)	Chromium Total (µg/L)	Mercury Total (µg/L)
12/10	0.56	<25.0	<2.0	<10.0	<0.40

	Selenium Total (µg/L)	Barium Total (µg/L)	Fluoride (mg/L)
12/10	<2.0	<200	<0.2

Table C - 1.19

1997 Radioactivity Concentrations (µCi/mL) and Water Quality Parameters Storage and Disposal Area Drainage (WNNDADR)

Month	Alpha	Beta	H-3	Sr-90**	I-129**	Cs-137
January	2.11±1.18E-09	1.45±0.06E-07	1.16±0.10E-06			0.00±1.53E-08
February	1.16±1.33E-09	1.47±0.06E-07	1.65±0.11E-06			1.78±1.48E-08
March	1.23±0.77E-09	1.18±0.04E-07	8.41±0.92E-07			0.00±1.65E-08
1st Qtr				6.24±0.47E-08	4.57±7.20E-10	
April	-1.26±1.78E-09	1.18±0.06E-07	1.55±0.11E-06			0.00±1.45E-08
May	1.10±1.55E-09	1.68±0.06E-07	2.08±0.12E-06			0.00±1.73E-08
June	1.28±1.58E-09	1.62±0.06E-07	2.29±0.13E-06			0.00±1.89E-08
2nd Qtr				6.40±0.61E-08	4.41±7.16E-10	
July	0.34±1.62E-09	1.64±0.06E-07	3.75±0.17E-06			0.00±1.33E-08
August	1.05±1.31E-09	1.43±0.06E-07	3.25±0.15E-06			0.00±1.48E-08
September	1.02±1.39E-09	1.58±0.06E-07	2.47±0.13E-06			0.00±1.47E-08
3rd Qtr				5.29±0.34E-08	5.97±6.91E-10	
October	7.39±7.75E-10	1.62±0.04E-07	2.39±0.13E-06			0.00±2.08E-08
November	1.54±1.10E-09	1.38±0.06E-07	9.77±0.96E-07			0.00±1.02E-08
December	1.04±0.87E-09	1.23±0.06E-07	7.03±0.90E-07			0.00±1.60E-08
4th Qtr				3.17±1.36E-09	0.62±9.48E-10	

	NPOC (mg/L)	**TOX** (µg/L)	**pH*** (standard units)
January	6.28	9.6	7.4
February	5.28	11.0	7.5
March	4.90	10.5	8.1
April	9.26	8.6	7.3
May	6.98	10.6	7.5
June	6.85	11.2	6.8
July	7.68	15.0	7.4
August	7.68	17.2	7.4
September	9.15	17.4	7.4
October	9.58	14.9	6.7
November	7.88	13.0	7.5
December	5.46	11.8	7.8

** pH is monthly average of weekly measurements.*
*** Monthly samples are composited and analyzed quarterly.*

Table C - 1.20
1997 Radioactivity Concentrations (µCi/mL), NPOC, and TOX in Groundwater at the NDA Interceptor Trench (WNNDATR)

Month	Alpha	Beta	H-3	I-129	Cs-137
January	0.75±1.06E-09	6.46±0.42E-08	1.46±0.10E-06		0.00±1.37E-08
February	2.17±1.40E-09	7.73±0.46E-08	8.82±0.31E-06		0.00±2.61E-08
March	1.28±1.28E-09	6.86±0.43E-08	6.76±0.25E-06		0.00±1.65E-08
1st Qtr				-0.71±5.62E-10	
April	1.66±1.37E-09	1.13±0.04E-07	1.52±0.05E-05		0.00±1.34E-08
May	2.38±2.06E-09	9.34±0.51E-08	1.89±0.06E-05		0.00±1.49E-08
June	2.39±0.88E-09	6.84±0.30E-08	3.04±0.15E-06		0.00±1.40E-08
2nd Qtr				0.69±1.11E-09	
July	1.89±1.89E-09	7.87±0.48E-08	5.90±0.23E-06		0.00±1.95E-08
August	3.23±2.24E-09	6.94±0.46E-08	1.75±0.06E-05		0.00±1.02E-08
September	2.24±1.40E-09	7.72±0.35E-08	1.14±0.04E-05		0.00±1.56E-08
3rd Qtr				5.46±5.25E-10	
October	2.36±1.49E-09	7.38±0.47E-08	3.04±0.15E-06		0.00±1.91E-08
November	1.40±0.70E-09	4.84±0.31E-08	2.91±0.15E-06		0.00±1.07E-08
December	0.75±1.11E-09	9.44±0.57E-08	4.02±0.18E-06		0.00±2.04E-08
4th Qtr				1.33±1.13E-09	

	NPOC (mg/L)	**TOX** (µg/L)
January	7.00	10.6
February	5.60	10.9
March	4.50	7.6
April	4.50	12.7
May	4.00	9.1
June	*NR*	8.6
July	5.05	12.3
August	4.20	19.6
September	5.20	10.3
October	7.20	22.8
November	6.00	20.2
December	5.50	12.4

NR - Not reported. These results have not been reported because the data validation process indicated the data were not reliable.

Table C - 1.21

1997 Radioactivity Concentrations (µCi/mL) and Water Quality Parameters in Surface Water at the Standing Water (WNSTAW-series) Sampling Locations

Location	Date	Alpha	Beta	H-3	pH (standard units)	Conductivity (µmhos/cm@25°C)
WNSTAW4	10/23	4.90±4.43E-10	4.77±1.69E-09	2.22±0.72E-07	6.40	114
WNSTAW5	10/23	3.39±4.60E-10	2.95±1.83E-09	1.94±0.82E-07	6.35	64
WNSTAW6	10/24	4.47±6.06E-10	3.33±1.88E-09	1.68±0.81E-07	6.72	310
WNSTAW9	10/28	1.34±5.52E-10	2.66±1.84E-09	2.25±0.82E-07	6.39	231
WNSTAWB*	10/28	1.10±0.85E-09	3.28±1.91E-09	2.23±0.82E-07	6.96	361

	Date	Chloride (mg/L)	Iron Total (µg/L)	Manganese Total (µg/L)	Sodium Total (µg/L)	Nitrate+ Nitrite (mg/L)	Sulfate (mg/L)
WNSTAW4	10/23	6.8	509	76.5	5,190	<0.05	7.9
WNSTAW5	10/23	1.2	888	173.0	1,410	<0.05	7.0
WNSTAW6	10/24	1.9	112	18.8	1,330	<0.05	10.8
WNSTAW9	10/28	4.8	680	226.0	4,790	0.11	15.6
WNSTAWB*	10/28	17.2	217	93.5	13,400	0.05	18.8

* *Background location.*

Table C - 1.22

*1997 Radioactivity Concentrations (µCi/mL) in Surface Water Upstream of the WVDP in Buttermilk Creek at Fox Valley (WFBCBKG)**

Month	Alpha	Beta	H-3
January	5.10±4.48E-10	1.40±1.13E-09	2.51±7.82E-08
February	2.21±5.26E-10	0.72±1.31E-09	1.68±0.79E-07
March	8.07±5.42E-10	1.72±1.25E-09	2.05±8.11E-08
April	7.20±6.26E-10	0.57±1.26E-09	-1.14±0.79E-07
May	1.64±0.82E-09	1.53±1.30E-09	-5.02±8.04E-08
June	1.08±0.75E-09	2.16±1.25E-09	4.89±8.18E-08
July	4.73±7.31E-10	2.20±1.35E-09	-1.09±0.80E-07
August	3.48±6.95E-10	2.10±1.30E-09	7.15±7.88E-08
September	8.55±7.39E-10	2.32±1.33E-09	-9.02±7.92E-08
October	2.34±4.68E-10	1.17±1.28E-09	8.39±8.18E-08
November	8.31±5.45E-10	1.62±1.23E-09	3.29±8.21E-08
December	6.44±3.42E-10	4.71±9.56E-10	0.11±8.07E-08

Quarter	C-14	Sr-90	Tc-99	I-129	Cs-137
1st Quarter	2.59±4.46E-09	0.59±1.04E-09	-0.97±1.03E-09	-0.44±1.02E-09	0.00±4.47E-09
2nd Quarter	-0.36±1.31E-08	0.96±1.19E-09	-1.19±1.12E-09	0.19±1.22E-09	0.00±4.18E-09
3rd Quarter	6.35±5.11E-09	6.04±8.67E-10	1.08±1.92E-09	3.50±5.08E-10	0.00±7.23E-09
4th Quarter	-0.45±1.27E-08	2.77±1.30E-09	-1.06±1.60E-09	-1.80±8.97E-10	0.00±4.26E-09

	U-232	U-233/234	U-235/236	U-238	Total U (µg/mL)
1st Quarter	2.94±3.09E-11	2.40±0.41E-10	2.90±1.26E-11	1.79±0.39E-10	5.62±0.05E-04
2nd Quarter	-0.18±3.13E-11	4.96±3.92E-11	-0.67±1.40E-11	5.58±3.38E-11	3.42±0.17E-04
3rd Quarter	6.51±5.35E-11	1.12±0.38E-10	1.31±1.74E-11	7.59±3.01E-11	1.18±0.06E-03
4th Quarter	2.02±3.87E-11	6.80±4.04E-11	1.28±1.48E-11	4.68±2.85E-11	6.84±0.22E-05

	Pu-238	Pu-239/240	Am-241
1st Quarter	0.57±3.80E-11	0.09±2.53E-11	3.09±5.88E-11
2nd Quarter	0.52±4.70E-11	-1.27±2.51E-11	1.94±3.80E-11
3rd Quarter	3.00±0.83E-10	8.57±3.63E-11	2.46±3.27E-11
4th Quarter	1.02±0.55E-10	4.44±3.02E-11	3.28±4.51E-11

* *Background location. See Table C-1.27 for a summary of water quality parameters at WFBCBKG.*

Table C - 1.23
1997 pH and Radioactivity Concentrations (µCi/mL) in Surface Water Downstream of the WVDP in Buttermilk Creek at Thomas Corners (WFBCTCB)

Month	pH (standard units)	Alpha	Beta	H-3	Sr-90	Cs-137
January	6.72	8.96±5.37E-10	4.78±1.39E-09	-0.27±7.81E-08		
*February**	7.27	1.99±0.89E-09	5.31±1.57E-09	1.67±0.79E-07		
*March**	8.41	1.80±0.79E-09	3.52±1.37E-09	-2.40±8.13E-08		
1st Qtr					4.38±1.72E-09	0.00±6.90E-09
*April**	6.65	-0.55±6.07E-10	3.78±1.44E-09	-5.04±8.04E-08		
May	7.00	2.07±1.03E-09	4.77±1.50E-09	2.67±8.03E-08		
*June**	6.74	1.31±0.65E-09	6.45±1.06E-09	9.52±8.17E-08		
2nd Qtr					3.03±1.40E-09	0.00±6.52E-09
July	7.04	6.64±8.48E-10	6.38±1.58E-09	-0.29±8.08E-08		
August	7.13	1.37±0.90E-09	5.85±1.51E-09	1.34±0.79E-07		
September	7.20	9.06±7.84E-10	8.05±1.63E-09	-1.42±8.02E-08		
3rd Qtr					3.29±1.14E-09	0.00±4.26E-09
*October**	6.40	4.44±5.32E-10	6.84±1.58E-09	8.04±8.16E-08		
November	7.12	8.22±5.63E-10	5.06±1.42E-09	-3.85±8.12E-08		
*December**	7.27	1.37±0.59E-09	6.50±1.53E-09	-6.21±8.02E-08		
4th Qtr					3.40±1.38E-09	0.00±4.29E-09

Table C - 1.24
1997 pH and Radioactivity Concentrations (µCi/mL) in Surface Water Downstream of the WVDP in Cattaraugus Creek at Felton Bridge (WFFELBR)

Month	pH (standard units)	Alpha	Beta	H-3	Sr-90	Cs-137
January	6.94	1.96±0.80E-09	4.40±1.40E-09	9.19±8.21E-08	1.03±1.38E-09	0.00±6.60E-09
*February**	6.84	1.80±0.96E-09	1.71±1.40E-09	-2.66±8.70E-08	3.74±1.69E-09	0.00±4.61E-09
*March**	8.19	2.53±1.03E-09	3.90±1.42E-09	5.61±8.94E-08	1.66±1.10E-09	0.00±4.53E-09
*April**	7.14	1.17±0.65E-09	1.79±0.97E-09	-7.38±8.85E-08	0.63±2.32E-09	0.00±6.88E-09
May	7.24	1.28±0.97E-09	4.64±1.49E-09	-8.41±8.63E-08	2.55±2.54E-09	0.00±4.53E-09
*June**	6.99	1.29±0.97E-09	3.16±1.56E-09	-6.56±8.28E-08	0.56±1.80E-09	0.00±6.60E-09
July	7.27	7.22±7.74E-10	3.41±1.04E-09	-1.16±0.83E-07	2.12±1.43E-09	0.00±4.49E-09
August	7.36	8.94±7.74E-10	3.53±0.98E-09	-1.24±0.81E-07	7.90±8.94E-10	0.00±4.18E-09
September	7.16	1.77±0.97E-09	3.42±1.41E-09	-1.11±0.81E-07	-0.34±1.42E-09	0.00±4.27E-09
*October**	6.69	9.87±6.98E-10	3.47±1.44E-09	-2.00±0.81E-07	1.83±1.08E-09	0.00±4.42E-09
November	6.56	5.13±4.19E-10	1.53±0.88E-09	-5.76±8.36E-08	1.34±1.68E-09	0.00±4.27E-09
*December**	7.57	1.38±0.46E-09	3.12±0.97E-09	-2.52±0.85E-07	1.84±1.94E-09	0.00±4.15E-09

** Month of discharge from WNSP001.*

Table C - 1.25
*1997 Radioactivity Concentrations (µCi/mL) in Surface Water Upstream of the WVDP in Cattaraugus Creek at Bigelow Bridge (WFBIGBR)**

Month	Alpha	Beta	H-3	Sr-90	Cs-137
January	6.96±4.48E-10	1.98±0.74E-09	2.00±5.48E-08	0.66±1.17E-09	0.00±4.44E-09
February	1.52±0.70E-09	1.82±1.08E-09	1.60±5.70E-08	3.15±1.62E-09	0.00±6.80E-09
March	6.91±4.07E-10	2.35±0.72E-09	2.85±8.06E-08	1.34±1.39E-09	0.00±4.61E-09
April	1.16±8.00E-10	1.42±1.06E-09	-2.94±8.01E-08	1.16±1.05E-09	0.00±4.09E-09
May	-0.09±8.86E-10	0.52±1.01E-09	9.96±7.87E-08	0.85±2.95E-09	0.00±4.24E-09
June	4.04±9.60E-10	1.27±1.17E-09	-6.18±7.93E-08	0.55±1.15E-09	0.00±6.40E-09
July	0.56±1.11E-09	1.75±1.07E-09	1.36±7.77E-08	8.28±6.98E-10	0.00±4.74E-09
August	0.46±1.06E-09	2.44±1.07E-09	-1.13±0.56E-07	5.26±8.62E-10	0.00±6.81E-09
September	4.23±8.46E-10	1.75±1.04E-09	2.31±5.51E-08	-0.22±1.16E-09	0.00±4.66E-09
October	2.67±6.49E-10	0.71±1.00E-09	-7.06±8.22E-08	0.12±1.88E-09	0.00±4.22E-09
November	6.09±6.22E-10	3.22±1.00E-09	1.55±0.83E-07	2.93±1.94E-09	0.00±4.34E-09
December	3.84±5.55E-10	1.62±1.07E-09	-1.42±0.80E-07	-0.46±1.92E-09	0.00±1.58E-08

Table C - 1.26

1997 pH, Conductivity, and Radioactivity Concentrations (µCi/mL) in Potable Well Water around the WVDP

Well	pH (standard units)	Conductivity (µmhos/cm@25°C)	Alpha	Beta	H-3	Cs-137
WFWEL01	7.34	383	2.59±7.82E-10	2.10±1.85E-09	-6.13±7.92E-08	0.00±1.66E-08
WFWEL02	7.10	340	1.44±5.18E-10	0.48±1.24E-09	-1.34±8.05E-08	0.00±2.13E-08
WFWEL03	6.91	514	5.26±9.05E-10	3.04±1.92E-09	-0.83±5.62E-08	0.00±1.78E-08
WFWEL04	7.97	1686	2.14±2.41E-09	3.92±2.25E-09	6.42±0.88E-07	0.00±2.08E-08
WFWEL05	6.22	313	8.27±7.59E-10	3.87±1.89E-09	1.95±5.80E-08	0.00±2.31E-08
WFWEL06*	6.77	276	4.43±6.71E-10	0.17±1.71E-09	-6.71±8.03E-08	0.00±1.94E-08
WFWEL07	7.02	350	5.10±7.72E-10	1.42±1.81E-09	-5.92±7.93E-08	0.00±1.39E-08
WFWEL08	7.27	489	4.64±9.28E-10	4.03±1.99E-09	-1.08±0.78E-07	0.00±2.04E-08
WFWEL09	7.71	652	0.44±1.05E-09	3.96±2.00E-09	-1.30±0.79E-07	0.00±2.29E-08
WFWEL10	7.69	663	0.50±1.00E-09	-0.64±1.72E-09	-1.32±0.79E-07	0.00±1.34E-08

** Background location*

Table C - 1.27
1997 Surface Water Quality at Locations WFBCBKG, WNSP006, WNSWAMP, and WNSW74A*

Location	Date	pH	Conductivity (µmhos/cm@25C)	NPOC (mg/L)	TOX (µg/L)	Chloride (mg/L)	Sulfate (mg/L)
WFBCBKG*	7/1	7.01	209	2.2	6.0	6.6	21.6
WFBCBKG*	12/23	6.90	236	2.6	6.6	7.4	22.0
WNSP006	6/25	7.41	474	4.7	47.3	98.4	26.1
WNSP006	12/24	7.32	536	5.3	42.2	76.8	25.6
WNSW74A	6/25	7.28	952	4.2	16.7	78.1	29.8
WNSW74A	12/24	7.20	844	4.8	16.8	68.3	32.0
WNSWAMP	6/25	7.32	673	6.1	21.0	87.0	21.0
WNSWAMP	12/24	7.29	668	5.4	22.5	81.5	22.5

Location	Date	Nitrate/ Nitrite (mg/L)	Fluoride (mg/L)	Bicarbonate Alkalinity (as $CaCO_3$) (mg/L)	Carbonate Alkalinity (as $CaCO_3$) (mg/L)
WFBCBKG*	7/1	0.12	<0.10	83.6	<1.0
WFBCBKG*	12/23	0.12	<0.10	90.0	<1.0
WNSP006	6/25	4.80	0.11	112.0	<1.0
WNSP006	12/24	4.40	0.10	113.0	<1.0
WNSW74A	6/25	<0.05	0.14	186.0	<1.0
WNSW74A	12/24	<0.05	0.12	176.0	<1.0
WNSWAMP	6/25	0.23	0.47	180.0	<1.0
WNSWAMP	12/24	0.28	0.49	180.0	<5.5

Location	Date	Ca Total (µg/L)	Mg Total (µg/L)	Na Total (µg/L)	K Total (µg/L)	Ba Total (µg/L)	Mn Total (µg/L)	Fe Total (µg/L)
WFBCBKG*	6/17	35,700	5,020	5,710	1,700	<200	38.1	1,200
WFBCBKG*	10/24	36,800	4,820	7,390	1,170	<200	21.6	385
WNSP006	6/17	46,700	7,140	62,300	3,820	<200	16.0	525
WNSP006	10/24	43,900	6,460	40,200	3,320	<200	50.8	893
WNSW74A	6/17	74,500	8,400	41,200	1,400	<200	33.6	<100
WNSW74A	10/24	71,300	7,880	32,000	1,310	<200	24.5	<100
WNSWAMP	6/17	79,000	9,900	38,000	1,600	90	680.0	290
WNSWAMP	10/24	80,000	11,000	35,000	1,900	86	62.0	47

* *Backgound location.*

Table C - 1.28
1997 Radioactivity Concentrations (µCi/g dry weight from upper 5 cm) and Metals Concentrations (mg/kg dry) in On-site Soils/Sediments

Location	Alpha	Beta	K-40	Co-60	Sr-90	Cs-137
SNSP006	1.32±0.35E-05	5.60±0.46E-05	1.67±0.19E-05	6.39±3.30E-08	9.66±0.67E-07	2.99±0.29E-05
SNSW74A	2.20±0.55E-05	2.13±0.35E-05	1.34±0.16E-05	0.71±2.20E-08	3.10±0.50E-07	1.31±0.14E-06
SNSWAMP	1.18±0.38E-05	3.24±0.37E-05	1.71±0.21E-05	0.00±3.23E-08	8.97±0.73E-07	6.63±0.87E-07

	U-232	U-233/234	U-235/236	U-238	Total U (µg/g)	Pu-239/240
SNSP006	1.43±1.31E-07	7.73±1.63E-07	7.45±4.55E-08	7.43±1.59E-07	1.47±0.03E+00	2.49±2.21E-08
SNSW74A	-2.89±5.65E-08	7.72±1.64E-07	9.38±5.32E-08	7.52±1.61E-07	1.70±0.05E+00	3.16±5.90E-08
SNSWAMP	3.61±8.53E-08	9.05±1.40E-07	1.77±0.53E-07	8.37±1.32E-07	1.91±0.05E+00	2.44±2.65E-08

	Am-241
SNSP006	4.22±2.53E-08
SNSW74A	7.98±4.36E-08
SNSWAMP	6.58±3.10E-08

	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium
SNSP006	7,500	2.3	5.0	38.0	0.36	<0.50
SNSW74A	13,500	<6.0	7.1	59.5	0.56	<0.50
SNSWAMP	11,000	3.9	6.9	86.0	0.48	<0.50

	Calcium	Chromium	Cobalt	Copper	Iron	Lead
SNSP006	9,700	9.9	5.2	9.9	13,000	8.6
SNSW74A	3,050	15.5	6.2	25.5	21,000	14.0
SNSWAMP	7,300	13.0	5.0	19.0	17,000	11.0

	Magnesium	Manganese	Mercury	Nickel	Potassium	Selenium
SNSP006	3,900	360	<0.02	13.0	1,600	0.05
SNSW74A	4,200	420	<0.02	17.5	2,300	0.68
SNSWAMP	4,600	190	<0.02	14.0	2,200	0.42

	Silver	Sodium	Thallium	Vanadium	Zinc
SNSP006	< 1.00	80.0	< 1.0	16.0	45
SNSW74A	< 1.00	75.5	< 1.0	21.5	105
SNSWAMP	0.71	84.0	< 1.0	18.0	53

Table C - 1.29

1997 Radioactivity Concentrations in Surface Soil Collected at Air Sampling Stations around the WVDP (µCi/g dry weight from upper 5 cm)

Location	Alpha	Beta	K-40	Co-60
SFBLKST	1.95±0.54E-05	2.96±0.46E-05	1.89±0.22E-05	-0.73±2.37E-08
SFBOEHN	1.63±0.49E-05	3.06±0.46E-05	1.53±0.23E-05	-1.18±3.26E-08
SFFXVRD	1.76±0.48E-05	2.07±0.40E-05	1.12±0.16E-05	-0.44±2.54E-08
SFGRVAL*	1.85±0.56E-05	2.31±0.46E-05	1.09±0.15E-05	2.12±2.54E-08
SFNASHV*	1.35±0.47E-05	2.50±0.45E-05	1.71±0.20E-05	-1.20±2.62E-08
SFRSPRD	1.70±0.53E-05	2.44±0.49E-05	1.48±0.17E-05	1.56±2.50E-08
SFRT240	1.38±0.46E-05	2.17±0.42E-05	1.19±0.15E-05	-0.99±2.27E-08
SFSPRVL	2.02±0.62E-05	2.57±0.48E-05	1.29±0.15E-05	-0.24±1.68E-08
SFTCORD	2.49±0.64E-05	2.32±0.43E-05	1.97±0.23E-05	-3.11±2.84E-08
SFWEVAL	2.72±0.66E-05	2.28±0.43E-05	7.54±1.12E-06	0.25±2.19E-08

	Sr-90	Cs-137	Pu-239/240	Am-241
SFBLKST	8.80±3.68E-08	2.78±0.50E-07	2.34±0.45E-07	1.52±3.36E-08
SFBOEHN	2.57±0.74E-07	6.33±1.03E-07	1.72±1.00E-08	1.93±0.67E-07
SFFXVRD	1.31±0.49E-07	5.32±0.82E-07	1.54±1.08E-08	1.41±1.79E-08
SFGRVAL*	1.65±0.38E-07	6.93±0.95E-07	2.80±1.79E-08	2.98±4.14E-08
SFNASHV*	1.84±3.91E-08	2.18±0.58E-07	4.32±1.60E-08	1.01±3.11E-08
SFRSPRD	2.78±0.87E-07	1.40±0.16E-06	1.90±0.95E-08	0.91±1.97E-08
SFRT240	1.56±0.69E-07	7.47±1.00E-07	0.94±1.66E-08	1.99±2.21E-08
SFSPRVL	2.07±0.89E-07	5.69±0.67E-07	6.41±2.37E-08	2.96±2.79E-08
SFTCORD	1.57±0.25E-06	2.17±0.54E-07	-1.54±1.41E-08	2.36±5.69E-08
SFWEVAL	3.01±1.40E-07	5.46±0.82E-07	9.16±2.89E-08	1.46±2.91E-08

	U-232	U-233/234	U-235/236	U-238	Total U (µg/g)
SFBOEHN	1.37±0.98E-08	8.12±1.03E-07	3.10±1.75E-08	8.32±1.04E-07	1.78±0.05E+00
SFGRVAL*	4.71±9.19E-09	6.60±0.90E-07	2.29±1.35E-08	6.86±0.93E-07	2.31±0.04E+00
SFRSPRD	8.59±8.13E-09	6.80±0.86E-07	1.80±1.16E-08	7.02±0.89E-07	1.73±0.03E+00

* *Background location.*

Table C - 1.30

1997 Radioactivity Concentrations in Stream Sediments around the WVDP (µCi/g dry weight from upper 15 cm)

Location	Alpha	Beta	K-40	Co-60	Sr-90	Cs-137
SFBCSED*	8.61±3.85E-06	1.63±0.34E-05	1.07±0.13E-05	-0.45±1.72E-08	4.91±4.26E-08	0.11±1.65E-08
SFBISED*	1.57±0.42E-05	2.00±0.28E-05	1.08±0.13E-05	0.15±1.68E-08	2.35±4.62E-08	0.42±1.55E-08
SFCCSED	1.12±0.40E-05	1.73±0.30E-05	1.20±0.15E-05	2.03±1.91E-08	8.57±5.08E-08	3.37±0.60E-07
SFSDSED	1.56±0.54E-05	1.97±0.36E-05	1.55±0.19E-05	0.59±2.26E-08	2.22±4.49E-08	3.94±0.65E-07
SFTCSED	7.91±4.54E-06	3.74±0.46E-05	1.29±0.15E-05	-0.57±1.50E-08	5.01±3.49E-08	8.24±0.95E-07

Location	U-232	U-233/234	U-235/236	U-238	Total U (µg/g)	Pu-238
SFBCSED*	2.46±1.64E-08	2.40±0.46E-07	5.47±7.75E-09	1.71±0.36E-07	2.00±0.07E+00	1.29±0.28E-07
SFBISED*	0.96±1.99E-08	1.82±0.36E-07	1.13±0.90E-08	1.71±0.35E-07	1.93±0.07E+00	1.12±0.26E-07
SFCCSED	1.23±0.25E-07	2.03±0.27E-07	1.31±0.68E-08	1.92±0.26E-07	2.16±0.05E+00	9.52±2.27E-08
SFSDSED	9.54±2.61E-08	2.24±0.35E-07	1.42±0.77E-08	1.76±0.31E-07	2.08±0.06E+00	1.11±0.24E-07
SFTCSED	1.66±0.31E-07	2.77±0.33E-07	1.64±0.68E-08	2.46±0.30E-07	2.12±0.05E+00	7.28±1.60E-08

Location	Pu-239/240	Am-241
SFBCSED*	4.89±2.14E-08	0.04±1.04E-08
SFBISED*	5.24±2.12E-08	0.25±1.62E-08
SFCCSED	5.43±9.40E-09	0.81±1.15E-08
SFSDSED	1.20±1.24E-08	0.19±1.54E-08
SFTCSED	3.11±6.39E-09	0.32±1.17E-08

** Background location.*

Appendix C - 1

Summary of Water and Sediment Monitoring Data

Collecting a Sample at a WVDP Stream SamplingLocation

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Table C - 1.1

Total Radioactivity of Liquid Effluents Released from Lagoon 3 in 1996 (curies)*

Isotope	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Annual Total
Alpha	3.97±1.98E-04	1.82±1.14E-04	3.45±4.47E-05	2.30±1.20E-04	8.43±2.62E-04
Beta	1.13±0.04E-02	1.28±0.04E-02	2.21±0.13E-03	6.83±0.29E-03	3.31±0.06E-02
H-3	2.40±0.06E-01	1.96±0.05E-01	6.83±0.22E-02	2.48±0.06E-01	7.52±0.10E-01
Sr-90	1.90±0.09E-03	1.97±0.07E-03	3.24±0.13E-04	1.25±0.06E-03	5.44±0.13E-03
Cs-137	1.45±0.07E-03	1.46±0.06E-03	6.42±0.29E-04	2.82±0.10E-03	6.38±0.14E-03
Co-60	1.77±0.55E-04	0.00±5.21E-05	0.00±2.06E-05	0.00±5.99E-05	1.77±0.99E-04
K-40	1.70±7.58E-04	8.35±7.18E-04	0.71±2.62E-04	3.01±8.47E-04	1.38±1.37E-03
U-232	3.04±0.24E-04	1.30±0.08E-04	1.96±0.17E-05	2.09±0.13E-04	6.63±0.29E-04
U-233/234	1.21±0.10E-04	7.73±2.13E-05	9.38±1.00E-06	1.05±0.05E-04	3.13±0.24E-04
U-235/236	4.61±1.82E-06	2.88±0.90E-06	5.18±2.13E-07	3.66±0.81E-06	1.17±0.22E-05
U-238	8.30±0.79E-05	4.77±0.38E-05	4.65±0.67E-06	4.25±0.31E-05	1.78±0.09E-04
Pu-238	1.11±0.19E-05	1.77±0.61E-06	4.10±2.67E-07	2.38±0.24E-05	3.71±0.31E-05
Pu-239/240	4.22±1.25E-06	6.97±3.53E-07	1.06±1.26E-07	5.27±0.88E-06	1.03±0.16E-05
Am-241	4.96±1.17E-06	4.64±1.81E-06	5.81±2.68E-07	2.37±0.80E-06	1.25±0.23E-05
I-129	4.57±2.44E-05	2.24±1.54E-05	2.30±0.59E-05	3.44±1.24E-05	1.25±0.32E-04
C-14	1.66±0.52E-04	1.30±0.39E-04	0.86±2.24E-05	1.54±0.42E-04	4.59±0.80E-04
Tc-99	1.64±0.15E-02	1.43±0.02E-02	2.62±0.06E-03	5.21±0.10E-03	3.85±0.15E-02
Total U (g)	2.57±0.50E+02	1.33±0.01E+02	1.43±0.02E+01	8.84±0.13E+01	4.93±0.50E+02

* *Results for samples collected from monitoring location WNSP001.*

Table C - 1.2

Comparison of 1996 Lagoon 3 Liquid Effluent Radioactivity Concentrations with Department of Energy Guidelines*

Isotope	**Discharged Activity**[a] (Ci)	(Becquerels)	**Concentration** (μCi/mL)	**DCG** (μCi/mL)	**% of DCG**
Alpha	8.43±2.62E-04	3.12±0.97E+07	1.67±0.52E-08	N/A[b]	N/A
Beta	3.31±0.06E-02	1.23±0.02E+09	6.55±0.12E-07	N/A[b]	N/A
H-3	7.52±0.10E-01	2.78±0.04E+10	1.49±0.02E-05	2.00E-03	0.74
Sr-90	5.44±0.13E-03	2.01±0.05E+08	1.08±0.03E-07	1.00E-06	10.75
Cs-137	6.38±0.14E-03	2.36±0.05E+08	1.26±0.03E-07	3.00E-06	4.20
Co-60	1.77±0.99E-04	6.57±3.66E+06	3.51±1.96E-09	5.00E-06	0.07
K-40	1.38±1.37E-03	5.10±5.07E+07	2.72±2.71E-08	N/A[b]	N/A
U-232 [c]	6.63±0.29E-04	2.45±0.11E+07	1.31±0.06E-08	1.00E-07	13.11
U-233/234 [c]	3.13±0.24E-04	1.16±0.09E+07	6.19±0.48E-09	5.00E-07	1.24
U-235/236 [c]	1.17±0.22E-05	4.32±0.81E+05	2.31±0.43E-10	5.00E-07	0.05
U-238 [c]	1.78±0.09E-04	6.58±0.35E+06	3.52±0.18E-09	6.00E-07	0.59
Pu-238	3.71±0.31E-05	1.37±0.12E+06	7.33±0.61E-10	4.00E-08	1.83
Pu-239/240	1.03±0.16E-05	3.81±0.58E+05	2.03±0.31E-10	3.00E-08	0.68
Am-241	1.25±0.23E-05	4.64±0.86E+05	2.48±0.46E-10	3.00E-08	0.83
I-129	1.25±0.32E-04	4.64±1.18E+06	2.48±0.63E-09	5.00E-07	0.50
C-14	4.59±0.80E-04	1.70±0.30E+07	9.07±1.59E-09	7.00E-05	0.01
Tc-99	3.85±0.15E-02	1.43±0.06E+09	7.62±0.31E-07	1.00E-04	0.76
Total % of DCGs					**35.35**

** Results for samples collected from monitoring location WNSP001.*

[a] *Total volume released: 5.06E+10 mL.*
[b] *Derived concentration guides (DCGs) are not applicable (N/A) to gross alpha, gross beta, or potassium-40 activity.*
[c] *Total U (g) = 4.93±0.50E+02; average U (μg/mL) = 9.74±0.99E-03*
Half-lives are listed in Table B-1.

Table C - 1.3

1996 Monthly Radioactivity Concentrations (µCi/mL) and pH in Surface Water at Location WNSP005

Month	Alpha	Beta	H-3	pH (standard units)
January	-0.04±1.65E-09	6.76±0.62E-08	1.17±0.80E-07	7.73
February	0.26±1.31E-09	8.99±0.69E-08	1.36±0.78E-07	7.61
March	0.11±1.90E-09	2.61±0.11E-07	-6.74±7.92E-08	7.77
April	0.27±2.14E-09	9.02±0.72E-08	-1.49±0.78E-07	7.17
May	0.85±3.76E-09	2.38±0.11E-07	5.53±7.70E-08	7.61
June	4.36±1.76E-09	1.70±0.09E-07	-1.06±7.63E-08	7.42
July	2.69±2.05E-09	6.26±0.45E-08	3.56±7.98E-08	7.49
August	1.34±1.33E-09	4.59±0.56E-08	-2.69±7.96E-08	7.82
September	0.07±2.14E-09	8.75±0.71E-08	6.96±7.80E-08	7.37
October	2.15±3.32E-09	6.24±0.61E-08	1.46±0.84E-07	7.55
November	1.58±2.42E-09	1.44±0.09E-07	7.23±8.15E-08	7.36
December	2.26±2.59E-09	2.88±0.12E-07	8.08±7.92E-08	7.68

Table C - 1.4

1996 Radioactivity Concentrations (µCi/mL) in Surface Water Downstream of the WVDP at Frank's Creek (WNSP006)

Month	Alpha	Beta	H-3	Sr-90	Cs-137
January	5.50±8.38E-10	2.35±0.33E-08	1.15±0.72E-07	1.31±0.30E-08	0.00±1.36E-08
*February**	3.77±1.41E-09	9.14±0.54E-08	2.18±0.15E-06	3.42±0.43E-08	0.00±1.64E-08
*March **	1.45±0.98E-09	7.46±0.50E-08	9.28±1.06E-07	2.02±0.37E-08	0.00±1.57E-08
April	1.20±0.83E-09	2.06±0.29E-08	-1.11±7.46E-08	9.78±2.85E-09	0.00±1.40E-08
*May**	1.75±1.12E-09	8.67±0.55E-08	9.87±1.07E-07	3.00±0.41E-08	0.00±1.21E-08
*June**	2.04±1.44E-09	1.14±0.05E-07	1.58±0.13E-06	3.04±0.28E-08	0.00±2.08E-08
July	2.45±2.04E-09	1.29±0.06E-07	7.62±0.95E-07	3.61±0.34E-08	3.48±1.15E-08
*August**	-0.28±1.36E-09	6.31±0.46E-08	4.22±0.80E-07	2.58±0.25E-08	0.00±1.56E-08
September	0.42±1.44E-09	6.26±0.44E-08	6.20±0.75E-07	2.36±0.20E-08	4.24±3.56E-09
October	0.72±1.44E-09	3.56±0.41E-08	9.66±8.23E-08	1.38±0.25E-08	0.00±1.56E-08
*November**	4.28±9.97E-10	4.14±0.39E-08	9.59±0.97E-07	1.24±0.21E-08	0.00±1.96E-08
*December**	6.67±8.28E-10	2.68±0.33E-08	1.16±0.11E-06	1.10±0.23E-08	0.00±2.37E-08

Quarter	C-14	I-129	U-232	U-233/234	U-235/236
1st Qtr	-1.03±1.30E-09	3.38±8.31E-10	1.21±0.19E-09	5.58±1.07E-10	3.70±2.76E-11
2nd Qtr	-1.31±1.55E-09	-1.38±9.18E-10	6.39±1.21E-10	5.59±1.30E-10	6.19±4.15E-11
3rd Qtr	1.41±0.41E-08	1.91±1.39E-09	4.24±1.04E-10	5.17±1.07E-10	7.38±4.17E-11
4th Qtr	1.85±9.18E-09	1.18±1.06E-09	3.64±1.14E-10	5.82±1.36E-10	7.52±4.57E-11

	U-238	Total U (µg/mL)	Pu-238	Pu-239/240	Am-241
1st Qtr	4.06±0.90E-10	1.57±0.03E-03	5.56±1.02E-11	-0.68±2.21E-11	5.46±4.17E-11
2nd Qtr	3.46±1.01E-10	9.68±0.13E-04	2.14±4.73E-11	0.00±1.79E-11	3.67±5.95E-11
3rd Qtr	3.87±0.93E-10	1.07±0.02E-03	0.76±3.16E-11	2.56±2.46E-11	3.15±4.53E-11
4th Qtr	4.09±1.11E-10	1.58±0.07E-04	1.56±3.06E-11	1.17±1.51E-11	4.74±3.24E-11

	Tc-99
1st Qtr	5.78±0.43E-08
2nd Qtr	5.52±0.34E-08
3rd Qtr	2.03±0.29E-08
4th Qtr	1.09±0.24E-08

** Month of discharge from WNSP001. See Table C-1.27 for a summary of water quality data at WNSP006.*

Table C - 1.5

1996 Monthly Radioactivity Concentrations (µCi/mL) in Surface Water at Sewage Treatment Facility Location WNSP007

Month	Alpha	Beta	H-3	Cs-137
January	0.53±1.75E-09	2.08±0.45E-08	9.39±7.95E-08	
February	0.94±1.50E-09	1.72±0.39E-08	1.20±0.78E-07	
March	0.10±1.73E-09	2.55±0.47E-08	2.46±7.23E-08	
1st Qtr				0.00±4.49E-09
April	0.59±2.08E-09	2.74±0.49E-08	1.11±7.91E-08	
May	0.39±2.92E-09	3.21±0.43E-08	-0.57±7.82E-08	
June	1.67±2.84E-09	2.60±0.49E-08	1.73±7.75E-08	
2nd Qtr				0.00±1.50E-08
July	0.13±2.42E-09	1.63±0.44E-08	-2.97±7.25E-08	
August	-0.11±1.59E-09	1.98±0.39E-08	-4.03±7.79E-08	
September	0.35±2.16E-09	2.08±0.38E-08	-1.27±7.12E-08	
3rd Qtr				0.00±4.60E-09
October	1.77±4.61E-09	2.16±0.59E-08	0.78±8.01E-08	
November	0.54±2.79E-09	2.44±0.54E-08	1.77±8.20E-08	
December	0.57±1.51E-09	2.06±0.40E-08	7.22±6.52E-08	
4th Qtr				0.00±7.68E-09

Table C - 1.6

1996 Monthly Radioactivity Concentrations (µCi/mL) in Surface Water at French Drain Location WNSP008

Month	Alpha	Beta	H-3
January	0.11±1.88E-09	5.01±0.44E-08	2.82±0.14E-06
February	1.47±1.73E-09	4.36±0.42E-08	2.71±0.14E-06
March	1.56±1.16E-09	4.64±0.31E-08	2.59±0.14E-06
April	0.63±2.13E-09	4.36±0.44E-08	2.47±0.13E-06
May	0.93±1.77E-09	3.25±0.38E-08	1.44±0.10E-06
June	0.33±1.27E-09	4.02±0.43E-08	1.86±0.11E-06
July	-1.06±3.01E-09	4.31±0.45E-08	2.72±0.14E-06
August	3.37±2.39E-09	4.03±0.44E-08	3.27±0.15E-06
September	2.38±2.70E-09	3.61±0.55E-08	3.25±0.11E-06
October	1.73±2.40E-09	3.40±0.48E-08	3.40±0.16E-06
November	0.00±1.72E-09	1.98±0.45E-08	1.59±0.11E-06
December	0.85±2.02E-09	3.18±0.51E-08	2.16±0.12E-06

Table C - 1.7

1996 Radioactivity Concentrations (µCi/mL) in Surface Water at the Northeast Swamp Location (WNSWAMP)

Month	Alpha	Beta	H-3	Sr-90	Cs-137
January	1.20±1.30E-09	2.14±0.02E-06	3.11±0.79E-07	1.10±0.00E-06	0.00±4.32E-09
February	0.51±1.32E-09	2.07±0.02E-06	2.81±0.79E-07	1.05±0.02E-06	0.00±4.56E-09
March	0.04±1.16E-09	1.95±0.02E-06	2.72±0.78E-07	9.85±0.22E-07	0.00±4.84E-09
April	0.35±1.08E-09	1.90±0.02E-06	2.05±0.79E-07	9.43±0.28E-07	0.00±4.51E-09
May	1.09±1.28E-09	2.12±0.02E-06	2.41±0.78E-07	1.11±0.02E-06	0.00±4.50E-09
June	1.10±1.69E-09	2.96±0.03E-06	2.63±0.80E-07	1.35±0.03E-06	0.00±4.48E-09
July	-0.32±2.11E-09	4.12±0.04E-06	3.75±0.81E-07	1.98±0.02E-06	0.00±4.43E-09
August	0.43±1.59E-09	3.81±0.03E-06	2.89±0.81E-07	1.95±0.03E-06	0.00±4.62E-09
September	0.50±1.75E-09	4.16±0.04E-06	3.08±0.80E-07	2.26±0.04E-06	0.00±1.44E-08
October	1.32±1.66E-09	3.00±0.03E-06	1.67±0.81E-07	1.47±0.03E-06	0.00±4.43E-09
November	-0.14±1.31E-09	2.09±0.02E-06	2.12±0.81E-07	1.04±0.02E-06	0.00±6.78E-09
December	0.59±1.28E-09	1.42±0.02E-06	1.58±0.80E-07	6.96±0.24E-07	0.00±7.09E-09

Quarter	C-14	I-129	U-232	U-233/234	U-235/236
1st Qtr	1.16±1.64E-09	0.23±1.06E-09	1.33±0.97E-11	8.52±3.99E-11	3.20±2.47E-11
2nd Qtr	1.63±5.41E-09	2.95±6.56E-10	4.19±5.76E-11	2.74±0.90E-10	1.95±3.45E-11
3rd Qtr	-1.09±9.14E-09	2.74±1.29E-09	3.67±3.74E-11	1.63±0.40E-10	1.95±1.50E-11
4th Qtr	2.53±9.15E-09	-0.24±1.14E-09	0.49±1.10E-10	1.58±1.23E-10	1.84±5.90E-11

	U-238	Total U (µg/mL)	Pu-238	Pu-239/240	Am-241
1st Qtr	8.53±3.85E-11	2.30±0.10E-04	5.97±0.81E-12	3.96±1.21E-11	6.07±5.21E-11
2nd Qtr	1.56±0.72E-10	1.78±0.04E-04	1.14±1.62E-11	1.74±2.53E-11	1.86±0.66E-10
3rd Qtr	1.10±0.33E-10	2.11±0.06E-04	4.44±6.06E-11	0.64±2.04E-11	0.46±3.34E-11
4th Qtr	1.12±0.92E-10	-6.03±0.43E-05	3.09±2.28E-11	1.29±1.16E-11	1.48±2.61E-11

See Table C-1.27 for a summary of water quality data at WNSWAMP.

Table C - 1.8
1996 Radioactivity Concentrations (µCi/mL) in Surface Water at the North Swamp Location (WNSW74A)

Month	Alpha	Beta	H-3	Sr-90	Cs-137
January	1.15±9.22E-10	1.53±0.24E-08	8.62±8.05E-08	9.13±2.64E-09	0.00±1.63E-08
February	0.27±1.39E-09	1.60±0.26E-08	1.18±0.77E-07	1.00±0.27E-08	0.00±8.56E-09
March	0.55±1.49E-09	1.61±0.26E-08	7.10±7.75E-08	1.57±0.34E-08	0.00±1.22E-08
April	0.89±1.45E-09	1.55±0.26E-08	3.02±7.88E-08	1.10±0.28E-08	0.00±1.88E-08
May	0.54±1.26E-09	1.29±0.24E-08	-1.11±6.91E-08	9.18±2.61E-09	0.00±1.49E-08
June	0.29±1.27E-09	1.51±0.22E-08	0.45±7.05E-08	9.43±2.66E-09	0.00±1.63E-08
July	0.52±1.63E-09	1.08±0.24E-08	-3.68±7.45E-08	7.48±1.54E-09	0.00±1.33E-08
August	0.06±1.48E-09	1.19±0.24E-08	-2.52±7.33E-08	6.06±1.51E-09	0.00±1.03E-08
September	0.85±1.38E-09	1.23±0.24E-08	-3.35±7.61E-08	4.16±1.62E-09	0.00±1.20E-08
October	0.37±1.08E-09	1.22±0.23E-08	1.48±7.47E-08	5.39±1.95E-09	0.00±1.10E-08
November	1.25±1.52E-09	1.18±0.25E-08	1.65±7.52E-08	6.97±1.71E-09	0.00±1.75E-08
December	-0.02±1.49E-09	1.49±0.33E-08	1.08±0.79E-07	4.90±1.77E-09	0.00±1.44E-08

Quarter	C-14	I-129	U-232	U-233/234	U-235/236
1st Qtr	0.16±1.31E-09	5.16±8.74E-10	2.94±3.78E-11	1.22±0.49E-10	1.52±1.80E-11
2nd Qtr	-1.16±1.62E-09	9.75±8.86E-10	7.95±4.31E-11	1.51±0.70E-10	0.38±1.74E-11
3rd Qtr	1.07±3.76E-09	8.50±6.95E-10	2.28±3.93E-11	2.04±0.73E-10	7.62±4.48E-11
4th Qtr	-0.13±9.11E-09	0.00±1.56E-09	1.82±3.44E-11	1.70±0.73E-10	2.84±2.85E-11

	U-238	Total U (µg/mL)	Pu-238	Pu-239/240	Am-241
1st Qtr	9.37±4.16E-11	9.87±1.01E-05	1.07±0.18E-10	1.34±0.64E-11	-1.12±0.98E-10
2nd Qtr	7.72±5.27E-11	1.71±0.05E-04	4.14±3.39E-11	1.03±2.07E-11	5.96±3.34E-11
3rd Qtr	9.59±4.96E-11	2.55±0.06E-04	8.24±5.97E-11	3.02±3.12E-11	4.86±3.12E-11
4th Qtr	1.13±0.57E-10	4.82±0.14E-05	-0.03±3.35E-11	3.05±2.79E-11	3.15±3.46E-11

See Table C-1.27 for a summary of water quality parameters at WNSW74A.

Table C - 1.9
1996 Monthly Radioactivity Concentrations (µCi/mL) and pH in Surface Water at Location WNFRC67

Month	Alpha	Beta	H-3	pH (standard units)
January	6.98±6.92E-10	6.30±1.88E-09	1.43±0.78E-07	7.25
February	5.38±5.85E-10	1.84±1.69E-09	1.93±0.79E-07	7.34
March	0.52±5.39E-10	2.71±1.75E-09	-7.51±7.88E-08	7.95
April	-1.28±5.46E-10	3.03±1.81E-09	6.67±7.68E-08	6.22
May	2.27±5.96E-10	2.64±1.69E-09	-3.40±7.58E-08	7.60
June	6.06±6.30E-10	2.50±1.76E-09	-6.87±7.78E-08	7.57
July	-2.32±8.62E-10	0.88±1.72E-09	1.22±0.82E-07	7.52
August	1.05±1.05E-09	4.44±1.74E-09	-8.20±7.98E-08	8.24
September	4.00±6.87E-10	5.73±1.49E-09	3.96±7.82E-08	8.07
October	2.33±7.41E-10	4.06±2.11E-09	2.11±0.84E-07	7.77
November	6.91±6.83E-10	0.61±1.93E-09	1.02±0.82E-07	7.88
December	6.24±6.61E-10	1.44±1.81E-09	-3.24±7.86E-08	7.82

Table C - 1.10

1996 Monthly Radioactivity Concentrations (µCi/mL) and pH in Surface Water at Location WNERB53

Month	**Alpha**	**Beta**	**H-3**	**pH** (standard units)
January	0.71±1.01E-09	1.80±0.31E-08	1.54±0.83E-07	7.40
February	0.71±1.05E-09	1.26±0.30E-08	1.81±0.78E-07	7.48
March	6.60±9.60E-10	1.56±0.31E-08	9.20±7.81E-08	7.51
April	4.17±8.66E-10	1.09±0.27E-08	3.78±7.45E-08	6.98
May	5.70±9.86E-10	1.27±0.27E-08	2.32±7.84E-08	7.50
June	1.50±1.41E-09	1.71±0.32E-08	1.01±7.78E-08	7.89
July	0.29±1.93E-09	1.97±0.32E-08	2.96±7.90E-08	7.70
August	-0.02±1.72E-09	2.47±0.35E-08	1.47±7.87E-08	7.85
September	1.20±1.65E-09	2.87±0.33E-08	9.28±7.85E-08	7.77
October	0.34±1.35E-09	1.69±0.29E-08	1.46±8.04E-08	7.76
November	-2.25±9.23E-10	1.17±0.30E-08	8.58±8.01E-08	7.71
December	0.62±1.02E-09	1.64±0.33E-08	1.73±0.75E-07	6.92

Table C - 1.11

1996 Monthly Radioactivity Concentrations (µCi/mL) and pH in Surface Water at Location WNCOOLW

Month	**Alpha**	**Beta**	**H-3**	**pH** (standard units)
January	-0.03±1.16E-09	9.40±3.55E-09	4.53±7.72E-08	8.30
February	-0.48±1.19E-09	2.00±0.43E-08	5.58±7.38E-08	7.85
March	2.82±7.11E-10	1.40±0.23E-08	-2.42±0.81E-07	8.30
April	0.14±1.14E-09	1.21±0.29E-08	4.34±7.79E-08	7.63
May	-0.28±1.52E-09	1.77±0.26E-08	-0.75±7.70E-08	8.48
June	0.43±1.63E-09	2.56±0.38E-08	-1.22±0.78E-07	8.76
July	-1.06±1.81E-09	1.64±0.33E-08	4.86±8.03E-08	8.51
August	1.05±1.94E-09	1.61±0.45E-08	-1.08±0.80E-07	8.73
September	0.43±2.10E-09	1.16±0.31E-08	3.87±7.74E-08	8.90
October	-0.95±1.53E-09	1.37±0.32E-08	8.12±5.81E-08	8.50
November	-0.88±1.86E-09	2.04±0.36E-08	1.97±0.84E-07	8.91
December	0.14±1.74E-09	2.23±0.48E-08	-4.99±7.83E-08	8.82

Table C - 1.12

1996 Monthly Radioactivity Concentrations (µCi/mL) in Surface Water at Location WNSDADR

Month	Alpha	Beta	H-3	Cs-137
January	3.64±4.19E-10	1.97±1.80E-09	1.17±0.78E-07	0.00±1.26E-08
February	2.67±2.77E-10	2.39±1.29E-09	9.26±5.44E-08	0.00±1.36E-08
March	3.59±4.18E-10	2.45±1.50E-09	2.41±0.77E-07	0.00±8.66E-09
April	8.25±4.39E-10	1.80±1.04E-09	1.66±0.80E-07	0.00±1.02E-08
May	1.71±3.70E-10	0.34±1.43E-09	-1.87±7.70E-08	0.00±1.55E-08
June	7.50±4.98E-10	4.15±1.54E-09	-1.76±7.84E-08	0.00±1.57E-08
July	-2.26±5.23E-10	0.96±1.68E-09	9.56±7.96E-08	0.00±1.62E-08
August	2.39±3.84E-10	2.66±1.53E-09	8.26±5.45E-08	0.00±1.25E-08
September	1.61±4.64E-10	2.84±1.29E-09	4.08±0.78E-07	0.00±1.40E-08
October	0.29±4.20E-10	6.74±8.93E-10	2.31±0.89E-07	0.00±1.84E-08
November	2.34±3.85E-10	0.99±1.25E-09	3.12±7.72E-08	0.00±1.31E-08
December	7.58±2.00E-10	3.61±0.64E-09	6.70±7.87E-08	0.00±1.05E-08

Table C - 1.13

1996 Monthly Radioactivity Concentrations (µCi/mL) in Surface Water at Location WN8D1DR

Month	Alpha	Beta	H-3	Sr-90	Cs-137
January	1.82±1.99E-09	8.91±0.49E-08	1.60±0.73E-07	2.42±0.36E-08	0.00±1.26E-08
February	1.45±2.47E-09	7.50±0.54E-08	2.79±0.79E-07	2.76±0.38E-08	0.00±1.37E-08
March	1.52±3.93E-09	6.76±0.72E-08	1.07±0.79E-07	2.44±0.36E-08	0.00±1.62E-08
April	3.04±3.80E-09	3.23±0.65E-08	5.09±7.95E-08	2.32±0.37E-08	0.00±1.56E-08
May	1.43±1.62E-09	1.27±0.46E-08	-1.81±7.70E-08	1.36±0.34E-08	0.00±1.59E-08
June	0.60±1.46E-09	1.51±0.45E-08	-3.18±7.16E-08	2.70±0.99E-09	0.00±1.33E-08
July	0.05±2.11E-09	1.59±0.53E-08	-5.34±7.87E-08	3.34±1.28E-09	0.00±1.38E-08
August	-0.09±1.70E-09	9.27±4.30E-09	-3.29±7.78E-08	4.89±1.85E-09	0.00±1.56E-08
September	0.73±2.28E-09	1.76±0.44E-08	-4.24±7.67E-08	6.20±1.54E-09	0.00±1.36E-08
October	0.74±2.43E-09	2.34±0.48E-08	0.29±6.88E-08	5.00±1.93E-09	0.00±1.58E-08
November	0.59±2.70E-09	2.15±0.49E-08	1.27±0.81E-07	6.61±1.68E-09	0.00±1.07E-08
December	0.40±2.77E-09	2.15±0.47E-08	5.80±7.82E-08	6.61±1.93E-09	0.00±1.57E-08

Table C - 1.14

1996 Radioactivity Concentrations (μCi/mL) in Surface Water at Location WNDCELD

Month	Alpha	Beta	H-3	Cs-137	I-129	Sr-90
January	0.42±3.26E-10	1.32±1.20E-09				
February	3.13±3.56E-10	1.23±1.22E-09				
March	3.59±2.76E-10	1.63±0.83E-09				
1st Qtr			4.04±7.81E-08	0.00±1.46E-08	7.95±7.70E-10	8.93±2.46E-09
April	0.97±3.45E-10	1.99±1.17E-09				
May	4.67±5.38E-10	1.26±1.21E-09				
June	5.91±7.96E-10	0.87±1.24E-09				
2nd Qtr			-0.53±7.80E-08	0.00±1.21E-08	-2.34±9.06E-10	1.29±0.67E-09
July	2.00±7.33E-10	7.28±1.15E-09				
August	1.83±0.76E-09	4.75±1.04E-09				
September	0.11±7.13E-10	4.41±1.44E-09				
3rd Qtr			1.68±0.77E-07	0.00±1.65E-08	2.56±7.57E-10	2.37±1.00E-09
October	2.83±6.36E-10	1.80±1.33E-09				
November	1.70±3.13E-10	-0.56±8.85E-10				
December	5.28±4.80E-10	1.83±1.37E-09				
4th Qtr			1.18±0.79E-07	0.00±2.29E-08	-2.22±8.09E-10	3.61±1.19E-09

Table C - 1.15

1996 Monthly Radioactivity Concentrations (μCi/mL), pH, and Conductivity at Site Potable Water Location WNDNKEL

Month	Alpha	Beta	H-3	pH (standard units)	Conductivity (μmhos/cm@25°C)
January	-2.37±2.99E-10	2.55±0.77E-09	4.03±7.78E-08	7.90	210
February	0.28±2.11E-10	3.32±0.59E-09	3.50±7.72E-08	7.48	220
March	1.32±2.88E-10	9.94±7.05E-10	-9.42±5.54E-08	8.78	190
April	1.22±3.24E-10	1.16±0.74E-09	8.46±7.66E-08	8.07	208
May	0.78±3.42E-10	1.88±0.74E-09	0.95±7.58E-08	8.23	162
June	6.76±4.10E-10	2.10±0.80E-09	-2.52±7.54E-08	8.51	218
July	2.50±5.51E-10	1.75±0.83E-09	1.38±0.81E-07	6.52	252
August	0.84±4.41E-10	2.26±0.87E-09	-9.94±7.89E-08	6.92	240
September	1.00±4.82E-10	1.43±0.81E-09	-0.58±7.66E-08	8.03	260
October	6.96±5.10E-10	2.48±0.91E-09	1.59±0.82E-07	8.35	249
November	0.61±2.40E-10	1.29±0.83E-09	1.02±0.81E-07	8.07	192
December	1.51±2.37E-10	1.28±0.56E-09	-6.88±7.72E-08	8.78	186

Table C - 1.16

1996 Monthly Radioactivity Concentrations (µCi/mL), pH, and Conductivity at Site Potable Water Location WNDNKMS

Month	Alpha	Beta	H-3	pH (standard units)	Conductivity (µmhos/cm@25°C)
January	1.09±3.62E-10	1.96±0.74E-09	1.32±0.78E-07	7.20	203
February	1.45±3.18E-10	3.96±0.87E-09	2.45±7.79E-08	7.41	205
March	1.82±2.92E-10	1.13±0.71E-09	-1.25±0.78E-07	8.62	193
April	-0.96±2.89E-10	1.38±0.75E-09	-6.87±7.76E-08	8.04	184
May	-0.32±3.20E-10	2.36±0.77E-09	1.70±7.64E-08	8.41	157
June	4.10±3.63E-10	1.90±0.76E-09	-4.15±7.53E-08	8.14	223
July	2.84±4.72E-10	1.76±0.82E-09	8.20±5.70E-08	6.90	237
August	4.20±4.18E-10	1.06±0.79E-09	-7.19±5.67E-08	7.33	203
September	3.34±4.88E-10	2.34±0.86E-09	3.40±7.75E-08	8.08	252
October	1.22±4.47E-10	1.70±0.81E-09	9.12±8.19E-08	7.64	228
November	0.00±3.53E-10	1.42±0.82E-09	4.18±8.08E-08	7.90	191
December	0.26±3.12E-10	1.60±0.80E-09	-2.00±7.76E-08	8.61	203

Table C - 1.17

1996 Monthly Radioactivity Concentrations (µCi/mL), pH, and Conductivity at Site Potable Water Location WNDNKMP

Month	Alpha	Beta	H-3	pH (standard units)	Conductivity (µmhos/cm@25°C)
January	0.93±2.45E-10	1.93±0.52E-09	1.46±0.55E-07	7.59	201
February	0.03±3.16E-10	1.25±0.73E-09	1.18±0.76E-07	7.43	232
March	1.36±3.01E-10	1.30±0.76E-09	-8.46±7.87E-08	8.26	170
April	0.14±3.47E-10	1.73±0.78E-09	0.58±7.85E-08	7.96	182
May	-1.15±3.12E-10	1.84±0.74E-09	4.84±5.42E-08	8.17	170
June	2.05±2.98E-10	2.11±0.77E-09	-7.77±7.58E-08	8.17	208
July	3.71±5.53E-10	1.31±0.81E-09	3.97±7.96E-08	7.18	244
August	4.64±5.41E-10	4.83±1.00E-09	-2.52±7.95E-08	7.81	253
September	0.61±5.11E-10	2.20±0.86E-09	1.22±0.78E-07	8.02	262
October	6.92±5.07E-10	1.37±0.86E-09	5.82±8.11E-08	8.01	255
November	-1.14±3.72E-10	1.32±0.83E-09	2.87±8.09E-08	7.69	205
December	1.68±3.36E-10	7.76±7.56E-10	3.03±5.55E-08	8.36	180

Table C - 1.18

1996 Monthly Radioactivity Concentrations (µCi/mL), pH, Conductivity, Nitrate-Nitrogen, and Metals Concentrations at Site Potable Water Location WNDNKUR

Month	**Alpha**	**Beta**	**H-3**	**pH** (standard units)	**Conductivity** (µmhos/cm@25°C)
January	2.30±3.82E-10	1.35±0.70E-09	2.35±0.78E-07	7.53	211
February	1.17±2.57E-10	1.36±0.72E-09	1.00±0.77E-07	7.51	218
March	0.54±2.83E-10	1.15±0.72E-09	-1.05±0.78E-07	8.59	172
April	-1.37±1.99E-10	1.65±0.54E-09	-1.02±0.78E-07	8.29	180
May	0.22±3.23E-10	1.56±0.74E-09	3.50±7.65E-08	8.52	171
June	6.45±3.91E-10	1.75±0.78E-09	-3.26±7.56E-08	8.58	213
July	-1.38±4.68E-10	1.21±0.80E-09	-3.29±7.88E-08	7.49	244
August	4.80±3.39E-10	1.29±0.57E-09	-0.26±7.97E-08	7.50	236
September	1.42±4.85E-10	2.36±0.86E-09	-0.16±7.71E-08	8.17	262
October	2.50±4.23E-10	1.36±0.85E-09	1.64±0.83E-07	8.24	262
November	-3.31±3.24E-10	1.24±0.82E-09	1.87±8.04E-08	7.58	188
December	3.74±3.70E-10	1.10±0.78E-09	0.60±7.71E-08	8.73	178

Date	**Nitrate-N** (mg/L)	**Arsenic** Total (µg/L)	**Cadmium** Total (µg/L)	**Chromium** Total (µg/L)	**Mercury** Total (µg/L)
12/11	0.52	<25.0	<2.0	<10.0	<0.40

	Selenium Total (µg/L)	**Barium** Total (µg/L)	**Fluoride** (mg/L)
12/11	<2.00	<200.0	<0.10

Table C - 1.19

1996 Radioactivity Concentrations (µCi/mL), NPOC, TOX, and pH in Surface Water at Location WNNDADR

Month	Alpha	Beta	H-3	Cs-137	I-129	Sr-90
January	1.47±0.71E-09	1.29±0.04E-07	1.06±0.09E-06	0.00±1.43E-08		
February	0.42±1.10E-09	1.40±0.06E-07	1.55±0.10E-06	0.00±1.07E-08		
March	1.27±0.92E-09	9.24±0.47E-08	7.30±0.86E-07	0.00±1.37E-08		
1st Qtr					-0.01±1.05E-09	5.75±0.54E-08
April	9.11±6.88E-10	1.24±0.04E-07	1.00±0.10E-06	0.00±1.55E-08		
May	1.85±1.41E-09	1.59±0.06E-07	1.80±0.11E-06	0.00±1.66E-08		
June	0.69±1.06E-09	1.50±0.04E-07	1.83±0.12E-06	0.00±1.32E-08		
2nd Qtr					1.52±1.69E-09	4.91±0.33E-08
July	0.69±1.42E-09	1.64±0.05E-07	3.22±0.15E-06	0.00±1.43E-08		
August	-0.36±1.78E-09	1.76±0.07E-07	4.17±0.18E-06	0.00±1.41E-08		
September	-1.37±1.39E-09	1.63±0.06E-07	2.87±0.14E-06	0.00±1.30E-08		
3rd Qtr					0.89±1.04E-09	8.38±0.43E-08
October	-0.57±1.87E-09	2.09±0.07E-07	2.47±0.13E-06	0.00±1.51E-08		
November	1.79±1.29E-09	1.39±0.06E-07	1.13±0.10E-06	0.00±1.46E-08		
December	1.38±0.79E-09	1.41±0.04E-07	7.89±0.90E-07	0.00±1.34E-08		
4th Qtr					0.08±1.18E-09	8.17±0.51E-08

	NPOC (mg/L)	TOX (µg/L)	pH (standard units)
January	4.48	30.4	7.6
February	5.40	8.2	7.7
March	4.80	13.8	7.7
April	5.42	15.1	7.1
May	6.40	12.2	7.5
June	6.95	15.5	7.8
July	8.72	23.3	7.3
August	9.12	21.2	7.7
September	9.45	18.8	7.6
October	9.23	19.8	7.6
November	6.56	15.4	7.7
December	5.65	7.2	7.4

Table C - 1.20

1996 Radioactivity Concentrations (µCi/mL), NPOC, and TOX in Groundwater at Location WNNDATR

Month	Alpha	Beta	H-3	Cs-137	I-129
January	3.17±1.54E-09	9.83±0.36E-08	2.09±0.07E-05	0.00±1.27E-08	
February	1.14±0.86E-09	3.96±0.40E-08	3.10±0.10E-06	0.00±9.15E-09	
March	1.95±1.93E-09	9.23±0.50E-08	1.34±0.04E-05	0.00±1.50E-08	
1st Qtr					0.81±7.82E-10
April	3.18±2.17E-09	9.16±0.50E-08	1.85±0.06E-05	0.00±1.13E-08	
May	1.74±1.22E-09	6.48±0.42E-08	1.36±0.05E-05	0.00±1.66E-08	
June	3.82±2.36E-09	8.63±0.50E-08	2.20±0.07E-05	0.00±1.23E-08	
2nd Qtr					5.02±9.30E-10
July	2.76±2.43E-09	7.98±0.48E-08	2.03±0.06E-05	0.00±1.50E-08	
August	2.97±1.73E-09	6.08±0.42E-08	6.16±0.23E-06	0.00±1.34E-08	
September	1.64±1.69E-09	5.99±0.41E-08	1.19±0.04E-05	0.00±1.13E-08	
3rd Qtr					-0.08±1.07E-09
October	2.78±1.14E-09	6.02±0.30E-08	4.88±0.20E-06	0.00±8.53E-09	
November	0.99±1.72E-09	6.68±0.45E-08	7.44±0.27E-06	0.00±1.48E-08	
December	2.57±1.51E-09	8.02±0.47E-08	4.16±0.18E-06	0.00±1.43E-08	
4th Qtr					2.10±8.64E-10

	NPOC (mg/L)	**TOX** (µg/L)
January	4.00	16.0
February	2.60	9.8
March	3.40	13.1
April	3.10	15.3
May	4.50	7.6
June	7.70	11.4
July	4.00	12.0
August	3.70	14.0
September	6.10	9.2
October	5.40	21.7
November	7.40	18.4
December	5.10	12.8

Table C - 1.21

1996 Radioactivity Concentrations (µCi/mL) and Water Quality Parameters in Surface Water at the WNSTAW-Series Sampling Locations

Location	**Alpha**	**Beta**	**H-3**	**pH** (standard units)	**Conductivity** (µmhos/cm@25°C)
WNSTAW4	3.27±5.65E-10	6.45±2.21E-09	-1.04±0.86E-07	6.33	111
WNSTAW5	0.39±4.82E-10	-0.49±1.84E-09	-3.40±6.10E-08	6.63	57
WNSTAW6	0.54±6.54E-10	3.02±2.06E-09	-2.25±8.55E-08	7.79	199
WNSTAW9	3.21±6.40E-10	-0.58±1.86E-09	-4.62±8.42E-08	6.83	174
WNSTAWB*	9.08±6.79E-10	1.48±1.40E-09	-0.50±8.66E-08	7.22	378

	Date	**Chloride** (mg/L)	**Iron** Total (µg/L)	**Manganese** Total (µg/L)	**Sodium** Total (µg/L)	**Nitrate+ Nitrite** (mg/L)	**Sulfate** (mg/L)
WNSTAW4	11/06	4.8	647	132	4180	<0.05	9.7
WNSTAW5	11/06	1.8	525	52	2130	<0.05	10.9
WNSTAW6	11/06	1.9	143	11	1480	<0.05	13.2
WNSTAW9	11/06	4.8	370	163	5000	0.08	15.6
WNSTAWB*	11/06	18.4	<100	19	12500	<0.05	17.8

** Background location.*

Table C - 1.22

1996 Radioactivity Concentrations (µCi/mL) in Surface Water Upstream of the WVDP at Fox Valley (WFBCBKG)

Month	Alpha	Beta	H-3	Sr-90	Cs-137
January	2.48±0.71E-09	4.39±1.14E-09	1.55±7.38E-08		
February	1.92±0.70E-09	3.68±1.22E-09	1.26±0.78E-07		
March	4.04±2.79E-10	2.06±0.90E-09	9.79±7.85E-08		
1st Qtr				2.70±1.30E-09	0.00±4.30E-09
April	1.51±0.63E-09	1.36±1.24E-09	4.94±8.37E-08		
May	1.17±0.62E-09	1.53±1.28E-09	-2.18±7.65E-08		
June	1.12±0.91E-09	2.37±1.29E-09	-0.42±7.77E-08		
2nd Qtr				2.01±0.99E-09	0.00±4.64E-09
July	6.36±8.88E-10	1.48±1.24E-09	-1.41±0.76E-07		
August	1.57±8.85E-10	3.98±1.36E-09	-3.25±7.84E-08		
September	9.99±8.87E-10	1.94±1.26E-09	0.80±7.60E-08		
3rd Qtr				8.87±5.67E-10	0.00±4.58E-09
October	7.19±8.60E-10	1.43±1.22E-09	-1.15±0.80E-07		
November	6.50±6.07E-10	0.68±1.31E-09	-5.29±8.05E-08		
December	1.17±0.60E-09	1.28±1.35E-09	-7.12±7.61E-08		
4th Qtr				2.11±1.48E-09	0.00±3.83E-09

	C-14	I-129	U-232	U-233/234	U-235/236
1st Qtr	-1.50±1.30E-09	2.86±8.63E-10	2.52±2.57E-11	1.68±0.55E-10	2.08±1.86E-11
2nd Qtr	-0.48±1.56E-09	-2.68±8.45E-10	1.22±5.38E-11	1.57±0.68E-10	1.05±2.11E-11
3rd Qtr	-0.34±3.72E-09	3.36±9.68E-10	7.89±4.66E-11	1.29±0.53E-10	2.90±2.64E-11
4th Qtr	1.40±0.94E-08	0.00±1.73E-09	3.11±5.13E-11	1.98±0.81E-10	5.69±4.05E-11

	U-238	Total U (µg/mL)	Pu-238	Pu-239/240	Am-241
1st Qtr	7.89±3.80E-11	5.34±0.22E-04	4.89±0.82E-11	6.05±3.13E-12	1.47±2.94E-11
2nd Qtr	1.26±0.62E-10	2.38±0.03E-04	0.87±3.46E-11	-0.01±2.09E-11	6.39±5.36E-11
3rd Qtr	7.62±4.12E-11	3.11±0.06E-04	1.19±4.50E-11	-0.06±3.47E-11	6.91±4.29E-11
4th Qtr	2.09±0.80E-10	-1.96±0.15E-04	1.18±1.52E-11	0.94±1.29E-11	1.84±2.39E-11

	Tc-99
1st Qtr	-0.42±1.82E-09
2nd Qtr	-6.35±1.12E-09
3rd Qtr	4.08±2.21E-09
4th Qtr	-3.38±1.73E-09

See Table C-1.27 for a summary of water quality parameters at WFBCBKG.

Table C - 1.23

1996 Radioactivity Concentrations (µCi/mL) in Surface Water Downstream of the WVDP at Thomas Corners (WFBCTCB)

Month	Alpha	Beta	H-3	Sr-90	Cs-137
January	1.04±0.52E-09	6.04±1.20E-09	1.15±0.78E-07		
*February**	6.93±5.03E-10	6.84±1.21E-09	5.70±7.81E-08		
*March**	1.71±0.63E-09	9.00±1.55E-09	3.88±7.81E-08		
1st Qtr				4.73±1.93E-09	0.00±4.37E-09
April	7.06±6.17E-10	5.48±1.47E-09	3.32±8.33E-08		
*May**	8.10±5.86E-10	5.12±1.47E-09	7.36±7.70E-08		
*June**	3.62±7.95E-10	6.04±1.48E-09	2.10±7.78E-08		
2nd Qtr				2.60±1.05E-09	0.00±4.39E-09
July	1.08±9.68E-10	1.16±0.18E-08	-1.16±7.75E-08		
*August**	0.28±1.11E-09	1.30±0.18E-08	0.80±7.87E-08		
September	9.14±9.83E-10	1.44±0.18E-08	1.68±0.78E-07		
3rd Qtr				4.93±0.96E-09	0.00±4.51E-09
October	1.21±0.59E-09	9.32±1.18E-09	-4.36±8.08E-08		
*November**	3.14±5.44E-10	4.59±1.51E-09	-7.16±8.04E-08		
*December**	2.32±4.64E-10	4.39±1.50E-09	-1.46±7.86E-08		
4th Qtr				2.33±1.07E-09	0.00±5.81E-09

Table C - 1.24

1996 Monthly Radioactivity Concentrations (µCi/mL) in Surface Water Downstream of the WVDP in Cattaraugus Creek at Felton Bridge (WFFELBR)

Month	Alpha	Beta	H-3	Sr-90	Cs-137
January	1.61±0.58E-09	4.06±1.00E-09	4.01±7.67E-08	4.58±1.89E-09	0.00±4.46E-09
*February**	4.85±6.54E-10	9.40±1.64E-09	1.66±0.77E-07	0.89±1.36E-09	0.00±4.87E-09
*March**	8.72±5.29E-10	3.71±0.96E-09	0.27±7.67E-08	3.54±1.44E-09	0.00±4.40E-09
April	5.09±1.66E-09	5.16±1.46E-09	-7.07±8.14E-08	3.50±1.66E-09	0.00±4.54E-09
*May**	5.92±1.75E-09	5.79±1.57E-09	-2.12±7.63E-08	3.26±1.33E-09	0.00±4.37E-09
*June**	4.24±1.81E-09	5.31±1.54E-09	6.31±7.83E-08	1.40±0.68E-09	0.00±4.77E-09
July	0.17±1.08E-09	2.70±1.46E-09	-1.08±0.76E-07	4.28±1.37E-09	0.00±4.43E-09
*August**	1.91±1.18E-09	5.32±1.43E-09	3.94±7.92E-08	8.78±6.09E-10	0.00±4.47E-09
September	1.88±0.74E-09	2.39±0.93E-09	2.13±7.62E-08	1.40±0.62E-09	0.00±4.42E-09
October	1.03±1.15E-09	2.88±1.41E-09	-1.02±0.81E-07	1.23±0.97E-09	0.00±4.45E-09
*November**	5.18±1.92E-09	7.33±4.37E-09	-1.05±0.80E-07	2.82±1.43E-09	0.00±7.15E-09
*December**	1.47±0.82E-09	2.79±1.46E-09	6.69±7.84E-08	3.20±1.61E-09	0.00±4.46E-09

** Month of discharge from WNSP001.*

Table C - 1.25

*1996 Radioactivity Concentrations (µCi/mL) in Surface Water Upstream of the WVDP in Cattaraugus Creek at Bigelow Bridge (WFBIGBR)**

Month	Alpha	Beta	H-3	Sr-90	Cs-137
January	3.85±5.66E-10	1.84±0.98E-09	1.88±0.78E-07	4.61±1.69E-09	0.00±4.40E-09
February	7.23±4.39E-10	2.90±0.74E-09	1.27±0.56E-07	4.53±2.07E-09	0.00±4.43E-09
March	5.66±5.12E-10	2.30±0.98E-09	6.25±7.89E-08	5.67±1.74E-09	0.00±4.35E-09
April	1.43±0.73E-09	4.14±1.09E-09	-1.82±7.90E-08	1.22±1.28E-09	0.00±4.26E-09
May	8.01±6.52E-10	1.94±0.75E-09	-3.64±7.59E-08	1.85±1.15E-09	0.00±4.13E-09
June	6.37±7.50E-10	2.32±0.77E-09	-5.97±7.71E-08	1.86±0.81E-09	0.00±4.09E-09
July	1.32±1.26E-09	1.85±1.07E-09	-3.47±7.64E-08	5.43±8.98E-10	0.00±4.51E-09
August	-7.02±9.80E-10	2.22±1.04E-09	3.36±7.86E-08	0.00±7.48E-10	0.00±4.59E-09
September	2.21±5.85E-10	2.19±0.76E-09	1.07±0.74E-07	4.26±5.20E-10	0.00±4.47E-09
October	0.55±6.14E-10	1.99±0.77E-09	-2.13±0.85E-07	1.51±1.00E-09	0.00±3.12E-09
November	6.15±6.12E-10	1.94±1.08E-09	-7.18±5.79E-08	8.73±9.17E-10	0.00±5.10E-09
December	2.09±0.68E-09	2.28±1.08E-09	-7.64±7.83E-08	2.91±1.56E-09	0.00±4.21E-09

Table C - 1.26

1996 Radioactivity Concentrations (µCi/mL), pH, and Conductivity in Potable Well Water around the WVDP

Well	pH (standard units)	Conductivity (µmhos/cm@25°C)	Alpha	Beta	H-3	Cs-137
WFWEL01	7.15	394	6.02±6.52E-10	5.65±1.55E-09	1.16±5.20E-08	0.00±2.70E-08
WFWEL02	6.71	362	0.57±1.66E-09	2.63±3.92E-09	1.86±7.38E-08	0.00±2.66E-08
WFWEL03	6.81	579	-0.69±1.85E-09	3.02±4.00E-09	1.03±7.32E-08	0.00±1.87E-08
WFWEL04	7.5	2020	3.54±3.53E-09	1.33±3.01E-09	-7.10±7.32E-08	0.00±2.66E-08
WFWEL05	6.44	292	1.66±9.32E-10	4.65±2.73E-09	-3.37±7.43E-08	0.00±1.74E-08
WFWEL06*	8.13	275	1.27±7.15E-10	0.96±1.92E-09	0.38±7.80E-08	0.00±1.69E-08
WFWEL07	6.94	365	1.22±1.68E-09	0.87±3.64E-09	2.70±7.39E-08	0.00±1.20E-08
WFWEL08	7.26	487	1.91±2.20E-09	1.74±3.93E-09	-1.57±0.74E-07	0.00±1.91E-08
WFWEL09	8.25	622	1.48±4.30E-10	-0.23±7.68E-10	-2.11±7.66E-08	0.00±2.25E-08
WFWEL10	7.11	687	-0.75±4.21E-10	-6.08±7.36E-10	-4.86±7.55E-08	0.00±1.32E-08

** Background location*

Table C - 1.27

1996 Surface Water Quality at Locations WFBCBKG, WNSP006, WNSWAMP, and WNSW74A*

Location	Date	pH (standard units)	Conductivity (µmhos/cm@25°C)	NPOC (mg/L)	TOX (µg/L)	Chloride (mg/L)	Sulfate (mg/L)	Nitrate/ Nitrite (mg/L)	Fluoride (mg/L)	Bicarbonate Alkalinity (as $CaCO_3$) (mg/L)	Carbonate Alkalinity (as $CaCO_3$) (mg/L)
WFBCBKG	06/25	7.44	214	2.8	14.0	8.8	25.9	<0.150	<0.10	72	<2.0
WFBCBKG	12/24	7.38	268	2.4	<5.0	8.2	25.5	0.098	<0.10	121	<1.0
WNSP006	06/27	7.50	464	3.4	27.0	63.9	22.4	2.900	<0.10	101	<1.0
WNSP006	12/24	7.68	665	3.9	35.3	122	36.6	4.000	<0.10	156	<1.0
WNSWAMP	06/26	7.37	701	7.1	27.0	89.0	25.0	1.000	0.57	150	<10.0
WNSWAMP	12/24	7.40	800	3.4	21.0	110	32.0	0.760	0.64	190	<1.0
WNSW74A	06/26	7.29	947	5.4	20.0	166	42.9	0.053	0.11	164	<1.0
WNSW74A	12/24	7.26	733	3.2	14.2	76.0	36.9	0.410	<0.10	168	<1.0

	Date	Calcium Total (µg/L)	Magnesium Total (µg/L)	Sodium Total (µg/L)	Potassium Total (µg/L)	Barium Total (µg/L)	Manganese Total (µg/L)	Iron Total (µg/L)
WFBCBKG	05/22	25,200	3,820	6,070	1,830	<200	55.0	2,790
WFBCBKG	10/17	41,300	5,680	8,240	1,500	<200	32.5	484
WNSP006	05/22	40,400	5,680	38,200	2,220	<200	41.0	835
WNSP006	10/17	68,900	9,690	71,700	4,130	<200	27.9	381
WNSWAMP	05/22	74,000	9,600	35,000	2,600	90	980	870
WNSWAMP	10/17	97,000	12,000	53,000	1,500	110	78.0	43
WNSW74A	05/22	95,300	10,700	64,900	1,100	<200	44.0	226
WNSW74A	10/17	79,200	9,600	36,800	1,080	<200	17.3	<100

* *Backgound location.*

Table C - 1.28

1996 Radioactivity Concentrations (µCi/g dry weight from upper 5 cm) in On-site Soils/Sediments

Location	Alpha	Beta	K-40	Co-60	Sr-90	Cs-137
SNSP006	6.66±3.64E-06	5.38±0.65E-05	2.01±0.08E-05	5.44±2.72E-08	9.98±0.78E-06	4.58±0.03E-05
SNSW74A	1.10±0.45E-05	2.62±0.45E-05	1.70±0.07E-05	2.81±2.39E-08	4.53±1.12E-07	3.75±0.08E-06
SNSWAMP	1.99±0.60E-05	5.43±0.67E-05	2.36±0.10E-05	-0.40±2.05E-08	5.57±0.59E-06	1.07±0.05E-06

Location	U-232	U-233/234	U-235/236	U-238	Total U (µg/g)	Pu-239/240
SNSP006	4.56±4.27E-08	5.50±0.96E-07	1.93±1.88E-08	5.71±0.98E-07	1.62±0.02E-00	7.82±2.92E-08
SNSW74A	1.26±2.16E-08	5.51±0.89E-07	5.51±2.68E-08	6.73±1.00E-07	2.01±0.03E-00	1.30±0.29E-07
SNSWAMP	1.59±3.60E-08	9.24±1.54E-07	6.19±3.64E-08	1.07±0.17E-06	2.37±0.03E-00	2.22±1.00E-07

Location	Am-241
SNSP006	6.60±2.67E-08
SNSW74A	2.58±0.91E-07
SNSWAMP	4.70±3.22E-08

Table C - 1.29

1996 Metals Concentrations (mg/kg dry) in On-site Soils/Sediments

Location	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium
SNSP006	10,850	<8.4	11.0	69.5	0.50	0.46
SNSW74A	16,000	1.9	12.0	110	0.58	<0.93
SNSWAMP	24,000	<8.6	11.0	150	0.94	<0.71

Location	Calcium	Chromium	Cobalt	Copper	Iron	Lead
SNSP006	11,000	13.5	11.0	15.0	20,000	17.0
SNSW74A	9,500	20.0	8.6	25.0	23,000	24.0
SNSWAMP	18,000	27.0	13.0	27.0	29,000	19.0

Location	Magnesium	Manganese	Mercury	Nickel	Potassium	Selenium
SNSP006	4,750	820	<0.05	23.0	1,950	1.05
SNSW74A	5,700	1,700	<0.05	22.0	2,700	1.90
SNSWAMP	6,300	1,300	<0.05	35.0	5,800	1.10

Location	Silver	Sodium	Thallium	Vanadium	Zinc
SNSP006	<1	110	1.0	19	59.5
SNSW74A	<2	180	1.6	27	210
SNSWAMP	<1	170	2.2	37	91.0

Table C - 1.30

1996 Radioactivity Concentrations in Surface Soil Collected at Air Sampling Stations around the WVDP (µCi/g dry weight from upper 5 cm)

Location	Alpha	Beta	K-40	Co-60
SFBLKST	1.10±0.15E-05	2.42±0.19E-05	1.49±0.20E-05	-0.33±2.71E-08
SFBOEHN	1.31±0.16E-05	1.94±0.18E-05	1.41±0.16E-05	0.49±2.01E-08
SFFXVRD	1.14±0.15E-05	1.75±0.18E-05	1.26±0.16E-05	-0.68±2.71E-08
SFGRVAL*	1.25±0.16E-05	2.90±0.20E-05	1.26±0.15E-05	-1.39±2.19E-08
SFNASHV*	1.42±0.18E-05	2.50±0.20E-05	1.89±0.20E-05	-0.36±2.08E-08
SFRSPRD	1.18±0.15E-05	1.77±0.17E-05	1.37±0.16E-05	1.62±1.86E-08
SFRT240	1.19±0.23E-05	3.79±0.32E-05	1.19±0.15E-05	2.73±2.40E-08
SFSPRVL	1.54±0.28E-05	4.00±0.32E-05	1.49±0.17E-05	-0.86±1.83E-08
SFTCORD	1.62±0.28E-05	3.32±0.31E-05	2.20±0.24E-05	0.16±2.23E-08
SFWEVAL	1.43±0.25E-05	2.89±0.29E-05	1.32±0.16E-05	-1.36±2.01E-08

	Sr-90	Cs-137	Pu-239/240	Am-241
SFBLKST	8.12±6.31E-07	3.67±0.93E-07	2.32±7.41E-09	-0.14±1.77E-08
SFBOEHN	0.59±5.52E-08	6.48±0.86E-07	1.72±1.31E-08	-0.45±1.36E-08
SFFXVRD	-3.00±6.97E-07	5.82±0.90E-07	1.06±1.09E-08	1.02±1.72E-08
SFGRVAL*	6.25±5.42E-07	9.85±1.02E-07	2.17±1.39E-08	1.55±1.58E-08
SFNASHV*	3.09±2.53E-07	6.81±3.84E-08	7.34±8.68E-09	0.52±1.76E-08
SFRSPRD	1.03±0.40E-06	1.58±0.15E-06	1.10±1.12E-08	2.59±1.46E-08
SFRT240	2.87±0.53E-06	7.17±1.06E-07	1.94±1.22E-08	1.15±1.38E-08
SFSPRVL	-3.24±4.24E-07	3.73±0.52E-07	1.93±1.40E-08	1.23±1.35E-08
SFTCORD	1.73±2.70E-07	6.18±0.88E-07	1.23±1.38E-08	0.83±1.74E-08
SFWEVAL	-1.39±4.11E-07	9.21±1.29E-07	2.53±1.56E-08	1.49±1.72E-08

	U-232	U-233/234	U-235/236	U-238	Total U (µg/g)
SFBOEHN	0.60±1.82E-08	8.16±0.94E-07	1.09±0.29E-07	6.59±0.82E-07	2.14±0.06E-00
SFGRVAL*	1.89±1.38E-08	7.55±0.87E-07	6.68±2.16E-08	8.20±0.91E-07	2.12±0.05E-00
SFRSPRD	1.94±1.96E-08	7.46±0.88E-07	6.59±2.21E-08	6.81±0.83E-07	1.87±0.05E-00

** Background location.*

Table C - 1.31

1996 Radioactivity Concentrations in Stream Sediments around the WVDP (µCi/g dry weight from upper 15 cm)

Location	Alpha	Beta	K-40	Cs-137	Sr-90	Co-60
SFBCSED*	1.36±0.38E-05	1.99±0.36E-05	1.50±0.16E-05	3.88±3.43E-08	3.46±2.90E-08	-0.57±1.74E-08
SFBISED*	2.18±0.50E-05	2.26±0.39E-05	1.79±0.20E-05	7.84±3.10E-08	-5.77±0.82E-08	0.81±2.24E-08
SFCCSED	2.03±0.47E-05	2.35±0.37E-05	1.82±0.16E-05	1.20±0.36E-07	-1.20±2.43E-08	1.06±1.94E-08
SFSDSED	1.74±0.41E-05	2.45±0.38E-05	1.73±0.19E-05	3.46±0.57E-07	-1.16±0.14E-07	-0.31±1.63E-08
SFTCSED	1.23±0.40E-05	1.91±0.36E-05	1.66±0.18E-05	1.56±0.21E-06	3.18±0.54E-07	0.61±1.51E-08

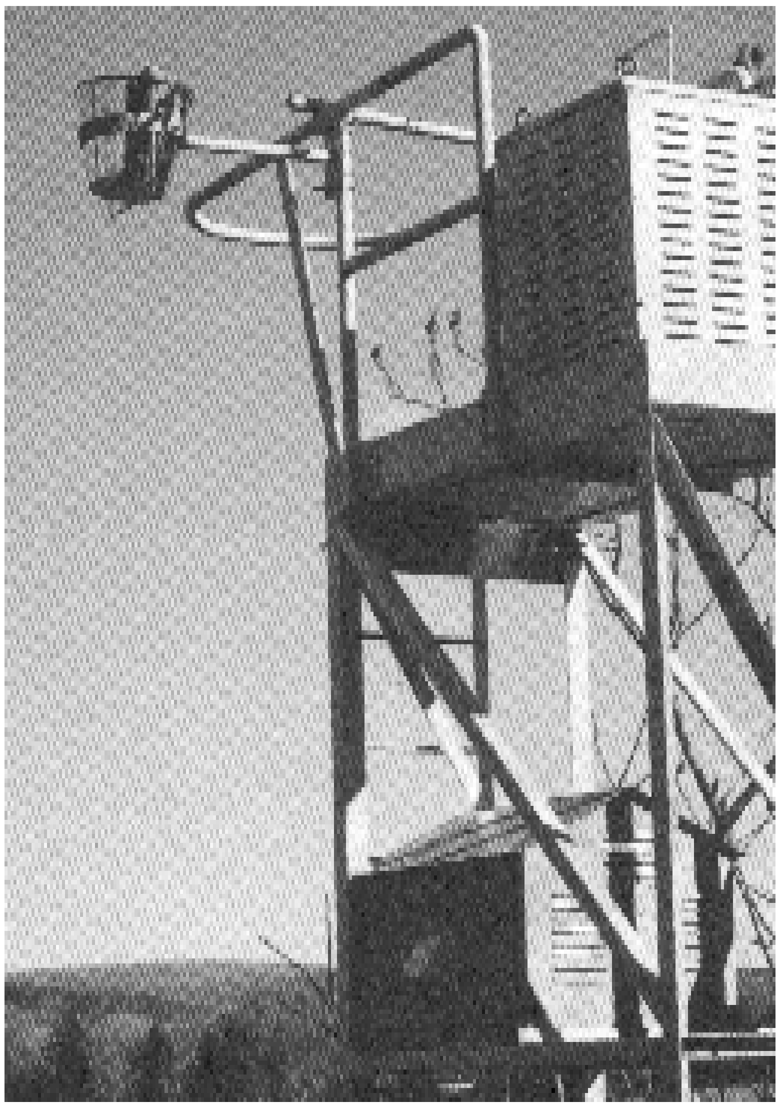
Location	U-233/234	U-235/236	U-238	Pu-238	Pu-239/240	Am-241
SFBCSED*	7.08±0.88E-07	4.50±2.20E-08	7.08±0.86E-07	4.07±2.26E-08	3.04±1.53E-08	1.46±1.53E-08
SFBISED*	0.27±1.83E-08	0.27±1.23E-08	1.37±1.99E-08	-4.17±3.75E-08	1.06±1.64E-08	8.60±3.46E-08
SFCCSED	9.77±1.00E-07	8.38±2.78E-08	9.15±0.95E-07	1.09±2.36E-08	0.19±1.09E-08	1.39±0.48E-07
SFSDSED	9.29±1.44E-07	1.27±0.50E-07	8.51±1.33E-07	3.89±2.75E-08	2.16±4.31E-09	7.28±4.02E-08
SFTCSED	7.77±1.25E-07	5.66±3.30E-08	8.27±1.26E-07	1.32±2.38E-08	9.57±8.58E-09	4.16±0.36E-06

Location	U-232	Total U (µg/g)
SFBCSED*	3.92±3.04E-08	1.71±0.03E-00
SFBISED*	0.46±3.38E-08	2.19±0.04E-00
SFCCSED	1.58±2.86E-08	2.64±0.05E-00
SFSDSED	2.75±2.77E-08	2.11±0.04E-00
SFTCSED	6.91±4.69E-08	2.13±0.04E-00

** Background location.*

Appendix C - 2

Summary of Air Monitoring Data



Ambient Air and Atmospheric Fallout Samples are Collected from Numerous Locations in the West Valley Area

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Table C - 2.1

1996 Airborne Radioactive Effluent Totals (curies) from the Main Ventilation Stack (ANSTACK)

Month	**Alpha**	**Beta**	**H-3**
January	2.13±2.18E-08	1.33±0.02E-05	1.65±0.03E-03
February	2.44±2.09E-08	8.91±0.76E-07	8.61±0.30E-04
March	2.17±2.31E-08	8.51±0.19E-06	8.89±0.30E-04
April	4.67±2.16E-08	1.74±0.09E-06	2.58±0.05E-03
May	1.44±2.06E-08	3.55±0.13E-06	4.13±0.07E-03
June	1.89±1.97E-08	1.67±0.09E-06	2.11±0.08E-03
*July***	2.08±1.55E-08	3.09±0.11E-06	6.63±0.12E-03
August	8.37±2.35E-08	1.75±0.03E-05	9.11±0.17E-03
September	3.14±1.92E-08	8.49±0.18E-06	1.18±0.02E-02
October	3.77±2.11E-08	1.31±0.03E-05	3.42±0.11E-03
November	5.14±2.43E-08	1.94±0.03E-05	2.99±0.10E-03
December	3.57±2.00E-08	1.44±0.02E-05	6.57±0.13E-03
Annual Total	4.08±0.73E-07	1.06±0.01E-04	5.28±0.04E-02

	Co-60	**Sr-90**	**I-129**	**Cs-134**	**Cs-137**
1st Qtr	-0.56±2.46E-08	5.90±0.39E-07	6.21E-06*	0.10±3.45E-08	2.26±0.03E-05
2nd Qtr	1.49±4.56E-08	6.93±0.42E-07	6.21E-06*	-2.85±4.86E-08	6.01±0.25E-06
3rd Qtr	2.47±3.52E-08	8.07±1.12E-07	4.30E-04*	1.93±5.60E-08	2.49±0.05E-05
4th Qtr	-0.61±2.40E-08	1.22±0.05E-06	7.54±0.88E-04	-1.35±3.51E-08	3.43±0.56E-05
Total	2.79±6.71E-08	3.31±0.14E-06	1.20E-03*	-2.18±8.90E-08	8.77±0.56E-05

	Eu-154	**U-232**	**U-233/234**	**U-235/236**	**U-238**
1st Qtr	5.03±6.70E-08	-0.03±2.48E-09	1.34±0.33E-08	1.01±0.83E-09	9.63±2.58E-09
2nd Qtr	-0.55±1.08E-07	-0.33±1.06E-08	1.31±0.42E-08	1.05±1.72E-09	1.36±0.41E-08
3rd Qtr	0.84±1.06E-07	-0.87±1.95E-09	1.69±0.46E-08	2.68±1.88E-09	2.03±0.50E-08
4th Qtr	3.78±7.57E-08	3.09±3.45E-09	9.94±4.23E-09	1.04±1.21E-09	1.01±0.38E-08
Total	1.17±1.82E-07	-0.11±1.16E-08	5.34±0.82E-08	5.79±2.94E-09	5.35±0.80E-08

	Total U (g)	**Pu-238**	**Pu-239/240**	**Am-241**
1st Qtr	2.89±0.04E-02	2.25±0.29E-08	1.86±0.36E-08	3.35±0.68E-08
2nd Qtr	6.01±0.08E-02	8.40±3.49E-09	9.27±3.90E-09	8.02±6.54E-08
3rd Qtr	1.73±0.03E-02	9.89±3.90E-09	1.38±0.36E-08	2.97±0.66E-08
4th Qtr	2.63±0.03E-02	1.99±0.48E-08	2.39±0.53E-08	6.80±0.90E-08
Total	1.33±0.01E-01	6.07±0.76E-08	6.55±0.83E-08	2.11±0.67E-07

* *Estimated. value*

** *Solidification of high-level waste in glass began in July 1996.*

Table C - 2.2

Comparison of 1996 Main Stack Exhaust Radioactivity Concentrations with Department of Energy Guidelines

Isotope	Half-Life (Years)	Total Radioactivity Released[a] (Ci)	(Becquerels)	Average Concentration (µCi/mL)	DCG (µCi/mL)	% of DCG
Alpha	N/A	4.08±0.73E-07	1.51±0.27E+04	5.51±0.99E-16	N/A[b]	N/A
Beta	N/A	1.06±0.01E-04	3.92±0.04E+06	1.43±0.01E-13	N/A[b]	N/A
H-3	12.35	5.28±0.04E-02	1.95±0.01E+09	7.14±0.05E-11	1.00E-07	0.1
Co-60	5.27	2.79±6.71E-08	1.03±2.48E+03	3.77±9.06E-17	8.00E-11	0.0
Sr-90	29.124	3.31±0.14E-06	1.22±0.05E+05	4.47±0.18E-15	9.00E-12	0.0
I-129	1.57E+07	1.20E-03	4.44E+07	1.62E-12	7.00E-11	2.3
Cs-134	2.06	-2.18±8.90E-08	-0.81±3.29E+03	-0.29±1.20E-16	2.00E-10	0.0
Cs-137	30	8.77±0.56E-05	3.25±0.21E+06	1.19±0.08E-13	4.00E-10	0.0
Eu-154	8.8	1.17±1.82E-07	4.34±6.73E+03	1.58±2.46E-16	5.00E-11	0.0
U-232[c]	72	-0.11±1.16E-08	-0.41±4.30E+02	-0.15±1.57E-17	2.00E-14	<0.1
U-233/234[c]	2.45E+05	5.34±0.82E-08	1.97±0.30E+03	7.21±1.11E-17	9.00E-14	0.1
U-235/236[c]	7.04E+08	5.79±2.94E-09	2.14±1.09E+02	7.83±3.97E-18	1.00E-13	0.0
U-238[c]	4.47E+09	5.35±0.80E-08	1.98±0.30E+03	7.23±1.08E-17	1.00E-13	0.1
Pu-238	87.07	6.07±0.76E-08	2.24±0.28E+03	8.20±1.03E-17	3.00E-14	0.3
Pu-239/240	2.41E+04	6.55±0.83E-08	2.42±0.31E+03	8.86±1.12E-17	2.00E-14	0.4
Am-241	432	2.11±0.67E-07	7.82±2.47E+03	2.86±0.90E-16	2.00E-14	1.4
Total % of DCGs[d]						**4.8**

[a] Total volume released at 50,000 cfm = 7.4E+14 mL/yr.

[b] Derived concentration guides (DCGs) are not specified for gross alpha and gross beta activity.

[c] Total uranium = 1.33±0.01E-01 g; average = 1.79±0.01E-10 µg/mL.

[d] Total percent DCGs for applicable measured radionuclides.

N/A - Not applicable.

DCGs are listed for reference only. They are applicable to average concentrations at the site boundary but not to stack concentrations, as might be inferred from their inclusion in this table.

Table C - 2.3

1996 Airborne Radioactive Effluent Totals (curies) *from the Vitrification System Ventilation Stack (ANVITSK)***

Month	Alpha	Beta
January	-6.30±7.54E-09	4.13±2.24E-08
February	-2.00±7.94E-09	1.85±2.20E-08
March	-4.00±6.11E-09	2.73±1.73E-08
April	6.72±8.16E-09	0.14±2.09E-08
May	1.18±0.94E-08	-1.40±1.97E-08
June	-0.52±7.75E-09	-1.20±1.94E-08
*July***	0.09±5.88E-09	-0.60±2.02E-08
August	2.91±5.99E-09	-0.18±2.02E-08
September	-0.99±6.82E-09	-0.75±1.81E-08
October	-1.80±5.95E-09	-1.70±1.92E-08
November	4.84±7.73E-09	-0.02±2.10E-08
December	5.58±5.96E-09	0.23±1.80E-08
Annual Total	1.62±2.49E-08	3.12±6.90E-08

	Co-60	Sr-90	I-129	Cs-134	Cs-137
1st Qtr	0.27±1.13E-08	1.99±5.95E-09	5.96E-08*	0.10±1.10E-08	-0.22±1.16E-08
2nd Qtr	0.87±1.99E-08	-0.25±5.41E-09	5.75E-08*	-0.53±1.86E-08	-1.92±1.91E-08
3rd Qtr	-0.71±2.10E-08	2.10±1.66E-08	1.28E-07*	-0.05±1.78E-08	1.17±1.81E-08
4th Qtr	0.27±1.56E-08	5.25±5.26E-09	1.28±0.53E-07	-1.36±1.59E-08	0.41±1.69E-08
Total	0.69±3.48E-08	2.80±1.92E-08	3.73E-07*	-1.84±3.22E-08	-0.56±3.34E-08

	Eu-154	U-232	U-233/234	U-235/236	U-238
1st Qtr	3.79±3.29E-08	3.69±1.69E-09	5.26±1.40E-09	5.95±5.46E-10	4.91±1.27E-09
2nd Qtr	-4.68±5.48E-08	1.12±4.46E-09	9.91±2.30E-09	6.38±6.40E-10	7.19±1.95E-09
3rd Qtr	-0.15±1.11E-07	-3.26±8.24E-10	3.94±1.61E-09	3.30±5.78E-10	4.25±1.50E-09
4th Qtr	0.91±4.22E-08	-0.21±1.07E-09	3.54±1.53E-09	7.17±6.95E-10	5.49±1.83E-09
Total	-0.15±1.35E-07	4.28±4.95E-09	2.27±0.35E-08	2.28±1.23E-09	2.18±0.33E-08

	Total U (g)	Pu-238	Pu-239/240	Am-241
1st Qtr	1.44±0.02E-02	3.48±0.48E-09	1.49±0.47E-09	3.47±9.13E-10
2nd Qtr	1.40±0.02E-02	0.01±1.08E-09	-0.41±4.28E-10	-1.29±8.97E-09
3rd Qtr	9.63±0.21E-03	1.01±0.99E-09	0.48±3.01E-10	1.27±0.84E-09
4th Qtr	1.25±0.01E-02	1.13±1.13E-09	-1.39±4.49E-10	3.76±5.63E-10
Total	5.06±0.04E-02	5.64±1.91E-09	1.36±0.84E-09	0.70±9.08E-09

* *Estimated.value*
** *Solidification of high-level waste in glass began in July 1996.*

Table C - 2.4

1996 Airborne Radioactive Effluent Totals (curies) from the Seismic Sampler (ANSEISK)

Month	Alpha	Beta
January	1.64±8.62E-09	0.35±2.03E-08
February	-2.00±7.95E-09	0.86±2.16E-08
March	-2.70±7.35E-09	1.48±1.88E-08
April	4.50±8.27E-09	-0.79±2.18E-08
May	0.08±1.03E-08	0.01±2.59E-08
June	1.28±8.84E-09	-2.70±2.10E-08
July	1.41±6.75E-09	-2.10±2.15E-08
August	0.58±6.69E-09	-0.38±2.37E-08
September	1.18±7.53E-09	-0.25±1.91E-08
October	2.28±6.86E-09	-2.50±1.95E-08
November	-0.54±6.77E-09	0.68±2.10E-08
December	-0.79±6.53E-09	1.23±1.89E-08
Annual Total	0.75±2.69E-08	-4.20±7.35E-08

ANSEISK provides back-up samples for the primary vitrification sampler (ANVITSK).

Table C - 2.5

1996 Airborne Radioactive Effluent Totals (curies) from the O1-14 Building Ventilation Exhaust (ANCSSTK)

Month	Alpha	Beta
January	-1.00±3.10E-09	-5.90±7.59E-09
February	1.28±3.47E-09	-0.68±8.40E-09
March	-2.70±4.07E-09	-0.52±1.04E-08
April	0.00±2.76E-09	-2.50±7.96E-09
May	-0.01±3.38E-09	-3.80±8.46E-09
June	-2.80±2.61E-09	-8.50±7.53E-09
July	-0.99±2.17E-09	-9.00±7.85E-09
August	3.31±2.94E-09	3.29±8.80E-09
September	-1.90±2.68E-09	-7.90±7.44E-09
October	0.53±2.84E-09	-7.00±8.25E-09
November	-0.06±2.91E-09	-4.00±8.63E-09
December	1.46±3.46E-09	7.76±9.20E-09
Annual Total	-0.30±1.06E-08	-4.30±2.91E-08

	Co-60	Sr-90	I-129	Cs-134	Cs-137
1st Qtr	0.31±1.03E-08	2.28±2.20E-09	1.77E-07*	-2.13±7.69E-09	2.43±4.90E-09
2nd Qtr	2.31±8.15E-09	-0.48±1.95E-09	2.15E-07*	1.20±7.06E-09	-2.90±7.56E-09
3rd Qtr	-1.86±9.03E-09	1.95±0.79E-08	2.53E-07*	-1.56±7.00E-09	0.27±7.38E-09
4th Qtr	-5.01±4.62E-09	-0.07±2.33E-09	2.53±0.59E-07	-2.65±5.59E-09	4.02±4.79E-09
Total	-0.14±1.66E-08	2.12±0.88E-08	8.98E-07*	-0.51±1.38E-08	0.38±1.26E-08

	Eu-154	U-232	U-233/234	U-235/236	U-238
1st Qtr	-0.04±1.34E-08	1.99±7.16E-10	2.56±0.62E-09	-0.40±9.38E-11	2.36±0.56E-09
2nd Qtr	-0.82±2.06E-08	-0.96±2.09E-09	2.16±0.69E-09	1.73±2.85E-10	2.64±0.81E-09
3rd Qtr	-0.80±1.91E-08	4.94±5.08E-10	2.01±0.70E-09	-0.33±2.59E-10	1.99±0.68E-09
4th Qtr	-0.40±1.14E-08	5.64±5.54E-10	1.60±0.78E-09	1.84±3.22E-10	1.43±0.65E-09
Total	-2.06±3.32E-08	0.29±2.33E-09	8.33±1.39E-09	3.20±5.11E-10	8.42±1.36E-09

	Total U (g)	Pu-238	Pu-239/240	Am-241
1st Qtr	6.97±0.10E-03	1.17±0.17E-09	4.11±1.52E-10	2.63±2.24E-10
2nd Qtr	6.79±0.13E-03	-1.14±4.05E-10	0.92±2.38E-10	0.31±1.89E-09
3rd Qtr	4.66±0.09E-03	1.68±0.70E-09	0.67±3.53E-10	-0.22±7.43E-10
4th Qtr	3.33±0.03E-03	8.88±6.41E-10	1.08±4.35E-10	2.57±3.44E-10
Total	2.17±0.02E-02	3.63±1.04E-09	6.78±6.27E-10	0.81±2.07E-09

* *Estimated value*

Table C - 2.6

1996 Airborne Radioactive Effluent Totals (curies) from the Contact Size-reduction Facility Ventilation Stack (ANCSRFK)

Month	Alpha	Beta
January	5.13±7.11E-11	1.98±2.41E-10
February	-0.14±1.30E-10	8.86±3.56E-10
March	1.71±4.02E-11	3.46±1.28E-10
April	0.76±2.11E-10	7.85±6.02E-10
May	-1.10±1.94E-10	6.18±5.02E-10
June	0.00±4.47E-12	0.56±1.24E-11
July	Ventilation Off	Ventilation Off
August	Ventilation Off	Ventilation Off
September	Ventilation Off	Ventilation Off
October	Ventilation Off	Ventilation Off
November	0.06±1.93E-10	1.61±0.58E-09
December	0.67±1.57E-10	8.72±3.18E-10
Annual Total	0.89±4.10E-10	5.32±1.12E-09

	Co-60	**Sr-90**	**I-129**	**Cs-134**	**Cs-137**
1st Qtr	-7.34±7.84E-11	1.93±3.11E-11	7.48E-09*	1.74±8.14E-11	-0.53±7.62E-11
2nd Qtr	0.72±1.90E-10	1.03±0.79E-10	7.48E-09*	-1.52±2.26E-10	-1.14±2.35E-10
3rd Qtr	Ventilation Off	Ventilation Off	Ventilation Off	Ventilation Off	Ventilation Off
4th Qtr	-0.35±1.88E-10	-1.06±8.58E-11	7.62±5.52E-10	-1.08±1.89E-10	1.43±1.95E-10
Total	-0.36±2.78E-10	1.12±1.21E-10	1.57E-08*	-2.42±3.06E-10	0.24±3.14E-10

	Eu-154	**U-232**	**U-233/234**	**U-235/236**	**U-238**
1st Qtr	-1.19±1.93E-10	1.69±0.80E-11	3.50±0.85E-11	6.31±3.39E-12	2.35±0.66E-11
2nd Qtr	-0.90±5.63E-10	-2.21±5.46E-11	5.97±2.30E-11	3.58±7.23E-12	7.48±2.26E-11
3rd Qtr	Ventilation Off	Ventilation Off	Ventilation Off	Ventilation Off	Ventilation Off
4th Qtr	2.95±4.91E-10	-0.70±2.22E-11	4.43±2.24E-11	2.82±7.01E-12	6.21±2.44E-11
Total	0.87±7.71E-10	-1.22±5.95E-11	1.39±0.33E-10	1.27±1.06E-11	1.60±0.34E-10

	Total U (g)	**Pu-238**	**Pu-239/240**	**Am-241**
1st Qtr	7.92±0.15E-05	4.35±0.65E-11	6.04±2.44E-12	-2.73±9.71E-12
2nd Qtr	2.32±0.04E-04	2.75±9.14E-12	2.18±5.63E-12	1.26±2.62E-11
3rd Qtr	Ventilation Off	Ventilation Off	Ventilation Off	Ventilation Off
4th Qtr	1.73±0.02E-04	3.26±2.10E-11	-0.16±1.21E-11	0.46±2.73E-11
Total	4.84±0.05E-04	7.88±2.38E-11	0.67±1.35E-11	1.45±3.90E-11

* *Estimated value*

Table C - 2.7

1996 Airborne Radioactive Effluent Totals (curies) from the Supernatant Treatment System Ventilation Stack (ANSTSTK)

Month	**Alpha**	**Beta**	**H-3**
January	-0.47±1.73E-09	-5.10±4.06E-09	6.48±0.62E-05
February	-0.55±1.59E-09	-3.00±4.15E-09	5.34±0.67E-06
March	-1.00±1.90E-09	-3.00±4.45E-09	3.96±0.26E-05
April	0.12±1.50E-09	-4.00±4.16E-09	1.80±0.28E-05
May	-1.60±1.57E-09	-6.30±4.33E-09	7.09±0.20E-05
June	-0.01±1.66E-09	-3.40±4.11E-09	2.05±0.07E-05
July	0.28±1.28E-09	-1.30±4.20E-09	6.93±0.46E-06
August	0.87±1.42E-09	6.64±4.84E-09	7.21±0.89E-06
September	-1.20±1.37E-09	-1.90±4.03E-09	1.33±0.11E-05
October	-0.12±1.38E-09	1.14±0.49E-08	6.56±2.46E-06
November	0.73±1.58E-09	1.11±0.49E-08	Dry
December	2.27±1.69E-09	3.65±3.84E-09	Dry
Annual Total	-0.79±5.42E-09	0.44±1.50E-08	2.53±0.08E-04

	Co-60	**Sr-90**	**I-129**	**Cs-134**	**Cs-137**
1st Qtr	0.84±3.72E-09	-0.17±1.26E-09	4.76E-07*	0.22±4.27E-09	7.82±7.82E-09
2nd Qtr	0.76±4.63E-09	2.12±1.25E-09	4.76E-07*	-2.25±3.94E-09	1.17±0.55E-08
3rd Qtr	4.00±4.10E-09	-0.60±2.52E-09	1.56E-07*	-3.66±3.78E-09	1.89±0.78E-08
4th Qtr	-0.92±1.85E-09	-5.62±9.02E-10	1.56±0.25E-07	-0.71±1.80E-09	7.15±2.88E-09
Total	4.69±7.45E-09	0.80±3.21E-09	1.26E-06*	-6.40±7.16E-09	4.56±1.26E-08

	Eu-154	**U-232**	**U-233/234**	**U-235/236**	**U-238**
1st Qtr	0.64±9.98E-09	4.51±3.50E-10	1.36±0.46E-09	0.97±1.12E-10	2.81±4.12E-10
2nd Qtr	-0.31±1.08E-08	-0.21±1.13E-09	8.67±4.04E-10	0.73±1.04E-10	7.49±4.31E-10
3rd Qtr	-1.01±0.97E-08	5.09±3.16E-10	1.68±0.49E-09	-0.41±1.53E-10	1.26±0.42E-09
4th Qtr	-0.78±4.44E-09	-0.24±1.86E-10	1.21±0.51E-09	-1.52±2.36E-10	9.96±4.19E-10
Total	-1.32±1.81E-08	0.73±1.24E-09	5.13±0.94E-09	-0.23±3.20E-10	3.29±0.84E-09

	Total U(g)	**Pu-238**	**Pu-239/240**	**Am-241**
1st Qtr	2.22±0.03E-03	1.67±0.22E-09	1.04±0.41E-10	1.51±3.13E-10
2nd Qtr	3.32±0.05E-03	2.76±2.08E-10	-1.47±1.35E-10	9.56±6.67E-10
3rd Qtr	1.58±0.03E-03	3.26±3.04E-10	0.57±1.03E-10	1.78±2.15E-10
4th Qtr	4.19±0.05E-03	4.29±3.33E-10	1.84±1.43E-10	0.32±2.19E-10
Total	1.13±0.01E-02	2.70±0.54E-09	1.97±2.26E-10	1.32±0.80E-09

* *Estimated.value*

Table C - 2.8

1996 Airborne Radioactive Effluent Totals (curies) from the Container Sorting and Packaging Facility (ANCSPFK)

Month*	Alpha	Beta
April	-1.00±2.90E-10	-5.50±8.75E-10
May	-2.40±3.57E-10	-7.00±9.68E-10
June	-2.60±4.30E-10	-0.45±1.20E-09
July	0.23±3.91E-10	-1.60±1.27E-09
August	4.32±4.69E-10	-0.63±1.41E-09
September	-2.80±4.57E-10	-0.87±1.29E-09
October	0.23±3.77E-10	-1.80±1.10E-09
November	-1.70±3.06E-10	0.29±1.01E-09
December	0.84±4.18E-10	0.26±1.11E-09
Annual Total	-0.50±1.18E-09	-6.10±3.45E-09

	Co-60	**Sr-90**	**I-129**	**Cs-134**	**Cs-137**
2nd Qtr	-1.21±9.47E-10	-1.39±2.97E-10	7.51±E-08**	0.00±1.67E-09	-3.40±9.87E-10
3rd Qtr	-0.67±1.23E-09	0.61±1.04E-09	7.51±E-08**	0.41±1.13E-09	-0.79±1.09E-09
4th Qtr	2.51±6.51E-10	1.47±0.41E-09	7.51±0.99E-08	-5.56±6.37E-10	3.04±6.29E-10
Total	-0.54±1.68E-09	1.94±1.16E-09	2.25E-07**	-0.14±2.12E-09	-0.82±1.60E-09

	Eu-154	**U-232**	**U-233/234**	**U-235/236**	**U-238**
2nd Qtr	-1.37±2.69E-09	0.37±1.25E-10	2.78±1.18E-10	1.21±2.42E-11	2.73±1.18E-10
3rd Qtr	0.27±3.38E-09	5.69±8.40E-11	3.18±1.26E-10	8.01±5.97E-11	3.57±1.20E-10
4th Qtr	0.26±1.62E-09	7.40±6.49E-11	2.35±0.90E-10	0.68±3.43E-11	2.03±0.84E-10
Total	-0.84±4.61E-09	1.68±1.64E-10	8.31±1.95E-10	9.90±7.30E-11	8.33±1.88E-10

	Total U (g)	**Pu-238**	**Pu-239/240**	**Am-241**
2nd Qtr	6.99±0.24E-04	1.22±2.44E-11	2.44±3.45E-11	0.74±3.66E-10
3rd Qtr	5.39±0.10E-04	1.97±1.50E-10	2.39±1.39E-10	0.67±1.09E-10
4th Qtr	6.57±0.08E-04	1.44±0.84E-10	1.99±2.75E-11	-3.73±5.93E-11
Total	1.90±0.03E-03	3.53±1.73E-10	2.83±1.46E-10	1.04±3.86E-10

* *Sampling began at the end of March 1996 for the April 1996 sampling period.*
** *Estimated value*

Table C - 2.9

1996 Airborne Radioactive Effluent Totals (curies) from the Low-level Waste Treatment Facility (ANLLWTVH)

Month*	**Alpha**	**Beta**
May	0.53±1.09E-09	1.75±2.74E-09
June	0.36±1.25E-09	5.96±3.34E-09
July	6.31±9.91E-10	5.69±3.28E-09
August	1.40±1.11E-09	7.81±3.48E-09
September	0.51±1.15E-09	6.51±3.09E-09
October	-3.50±8.83E-10	4.12±3.18E-09
November	1.34±1.18E-09	8.15±3.28E-09
December	1.13±1.11E-09	6.93±2.87E-09
Annual Total	5.55±3.11E-09	4.69±0.89E-08

** Sampling started in May 1996.*

Table C - 2.10

1996 Airborne Radioactive Effluent Totals (curies) from the Laundry Change Room (ANLAUNV)

Month	**Alpha**	**Beta**
January	-0.92±3.14E-10	-1.20±1.52E-09
February	0.00±5.13E-10	-0.64±1.39E-09
March	2.77±8.30E-10	-0.35±1.32E-09
April	0.00±6.89E-10	0.41±1.40E-09
May	-2.60±5.18E-10	-2.00±1.54E-09
June	-0.88±5.70E-10	-0.61±1.55E-09
July	0.93±4.05E-10	-0.21±1.38E-09
August	4.40±6.22E-10	-0.47±1.42E-09
September	-0.92±6.00E-10	-0.85±1.49E-09
October	-0.86±4.50E-10	-0.34±1.49E-09
November	1.87±5.17E-10	-0.58±1.48E-09
December	2.98±5.14E-10	1.30±1.53E-09
Annual Total	0.67±1.94E-09	-5.60±5.06E-09

Table C - 2.11

1996 Radioactivity Concentrations in Airborne Particulates (µCi/mL) at the Lag Storage Area Air Sampler (ANLAGAM)

Month	Alpha	Beta
January	-1.43±5.96E-16	3.60±1.79E-15
February	1.27±0.86E-15	1.62±0.25E-14
March	9.73±8.33E-16	1.62±0.25E-14
April	9.47±7.42E-16	1.52±0.24E-14
May	5.80±6.98E-16	1.31±0.23E-14
June	5.10±7.34E-16	1.12±0.23E-14
July	8.03±6.92E-16	1.80±0.27E-14
August	9.44±6.94E-16	2.08±0.28E-14
September	9.77±8.12E-16	2.10±0.28E-14
October	0.69±1.94E-15	2.43±0.71E-14
November	5.66±7.05E-16	1.75±0.29E-14
December	9.96±7.60E-16	1.96±0.27E-14

	K-40	Co-60	Sr-90	Cs-137
1st Qtr	2.26±3.18E-15	0.44±1.26E-16	5.70±5.63E-17	0.12±1.30E-16
2nd Qtr	2.44±7.34E-15	-1.01±2.23E-16	5.84±7.09E-17	0.72±2.23E-16
3rd Qtr	2.05±3.76E-15	0.94±1.59E-16	1.10±0.31E-15	-0.92±1.81E-16
4th Qtr	1.70±3.34E-15	0.06±1.45E-16	1.15±0.64E-16	0.33±1.40E-16

	U-232	U-233/234	U-235/236	U-238	Total U (µg/mL)
1st Qtr	1.56±0.23E-16	5.18±0.98E-17	-2.92±3.28E-18	5.42±1.00E-17	1.17±0.02E-10
2nd Qtr	2.25±2.39E-17	6.86±1.68E-17	1.84±0.83E-17	4.47±1.38E-17	1.66±0.02E-10
3rd Qtr	1.55±1.59E-17	5.68±2.10E-17	6.45±8.92E-18	5.26±1.98E-17	1.41±0.03E-10
4th Qtr	0.09±1.89E-17	2.39±1.43E-17	6.08±8.71E-18	4.00±1.65E-17	1.20±0.03E-10

	Pu-238	Pu-239/240	Am-241
1st Qtr	4.28±0.62E-17	-9.71±4.67E-19	8.06±8.44E-18
2nd Qtr	2.35±1.26E-17	2.34±0.42E-16	3.64±2.99E-17
3rd Qtr	0.04±1.67E-17	-1.33±4.98E-18	0.81±1.43E-17
4th Qtr	3.62±1.82E-17	0.69±5.80E-18	0.31±1.34E-17

Table C - 2.12

1996 Radioactivity Concentrations in Airborne Particulates (µCi/mL) at the NDA Air Sampler (ANNDAAM)

Month	Alpha	Beta
January	1.22±0.91E-15	2.38±0.29E-14
February	8.96±7.84E-16	1.75±0.26E-14
March	9.42±8.28E-16	1.52±0.24E-14
April	9.04±7.33E-16	1.36±0.23E-14
May	7.80±7.42E-16	1.20±0.22E-14
June	0.84±6.18E-16	3.88±1.84E-15
July	1.09±0.95E-15	1.04±0.33E-14
August	1.16±0.77E-15	1.92±0.28E-14
September	1.10±0.87E-15	1.96±0.28E-14
October	7.06±7.28E-16	1.89±0.28E-14
November	7.92±7.16E-16	1.78±0.27E-14
December	8.64±7.48E-16	2.04±0.27E-14

	K-40	Co-60	Sr-90	Cs-137
1st Qtr	5.71±2.46E-15	1.21±1.44E-16	2.39±6.78E-17	-0.25±1.39E-16
2nd Qtr	5.07±2.89E-15	-0.14±1.96E-16	3.93±6.27E-17	-0.65±2.20E-16
3rd Qtr	0.02±4.28E-15	1.34±2.53E-16	4.79±2.35E-16	-0.79±2.32E-16
4th Qtr	0.00±1.93E-15	0.07±1.40E-16	2.40±0.79E-16	0.03±1.70E-16

	U-232	U-233/234	U-235/236	U-238	Total U (µg/mL)
1st Qtr	6.37±6.62E-18	5.89±1.12E-17	5.60±3.88E-18	4.77±0.96E-17	9.91±0.10E-11
2nd Qtr	-0.93±2.21E-17	4.32±1.24E-17	6.31±4.47E-18	6.00±1.40E-17	1.66±0.02E-10
3rd Qtr	1.40±1.41E-17	6.23±2.03E-17	1.68±1.16E-17	5.19±1.92E-17	1.21±0.03E-10
4th Qtr	2.17±1.26E-17	3.67±1.25E-17	1.79±0.89E-17	4.47±1.26E-17	1.32±0.02E-10

	Pu-238	Pu-239/240	Am-241
1st Qtr	3.37±0.48E-17	4.64±1.88E-18	1.02±0.95E-17
2nd Qtr	1.00±0.88E-17	3.19±4.51E-18	-3.80±5.29E-17
3rd Qtr	0.28±2.02E-17	1.11±0.95E-17	1.48±1.93E-17
4th Qtr	3.05±1.70E-17	3.33±6.08E-18	0.47±1.39E-17

Table C - 2.13

1996 Airborne Radioactivity Concentrations (µCi/mL) at the SDA Trench 9 Air Sampler (ANSDAT9)

Month	Alpha	Beta	H-3	
January	-0.02±1.61E-15	2.61±0.57E-14	1.13±0.46E-12	
February	3.83±5.52E-15	1.54±1.35E-14	9.60±4.10E-13	
March	2.12±9.70E-16	1.48±0.32E-14	1.18±0.33E-12	
April	2.85±8.34E-16	1.03±0.29E-14	2.25±0.45E-12	
May	0.97±1.07E-15	1.29±0.30E-14	1.24±0.55E-12	
June	5.42±9.90E-16	1.40±0.32E-14	3.33±8.52E-13	
July	1.13±0.97E-15	1.46±0.32E-14	1.31±0.90E-12	
August	0.53±4.99E-15	2.03±1.73E-14	0.06±4.03E-12	
September	0.70±1.01E-15	1.76±0.34E-14	7.56±7.66E-13	
October	1.85±2.08E-15	1.96±0.66E-14	9.59±7.34E-13	
November	6.79±8.75E-16	1.47±0.31E-14	1.69±0.49E-12	
December	6.32±8.74E-16	1.84±0.32E-14	1.28±1.10E-12	
	K-40	**Co-60**	**Cs-137**	**I-129**
1st Qtr	0.00±6.46E-15	0.00±5.03E-16	2.44±2.51E-16	-0.80±2.68E-16
2nd Qtr	0.23±1.14E-14	1.30±3.22E-16	-0.46±3.31E-16	1.19±2.16E-16
3rd Qtr	4.25±7.07E-15	0.71±3.44E-16	1.44±2.41E-16	1.93±1.57E-16
4th Qtr	2.73±4.31E-15	2.43±1.91E-16	-0.07±1.75E-16	-0.03±1.51E-16

Table C - 2.14

1996 Airborne Radioactive Effluent Totals (curies) from Outdoor Ventilation Enclosures/Portable Ventilation Units

Month	Alpha	Beta
January	NA	NA
February	NA	NA
March	NA	NA
April	NA	NA
May	NA	NA
June	NA	NA
July	NA	NA
August	NA	NA
September	-2.50±3.26E-10	-3.80±9.08E-10
October	0.27±1.58E-10	-1.00±5.34E-10
November	-1.80±3.00E-10	1.37±1.05E-09
December	NA	NA
Annual Total	-4.00±4.70E-10	0.89±1.49E-09

Table C - 2.15

1996 Airborne Radioactive Effluent Totals (curies) from the Demonstration CO_2 Decontamination Facility (ANCO2DV)

Month	Alpha	Beta
December	-1.52±1.28E-09	1.01±4.73E-09
Annual Total	-1.52±1.28E-09	1.01±4.73E-09

NA = Not applicable: no OVEs/PVUs were operated during this month.

Table C - 2.16

1996 Airborne Radioactivity Concentrations (µCi/mL) at the Rock Springs Road Air Sampler (AFRSPRD)

Month	Alpha	Beta	H-3
January	0.95±1.18E-15	2.43±0.38E-14	6.73±4.60E-13
February	0.69±1.03E-15	1.71±0.34E-14	3.03±1.75E-13
March	0.73±1.10E-15	1.42±0.31E-14	2.09±2.10E-13
April	5.37±9.01E-16	1.34±0.31E-14	2.59±3.11E-13
May	0.79±1.02E-15	1.28±0.30E-14	1.70±5.09E-13
June	1.10±1.11E-15	1.26±0.31E-14	0.06±1.04E-12
July	7.96±8.72E-16	1.63±0.33E-14	6.86±9.82E-13
August	7.37±8.27E-16	1.84±0.34E-14	-0.64±9.57E-13
September	0.82±1.02E-15	1.75±0.33E-14	-0.43±9.06E-13
October	6.67±9.10E-16	1.85±0.35E-14	0.83±6.84E-13
November	5.69±8.64E-16	1.52±0.32E-14	1.05±2.86E-13
December	6.24±9.01E-16	1.80±0.33E-14	1.92±2.73E-13

	K-40	Co-60	Sr-90	Cs-137	I-129
1st Qtr	0.84±5.28E-15	-0.33±2.11E-16	-3.46±9.18E-17	1.41±2.17E-16	3.04±3.33E-16
2nd Qtr	5.96±6.78E-15	-1.00±3.45E-16	-7.94±9.56E-17	-0.82±2.80E-16	0.35±1.90E-16
3rd Qtr	7.64±3.47E-15	-1.00±2.71E-16	2.35±0.48E-15	0.36±2.77E-16	0.88±1.35E-16
4th Qtr	3.48±4.34E-15	-1.20±1.60E-16	1.68±9.26E-17	-0.49±1.68E-16	0.15±2.08E-16

	U-232	U-233/234	U-235/236	U-238	Total U (µg/mL)
1st Qtr	2.65±8.73E-18	1.09±0.17E-16	7.80±6.20E-18	1.01±0.16E-16	2.34±0.02E-10
2nd Qtr	-0.97±3.83E-17	8.51±3.08E-17	0.40±1.40E-17	7.12±2.82E-17	1.90±0.03E-10
3rd Qtr	1.69±2.71E-17	7.88±2.63E-17	0.91±1.00E-17	4.96±2.14E-17	1.52±0.03E-10
4th Qtr	-0.36±2.02E-17	5.07±2.52E-17	-1.13±7.31E-18	7.92±2.91E-17	1.80±0.02E-10

	Pu-238	Pu-239/240	Am-241
1st Qtr	5.34±0.74E-18	1.24±0.42E-17	0.55±1.08E-17
2nd Qtr	1.38±1.98E-17	0.20±1.25E-17	-0.05±1.92E-16
3rd Qtr	1.79±1.23E-17	0.95±1.05E-17	1.93±2.23E-17
4th Qtr	3.30±1.58E-17	1.91±4.74E-18	8.30±8.79E-18

Table C - 2.17

1996 Radioactivity Concentrations in Airborne Particulates (µCi/mL) at the Dutch Hill Air Sampler (AFBOEHN)

Month	Alpha	Beta	Sr-90	Cs-137
January	0.76±1.15E-15	2.76±0.40E-14		
February	1.22±1.16E-15	2.06±0.36E-14		
March	0.49±1.03E-15	1.95±0.34E-14		
1st Qtr			9.96±9.12E-17	-0.04±1.97E-16
April	1.25±1.09E-15	1.56±0.33E-14		
May	6.41±9.94E-16	1.44±0.31E-14		
June	1.12±1.13E-15	1.78±0.34E-14		
2nd Qtr			1.97±1.05E-16	-2.36±3.42E-16
July	9.37±9.21E-16	2.04±0.35E-14		
August	1.41±1.01E-15	2.24±0.36E-14		
September	0.94±1.06E-15	2.13±0.35E-14		
3rd Qtr			6.21±3.28E-16	-2.43±2.58E-16
October	7.38±9.34E-16	2.19±0.37E-14		
November	6.70±8.89E-16	2.00±0.35E-14		
December	1.05±1.01E-15	2.11±0.35E-14		
4th Qtr			-0.17±1.13E-16	2.51±2.39E-16

Table C - 2.18

1996 Radioactivity Concentrations in Airborne Particulates (µCi/mL) at the Fox Valley Air Sampler (AFFXVRD)

Month	Alpha	Beta	Sr-90	Cs-137
January	1.34±1.26E-15	2.84±0.40E-14		
February	1.14±1.13E-15	1.96±0.35E-14		
March	0.91±1.13E-15	1.79±0.33E-14		
1st Qtr			4.35±9.14E-17	2.63±3.07E-16
April	6.64±9.36E-16	1.69±0.33E-14		
May	0.96±1.06E-15	1.45±0.31E-14		
June	0.64±1.01E-15	1.34±0.31E-14		
2nd Qtr			1.72±1.03E-16	4.08±3.43E-16
July	9.93±9.30E-16	1.45±0.32E-14		
August	9.92±8.98E-16	1.81±0.33E-14		
September	0.75±1.00E-15	1.98±0.34E-14		
3rd Qtr			-0.14±2.35E-16	-0.69±2.41E-16
October	5.37±8.69E-16	2.01±0.36E-14		
November	6.97±8.73E-16	1.65±0.32E-14		
December	7.67±9.19E-16	2.08±0.34E-14		
4th Qtr			2.01±1.02E-16	-1.02±3.62E-16

Table C - 2.19

1996 Radioactivity Concentrations in Airborne Particulates (µCi/mL) at the Bulk Storage Warehouse Air Sampler (AFBLKST)

Month	Alpha	Beta	Sr-90	Cs-137
January	0.79±1.14E-15	2.47±0.38E-14		
February	1.13±1.12E-15	1.92±0.35E-14		
March	0.72±1.09E-15	1.76±0.33E-14		
1st Qtr			3.16±8.89E-17	1.66±1.70E-16
April	1.07±1.03E-15	1.44±0.32E-14		
May	0.78±1.01E-15	1.30±0.30E-14		
June	0.90±1.06E-15	1.30±0.31E-14		
2nd Qtr			6.78±8.83E-17	0.35±2.98E-16
July	6.54±8.23E-16	1.55±0.32E-14		
August	1.13±0.93E-15	1.70±0.32E-14		
September	5.59±9.39E-16	1.71±0.33E-14		
3rd Qtr			6.18±2.83E-16	0.10±2.43E-16
October	7.74±9.17E-16	1.62±0.33E-14		
November	6.08±8.07E-16	1.53±0.30E-14		
December	7.64±8.73E-16	1.76±0.31E-14		
4th Qtr			-1.18±0.84E-16	0.52±2.43E-16

Table C - 2.20

1996 Radioactivity Concentrations in Airborne Particulates (µCi/mL) at the Route 240 Air Sampler (AFRT240)

Month	Alpha	Beta	Sr-90	Cs-137
January	1.63±1.32E-15	2.84±0.40E-14		
February	0.88±1.07E-15	2.02±0.35E-14		
March	1.24±1.21E-15	1.85±0.34E-14		
1st Qtr			-0.08±1.04E-16	1.04±1.60E-16
April	1.04±1.03E-15	1.59±0.33E-14		
May	0.88±1.04E-15	1.29±0.30E-14		
June	0.72±1.03E-15	1.33±0.31E-14		
2nd Qtr			-6.53±7.86E-17	1.96±2.97E-16
July	8.01±8.76E-16	1.69±0.33E-14		
August	1.19±0.95E-15	2.16±0.35E-14		
September	7.23±9.91E-16	1.86±0.34E-14		
3rd Qtr			3.30±2.92E-16	-0.68±2.34E-16
October	8.28±9.59E-16	1.76±0.35E-14		
November	6.18±9.04E-16	1.95±0.35E-14		
December	1.25±1.09E-15	2.10±0.36E-14		
4th Qtr			0.16±1.07E-16	-2.77±2.42E-16

Table C - 2.21

1996 Radioactivity Concentrations in Airborne Particulates (µCi/mL) at the Thomas Corners Road Air Sampler (AFTCORD)

Month	Alpha	Beta	Sr-90	Cs-137
January	0.89±1.19E-15	2.45±0.39E-14		
February	0.83±1.08E-15	1.93±0.35E-14		
March	0.87±1.14E-15	1.79±0.34E-14		
1st Qtr			4.88±8.81E-17	1.12±2.99E-16
April	0.93±1.02E-15	1.37±0.32E-14		
May	0.73±1.02E-15	1.29±0.31E-14		
June	0.99±1.06E-15	1.26±0.30E-14		
2nd Qtr			5.71±7.88E-17	0.52±3.56E-16
July	6.79±7.89E-16	1.58±0.31E-14		
August	9.84±9.82E-16	1.71±0.35E-14		
September	0.93±1.00E-15	1.65±0.32E-14		
3rd Qtr			1.80±1.97E-16	2.52±2.74E-16
October	6.85±8.63E-16	1.62±0.32E-14		
November	4.95±8.13E-16	1.61±0.31E-14		
December	5.77±8.60E-16	1.82±0.32E-14		
4th Qtr			4.69±9.46E-17	-0.54±2.25E-16

Table C - 2.22

1996 Radioactivity Concentrations in Airborne Particulates (µCi/mL) at the West Valley Air Sampler (AFWEVAL)

Month	Alpha	Beta	Sr-90	Cs-137
January	1.01±2.15E-15	2.48±0.59E-14		
February	1.14±1.13E-15	2.00±0.35E-14		
March	1.29±1.21E-15	1.66±0.33E-14		
1st Qtr			-0.10±1.98E-16	0.76±2.03E-16
April	1.01±1.02E-15	1.54±0.32E-14		
May	0.77±1.01E-15	1.29±0.30E-14		
June	0.78±1.03E-15	1.40±0.31E-14		
2nd Qtr			1.29±0.98E-16	-0.84±3.27E-16
July	7.29±8.49E-16	1.58±0.32E-14		
August	8.49±8.47E-16	1.94±0.34E-14		
September	0.95±1.04E-15	1.93±0.34E-14		
3rd Qtr			-9.45±0.68E-16	4.30±3.00E-16
October	1.50±1.09E-15	1.98±0.35E-14		
November	9.64±8.88E-16	1.84±0.31E-14		
December	4.39±7.66E-16	2.01±0.32E-14		
4th Qtr			1.05±0.89E-16	-0.25±1.44E-16

Table C - 2.23

1996 Radioactivity Concentrations in Airborne Particulates (µCi/mL) at the Springville Air Sampler (AFSPRVL)

Month	Alpha	Beta	Sr-90	Cs-137
January	0.47±1.06E-15	2.16±0.37E-14		
February	0.58±1.00E-15	1.57±0.33E-14		
March	0.93±1.13E-15	1.55±0.32E-14		
1st Qtr			-1.74±9.97E-17	-0.24±1.98E-16
April	7.58±9.58E-16	1.17±0.30E-14		
May	5.07±9.54E-16	1.10±0.29E-14		
June	3.12±9.36E-16	1.22±0.31E-14		
2nd Qtr			1.42±0.92E-16	1.02±3.11E-16
July	4.59±7.82E-16	1.29±0.31E-14		
August	7.32±8.24E-16	1.68±0.32E-14		
September	0.96±1.05E-15	1.72±0.33E-14		
3rd Qtr			-2.88±1.92E-16	1.24±2.73E-16
October	6.41±9.06E-16	1.47±0.33E-14		
November	5.86±8.58E-16	1.29±0.30E-14		
December	9.52±9.80E-16	1.53±0.31E-14		
4th Qtr			5.22±1.24E-16	-0.40±2.53E-16

Table C - 2.24

1996 Airborne Radioactivity Concentrations (µCi/mL) at the Great Valley Background Air Sampler (AFGRVAL)

Month	Alpha	Beta	H-3
January	1.35±1.26E-15	2.62±0.39E-14	3.38±2.68E-13
February	0.65±1.02E-15	1.62±0.33E-14	2.38±2.46E-13
March	1.01±1.15E-15	1.65±0.33E-14	3.41±3.87E-13
April	5.73±9.16E-16	1.47±0.32E-14	1.80±4.63E-13
May	2.73±8.76E-16	1.28±0.30E-14	2.44±5.41E-13
June	0.78±1.03E-15	1.27±0.30E-14	-0.06±9.79E-13
July	8.52±8.80E-16	1.46±0.31E-14	7.40±9.74E-13
August	8.97±8.59E-16	1.70±0.32E-14	1.71±1.22E-12
September	0.97±1.04E-15	1.96±0.34E-14	2.10±2.43E-12
October	5.94±8.80E-16	1.53±0.33E-14	-0.08±5.51E-13
November	4.98±8.16E-16	1.45±0.30E-14	1.50±3.39E-13
December	5.76±8.62E-16	1.90±0.33E-14	-0.14±2.42E-13

	K-40	Co-60	Sr-90	Cs-137	I-129
1st Qtr	0.29±4.81E-15	0.50±1.89E-16	5.53±9.45E-17	0.15±1.95E-16	-0.02±1.41E-16
2nd Qtr	0.00±8.14E-15	2.61±4.89E-16	1.77±1.08E-16	0.16±2.93E-16	-1.09±2.63E-16
3rd Qtr	3.35±5.98E-15	-1.60±2.95E-16	-2.14±2.07E-16	2.31±2.82E-16	-0.10±1.42E-16
4th Qtr	2.70±6.09E-15	1.82±2.66E-16	0.22±1.09E-16	0.73±2.72E-16	0.08±2.30E-16

	U-232	U-233/234	U-235/236	U-238	Total U (µg/mL)
1st Qtr	9.47±2.64E-17	1.21±0.30E-16	-0.81±9.43E-18	6.50±2.26E-17	2.40±0.02E-10
2nd Qtr	-2.29±5.54E-17	8.47±2.87E-17	2.99±9.58E-18	5.50±2.32E-17	1.81±0.03E-10
3rd Qtr	3.25±1.57E-17	5.51±1.72E-17	0.61±3.83E-18	7.24±1.81E-17	1.39±0.02E-10
4th Qtr	-0.29±1.35E-17	5.88±2.40E-17	-1.04±6.74E-18	6.41±2.57E-17	1.74±0.02E-10

	Pu-238	Pu-239/240	Am-241
1st Qtr	1.65±0.22E-16	7.50±3.11E-18	0.53±1.39E-17
2nd Qtr	2.06±1.73E-17	-0.04±1.03E-17	1.45±1.68E-16
3rd Qtr	1.82±1.16E-17	2.84±4.02E-18	1.21±1.63E-17
4th Qtr	3.52±1.58E-17	-0.61±3.94E-18	1.05±0.90E-17

Table C - 2.25

1996 Radioactivity Concentrations in Airborne Particulates (µCi/mL) at the Nashville Background Air Sampler (AFNASHV)

Month	Alpha	Beta	Sr-90	Cs-137
January	0.83±1.16E-15	2.61±0.39E-14		
February	0.62±1.01E-15	2.27±0.37E-14		
March	0.82±1.11E-15	1.69±0.33E-14		
1st Qtr			0.60±1.03E-16	1.43±2.03E-16
April	5.96±9.14E-16	1.44±0.32E-14		
May	0.72±1.01E-15	1.40±0.31E-14		
June	0.86±1.06E-15	1.17±0.30E-14		
2nd Qtr			0.78±1.04E-16	-0.08±3.14E-16
July	1.06±0.95E-15	1.81±0.34E-14		
August	1.32±0.98E-15	1.97±0.34E-14		
September	5.67±9.54E-16	1.82±0.34E-14		
3rd Qtr			3.59±2.62E-16	-1.50±2.69E-16
October	9.48±9.80E-16	1.90±0.35E-14		
November	5.24±8.27E-16	1.77±0.33E-14		
December	7.92±9.22E-16	1.93±0.33E-14		
4th Qtr			-2.39±7.87E-17	0.59±2.47E-16

Table C - 2.26

Radioactivity in Fallout During 1996 (nCi/m²/mo)

Dutch Hill (AFDHFOP)

Month	Alpha	Beta	H-3 (µCi/mL)
January	2.08±1.01E-02	6.14±0.57E-01	0.00±1.00E-07
February	1.35±0.40E-02	2.42±0.21E-01	-0.21±7.54E-08
March	5.27±0.59E-02	3.13±0.16E-01	1.76±7.76E-08
April	5.76±1.56E-02	9.60±0.70E-01	-1.06±0.81E-07
May	1.41±0.47E-01	1.58±0.11E+00	9.99±5.52E-08
June	6.73±1.80E-02	8.42±0.58E-01	-3.76±0.93E-07
July	1.28±0.48E-01	1.65±0.08E+00	-0.52±7.66E-08
August	4.08±1.61E-02	5.35±0.59E-01	-6.18±1.15E-07
September	4.46±1.41E-02	3.30±0.47E-01	1.14±0.77E-07
October	5.43±1.68E-02	4.25±0.55E-01	1.30±7.62E-08
November	6.03±1.71E-02	6.17±0.69E-01	1.68±0.83E-07
December	1.90±0.55E-02	4.50±0.31E-01	-2.38±7.81E-08

Route 240 (AF24FOP)

Month	Alpha	Beta	H-3 (µCi/mL)
January	2.80±1.10E-02	4.34±0.51E-01	5.64±7.38E-08
February	1.94±0.56E-02	2.51±0.26E-01	-1.13±0.75E-07
March	2.10±0.62E-02	3.54±0.28E-01	1.06±7.76E-08
April	4.06±1.40E-02	8.99±0.73E-01	-1.48±0.80E-07
May	6.99±1.41E-02	9.31±0.59E-01	6.55±7.69E-08
June	4.04±1.14E-02	8.78±0.55E-01	0.85±7.76E-08
July	2.22±0.72E-02	4.05±0.32E-01	-0.80±7.62E-08
August	4.38±0.99E-02	3.40±0.33E-01	3.03±8.11E-08
September	2.58±1.01E-02	3.35±0.44E-01	1.89±0.53E-07
October	2.33±1.48E-02	2.95±0.54E-01	-1.50±0.60E-07
November	6.42±1.63E-02	7.93±0.70E-01	-3.63±8.01E-08
December	2.72±0.69E-02	5.96±0.37E-01	-1.46±0.78E-07

Fox Valley Road (AFFXFOP)

Month	Alpha	Beta	H-3 (µCi/mL)
January	2.96±1.10E-02	3.22±0.46E-01	0.00±1.00E-07
February	2.04±0.64E-02	3.28±0.32E-01	1.43±0.77E-07
March	2.12±0.86E-02	2.97±0.34E-01	5.35±7.88E-08
April	2.80±1.29E-02	8.22±0.71E-01	-0.90±1.14E-07
May	1.01±0.20E-01	8.41±0.63E-01	4.95±7.67E-08
June	1.13±0.18E-01	9.43±0.59E-01	-0.42±1.10E-07
July	2.81±0.77E-02	3.54±0.29E-01	-5.52±7.72E-08
August	4.94±0.99E-02	6.35±0.43E-01	-2.93±7.84E-08
September	1.10±0.19E-01	5.85±5.85E-02	1.51±0.76E-07
October	7.27±1.95E-02	4.53±0.60E-01	-1.29±0.87E-07
November	4.82±1.75E-02	6.07±0.75E-01	1.09±8.13E-08
December	3.20±0.79E-02	4.15±0.35E-01	6.38±7.93E-08

Rain Gauge (ANRGFOP)

Month	Alpha	Beta	H-3 (µCi/mL)
January	2.87±1.00E-02	4.11±0.45E-01	0.00±1.00E-07
February	2.12±0.63E-02	4.63±0.35E-01	1.23±0.78E-07
March	2.09±1.01E-02	2.29±0.33E-01	5.33±5.53E-08
April	5.41±2.54E-02	7.00±0.78E-01	1.28±0.82E-07
May	8.37±1.89E-02	6.26±0.61E-01	1.41±7.74E-08
June	6.65±1.46E-02	1.11±0.07E+00	6.43±7.64E-08
July	2.54±0.83E-02	3.21±0.29E-01	4.20±7.91E-08
August	1.02±0.20E-01	7.18±0.51E-01	1.07±7.85E-08
September	3.42±1.08E-02	5.10±0.52E-01	1.60±0.75E-07
October	4.34±1.82E-02	4.59±0.67E-01	1.02±0.84E-07
November	4.46±1.79E-02	7.17±0.83E-01	1.09±8.10E-08
December	3.34±0.90E-02	4.50±0.40E-01	-7.29±7.85E-08

Thomas Corners Road (AFTCFOP)

Month	Alpha	Beta	H-3 (µCi/mL)
January	2.77±1.09E-02	4.67±0.52E-01	3.20±7.64E-08
February	2.77±0.79E-02	3.91±0.37E-01	-3.74±7.54E-08
March	3.34±0.93E-02	3.42±0.33E-01	3.22±7.89E-08
April	6.12±1.85E-02	1.68±0.11E+00	-0.53±8.14E-08
May	6.49±1.52E-02	8.64±0.63E-01	5.21±5.34E-08
June	6.31±1.59E-02	1.15±0.07E+00	-8.64±7.64E-08
July	2.80±0.77E-02	5.16±0.35E-01	-1.86±7.64E-08
August	5.36±1.00E-02	6.39±0.41E-01	4.87±7.82E-08
September	5.07±1.28E-02	5.69±0.55E-01	1.93±0.75E-07
October	4.80±1.75E-02	5.05±0.66E-01	-2.09±8.56E-08
November	5.49±1.83E-02	5.76±0.77E-01	4.27±8.10E-08
December	3.76±0.96E-02	4.21±0.40E-01	1.33±0.80E-07

Table C - 2.27

pH in Fallout During 1996 (standard units)

Month	**Dutch Hill AFDHFOP**	**Fox Valley Road AFFXFOP**	**Route 240 AF24FOP**	**Thomas Corners Road AFTCFOP**	**Rain Gauge ANRGFOP**
January	4.04	4.42	4.06	4.24	4.19
February	3.45	3.78	3.50	3.68	3.67
March	3.15	6.89	3.31	6.29	7.18
April	5.04	4.99	4.00	4.31	6.07
May	8.70	4.60	4.21	4.37	7.09
June	7.76	4.07	3.96	4.03	3.58
July	8.11	4.32	4.16	4.11	8.49
August	8.42	3.87	7.34	3.74	4.06
September	7.06	3.92	6.22	3.69	4.42
October	4.93	5.48	6.29	4.26	4.50
November	4.07	4.30	4.12	4.48	4.28
December	3.79	4.09	3.78	4.09	4.11

Appendix C - 3

Summary of Biological Data

Milk and Meat Samples are Collected from Local Bovine Herds

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Table C - 3.1

1996 Radioactivity Concentrations in Milk (µCi/mL)

Location	H-3	Sr-90	I-129	Cs-134	Cs-137	K-40
BFMCOBO (WNW Farm)						
1st Qtr	-0.86±1.08E-07	1.66±0.31E-09	-0.78±4.38E-10	-1.10±1.26E-09	1.94±2.08E-09	1.09±0.06E-06
2nd Qtr	-0.89±1.07E-07	7.25±1.75E-10	4.86±9.23E-10	-0.32±1.76E-09	0.97±1.87E-09	1.27±0.08E-06
3rd Qtr	-1.53±1.09E-07	5.64±2.96E-10	5.73±4.74E-10	0.25±1.63E-09	3.60±2.41E-09	1.25±0.08E-06
4th Qtr	0.23±1.02E-07	2.35±0.34E-09	1.49±4.84E-10	0.11±2.10E-09	0.71±2.33E-09	9.11±1.26E-07
BFMCTLN (Control)						
1st Qtr	-0.50±1.09E-07	1.46±0.26E-09	0.93±3.61E-10	-0.53±1.40E-09	-0.62±1.36E-09	1.33±0.07E-06
2nd Qtr	-1.27±1.04E-07	6.36±1.58E-10	2.66±3.66E-10	0.64±1.64E-09	0.68±1.82E-09	1.41±0.09E-06
3rd Qtr	-1.73±9.46E-08	8.29±2.97E-10	1.42±5.35E-10	-1.97±3.19E-09	-0.26±2.04E-09	1.49±0.10E-06
4th Qtr	1.44±1.04E-07	9.24±2.62E-10	-0.38±3.28E-10	-0.04±2.06E-09	1.25±2.17E-09	1.50±0.19E-06
BFMCTLS (Control)						
1st Qtr	-0.32±1.14E-07	1.19±0.26E-09	1.17±4.03E-10	-0.42±1.45E-09	1.46±1.44E-09	1.22±0.07E-06
2nd Qtr	-0.33±1.09E-07	4.01±1.57E-10	-1.56±3.79E-10	-0.56±1.79E-09	3.00±2.85E-09	1.59±0.18E-06
3rd Qtr	-1.83±1.08E-07	5.62±3.04E-10	-2.38±4.94E-10	-0.54±2.14E-09	2.48±1.84E-09	1.55±0.10E-06
4th Qtr	0.61±1.19E-07	1.82±0.33E-09	3.70±3.29E-10	0.26±2.36E-09	0.16±2.31E-09	1.36±0.17E-06
BFMREED (NNW Farm)						
1st Qtr	0.20±1.13E-07	1.76±0.38E-09	0.85±3.93E-10	-0.13±1.37E-09	0.37±1.41E-09	1.23±0.07E-06
2nd Qtr	-0.42±1.07E-07	5.03±1.57E-10	4.17±4.43E-10	0.53±1.65E-09	0.93±1.88E-09	1.50±0.09E-06
3rd Qtr	-1.14±1.07E-07	5.38±2.62E-10	2.11±4.44E-10	0.54±1.83E-09	2.11±2.23E-09	1.59±0.19E-06
4th Qtr	1.67±0.80E-07	1.41±0.32E-09	3.39±4.26E-10	-1.37±2.28E-09	0.62±2.24E-09	1.33±0.17E-06
BFMSCHT (S Farm)						
Annual	-1.81±0.99E-07	1.99±0.38E-09	-0.39±3.91E-10	-6.39±3.98E-09	1.32±4.61E-09	1.70±0.24E-06
BFMWIDR (SE Farm)						
Annual	-1.75±1.00E-07	1.37±0.31E-09	1.82±4.10E-10	-0.35±4.02E-09	0.75±3.54E-09	1.53±0.22E-06

Table C - 3.2

1996 Radioactivity Concentrations in Meat

1996 Radioactivity Concentrations in Beef
(µCi/g - Dry)

Location	% Moisture	H-3 (µCi/mL)	Sr-90	Cs-134	Cs-137	K-40
Beef Flesh Background (BFBCTRL 06/96)	67.5	0.28±1.04E-07	0.71±1.25E-08	0.00±1.23E-08	2.10±1.74E-08	1.59±0.37E-06
Beef Flesh Background (BFBCTRL 12/96)	62.0	-5.85±2.19E-07	1.02±0.44E-08	-0.19±1.67E-08	-0.21±1.69E-08	9.72±1.17E-06
Beef Flesh Near-site (BFBNEAR 06/96)	68.4	-0.05±1.00E-07	1.05±4.67E-09	-0.52±1.06E-08	1.41±0.97E-08	2.28±0.34E-06
Beef Flesh Near-site (BFBNEAR 12/96)	71.0	4.14±1.40E-07	-1.63±0.52E-08	-1.47±1.76E-08	-0.54±1.81E-08	7.14±1.03E-06

1996 Radioactivity Concentrations in Venison
(µCi/g - Dry)

Location	% Moisture	H-3 (µCi/mL)	Sr-90	Cs-134	Cs-137	K-40
Deer Flesh Background (BFDCTRL 1)	71.0	1.31±0.11E-06	2.46±3.69E-09	-0.07±1.47E-08	0.08±1.51E-08	3.86±0.70E-06
Deer Flesh Background (BFDCTRL 2)	65.0	1.05±0.11E-06	2.66±2.72E-09	0.48±1.28E-08	3.88±2.13E-08	4.05±0.58E-06
Deer Flesh Background (BFDCTRL 3)	56.0	8.46±1.04E-07	0.57±4.44E-09	-1.06±1.54E-08	3.06±2.45E-08	3.72±0.62E-06
Deer Flesh Near-site (BFDNEAR 1)	72.0	1.92±0.12E-06	0.63±5.78E-09	-0.63±1.70E-08	2.12±1.94E-08	3.37±0.67E-06
Deer Flesh Near-site (BFDNEAR 2)	70.0	3.25±0.14E-06	0.14±4.42E-09	0.38±1.77E-08	3.37±3.21E-08	2.70±0.59E-06
Deer Flesh Near-site (BFDNEAR 3)	68.0	1.68±0.12E-06	1.38±0.61E-08	-0.70±2.02E-08	4.82±2.83E-08	3.07±0.65E-06

Table C - 3.3
1996 Radioactivity Concentrations in Food Crops (µCi/g-Dry)

Location	% Moisture	H-3 (µCi/mL)	Sr-90	K-40	Co-60	Cs-137
CORN						
Background (BFVCTRC)	77.5	6.54±1.28E-07	6.01±1.86E-09	1.19±0.14E-05	0.61±2.20E-08	-0.36±1.82E-08
Near-site (BFVNEAC)	77.8	0.42±1.14E-07	2.10±0.23E-08	1.31±0.08E-05	-0.18±1.94E-08	1.47±1.90E-08
BEANS						
Background (BFVCTRB)	89.1	3.28±1.20E-07	1.37±0.14E-07	3.39±0.38E-05	2.22±4.74E-08	0.19±3.87E-08
Near-site (BFVNEAB)	92.0	-0.24±1.09E-07	1.65±0.15E-07	2.95±0.37E-05	1.46±5.66E-08	1.52±5.60E-08
APPLES						
Background (BFVCTRA)	86.3	0.08±1.11E-07	4.29±0.38E-08	7.61±1.71E-06	0.13±5.35E-08	-1.51±5.26E-08
Near-site (BFVNEAA)	89.7	0.15±1.11E-07	1.08±0.06E-07	1.24±0.18E-05	0.00±3.58E-08	0.28±3.4E-08
HAY						
Background (BFHCTLN)	NA	NA	1.56±0.14E-07	1.30±0.36E-05	0.13±1.01E-07	-0.02±9.24E-08
Near-site (BFHNEAR)	NA	NA	4.72±0.20E-07	1.28±0.27E-05	1.97±8.87E-08	7.03±8.17E-08

NA = Not applicable.

Table C - 3.4

1996 Radioactivity Concentrations in Fish Flesh from Cattaraugus Creek

Cattaraugus Creek above the Springville Dam (BFFCATC)
(µCi/g - dry)

1st half 1996

Species	% Moisture	Sr-90	Cs-134	Cs-137
Hog-nosed Sucker	83.2	1.71±1.33E-08	-0.80±1.72E-08	0.45±1.75E-08
Hog-nosed Sucker	84.5	0.01±1.16E-08	0.52±1.70E-08	-0.66±1.82E-08
Hog-nosed Sucker	84.1	3.78±7.56E-09	0.67±1.45E-08	0.63±1.65E-08
Hog-nosed Sucker	84.6	7.93±3.87E-08	-0.28±3.80E-08	3.13±5.09E-08
Hog-nosed Sucker	82.1	7.16±3.46E-08	1.19±3.87E-08	3.40±3.62E-08
Hog-nosed Sucker	83.9	0.46±3.67E-08	-0.75±4.25E-08	0.17±4.28E-08
Hog-nosed Sucker	82.0	3.27±1.29E-08	-2.30±2.97E-08	-0.59±3.02E-08
White Sucker	81.8	1.32±1.45E-08	-0.44±1.85E-08	-0.23±1.86E-08
Brown Trout	80.6	1.36±3.45E-08	-0.84±3.83E-08	0.53±3.89E-08
Horned Dace	83.5	5.28±4.28E-08	-0.73±5.62E-08	0.28±3.34E-08
Average % Moisture	83.0			
Median		3.36E-08	<3.39E-08	<3.18E-08
Maximum		7.93E-08	<5.62E-08	<5.09E-08
Minimum		<7.56E-09	<1.45E-08	<1.65E-08

2nd half 1996

Species	% Moisture	Sr-90	Cs-134	Cs-137
Hog-nosed Sucker	80.0	1.60±1.08E-08	-4.76±2.25E-08	-0.47±2.51E-08
Hog-nosed Sucker	79.0	1.58±1.21E-08	0.73±1.23E-08	2.02±1.32E-08
Hog-nosed Sucker	78.0	0.40±1.14E-08	-0.80±1.28E-08	1.42±1.25E-08
Hog-nosed Sucker	77.0	4.19±6.76E-09	-3.26±8.95E-09	2.76±9.08E-09
Hog-nosed Sucker	79.0	1.16±0.57E-08	-0.24±1.67E-08	0.19±1.57E-08
Hog-nosed Sucker	79.0	1.22±0.58E-08	-1.39±1.35E-08	1.59±2.09E-08
Hog-nosed Sucker	78.0	5.66±3.97E-09	0.76±1.72E-08	0.38±1.55E-08
Hog-nosed Sucker	79.0	7.69±5.06E-09	-1.11±1.46E-08	0.88±1.02E-08
Brown Trout	78.0	-0.79±1.58E-08	-4.81±9.46E-09	0.54±1.35E-08
Rainbow Trout	79.0	3.22±4.71E-09	-0.38±2.00E-08	-0.73±1.75E-08
Average % Moisture	78.6			
Median		1.15E-08	<1.41E-08	1.56E-08
Maximum		1.60E-08	<2.25E-08	2.02E-08
Minimum		<4.71E-09	<8.95E-09	<9.08E-09

Table C - 3.4 (continued)

1996 Radioactivity Concentrations in Fish Flesh from Cattaraugus Creek

Cattaraugus Creek Background (BFFCTRL)

(µCi/g - dry)

1st half 1996

Species	% Moisture	Sr-90	Cs-134	Cs-137
Hog-nosed Sucker	81.4	-1.05±7.47E-09	0.84±1.31E-08	0.83±1.46E-08
Hog-nosed Sucker	80.5	0.88±1.01E-08	-0.48±1.88E-08	-0.53±1.85E-08
White Sucker	79.2	4.07±8.29E-09	-0.72±1.62E-08	0.88±1.61E-08
White Sucker	80.2	-0.67±1.13E-08	-0.74±1.84E-08	-0.52±1.80E-08
White Sucker	81.3	3.67±6.55E-09	0.60±1.50E-08	0.78±1.47E-08
White Sucker	79.3	-0.38±2.69E-08	-0.86±4.14E-08	-2.67±3.33E-08
White Sucker	80.0	-0.31±2.73E-08	-3.75±3.45E-08	0.20±3.12E-08
Brown Trout	78.1	-1.40±7.90E-09	1.34±1.57E-08	1.21±1.55E-08
Brown Trout	76.0	1.39±0.76E-08	-0.62±1.95E-08	-0.69±1.62E-08
Brown Trout	76.9	-4.43±2.39E-08	-0.94±1.77E-08	-0.25±1.72E-08
Average % Moisture	79.3			
Median		<1.07E-08	<1.81E-08	<1.67E-08
Maximum		1.39E-08	<4.14E-08	<3.33E-08
Minimum		<6.55E-09	<1.31E-08	<1.46E-08

2nd half 1996

Species	% Moisture	Sr-90	Cs-134	Cs-137
Hog-nosed Sucker	68.0	6.67±4.28E-09	-1.92±1.78E-08	0.83±1.73E-08
Hog-nosed Sucker	68.0	3.07±4.49E-09	-6.04±8.06E-09	-2.86±7.80E-09
Hog-nosed Sucker	68.0	0.81±4.52E-09	1.39±8.24E-09	-5.79±8.31E-09
Hog-nosed Sucker	79.0	-4.75±3.08E-09	-0.67±1.55E-08	0.01±1.52E-08
Hog-nosed Sucker	79.0	9.98±5.58E-09	-0.04±1.58E-08	0.84±1.58E-08
Hog-nosed Sucker	79.0	5.10±4.93E-09	0.23±1.61E-08	-1.03±1.73E-08
Hog-nosed Sucker	78.0	1.56±0.51E-08	0.32±1.58E-08	0.58±1.52E-08
Hog-nosed Sucker	79.0	1.06±0.51E-08	-0.60±1.59E-08	0.57±1.46E-08
Brown Trout	79.0	0.15±1.73E-08	-0.52±1.09E-08	1.28±1.10E-08
Brown Trout	78.0	0.03±2.17E-08	-0.24±1.01E-08	-0.68±9.09E-09
Average % Moisture	75.5			
Median		8.32E-09	<1.57E-08	<1.49E-08
Maximum		1.56E-08	<1.78E-08	1.28E-08
Minimum		<3.08E-09	<8.06E-09	<7.80E-09

Table C - 3.4 *(concluded)*

1996 Radioactivity Concentrations in Fish Flesh from Cattaraugus Creek

Cattaraugus Creek below the Springville Dam (BFFCATD)

(µCi/g - dry)

Annual

Species	% Moisture	Sr-90	Cs-134	Cs-137
Steelhead	60.0	2.46±2.04E-09	-0.07±1.11E-08	1.37±1.06E-08
Steelhead	49.0	1.73±2.07E-09	1.60±0.85E-08	-0.77±1.02E-08
Steelhead	51.0	4.98±1.82E-09	-1.33±1.09E-08	6.23±8.50E-09
Steelhead	50.0	0.76±1.71E-09	-5.26±2.56E-08	-2.40±2.43E-08
Steelhead	60.0	-0.19±1.89E-09	0.00±1.38E-08	0.50±1.04E-08
Steelhead	60.0	0.03±1.01E-09	-4.03±2.05E-08	1.89±2.08E-08
Steelhead	64.0	1.87±2.30E-09	-0.02±1.52E-08	0.64±1.45E-08
Steelhead	51.0	2.60±1.30E-09	-0.87±1.39E-08	0.06±1.28E-08
Steelhead	52.0	-0.25±1.42E-09	0.54±1.43E-08	1.41±1.43E-08
Steelhead	55.0	-0.13±1.36E-09	-1.65±1.81E-08	-0.49±1.52E-08
Average % Moisture	55.2			
Median		<1.98E-09	<1.48E-08	<1.40E-08
Maximum		4.98E-09	1.60E-08	1.37E-08
Minimum		<1.01E-09	<1.09E-08	<8.50E-09

Appendix C - 4

Summary of Direct Radiation Monitoring Data

An Environmental TLD Package

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Table C - 4.1
Summary of 1996 Quarterly Averages of Off-site TLD Measurements
(mR ± 3 SD/Quarter)

Location Number*	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Location Average
DFTLD01	16±2.0	24±2.6	20±3.4	NR	20±2.7
DFTLD02	15±1.1	24±5.0	19±4.0	NR	19±3.4
DFTLD03	13±0.8	23±2.8	19±1.6	NR	18±1.7
DFTLD04	13±1.6	24±1.7	24±7.0	NR	20±3.4
DFTLD05	13±1.5	22±3.0	19±2.6	NR	18±2.4
DFTLD06	15±1.5	24±3.0	19±2.4	NR	19±2.3
DFTLD07	14±0.5	22±1.2	20±2.4	NR	19±1.4
DFTLD08	17±3.4	20±0.9	22±8.7	NR	20±4.3
DFTLD09	15±0.7	19±3.2	20±4.7	NR	18±2.9
DFTLD10	14±0.5	21±2.8	21±3.7	NR	19±2.3
DFTLD11	17±1.2	22±2.8	23±6.0	NR	21±3.3
DFTLD12	16±0.8	23±1.8	22±3.2	NR	20±1.9
DFTLD13	17±0.6	22±3.1	23±4.6	NR	21±2.8
DFTLD14	17±2.4	24±2.9	21±4.8	NR	21±3.4
DFTLD15	15±1.7	21±2.0	18±3.7	NR	18±2.5
DFTLD16	17±1.1	24±3.5	21±3.2	NR	21±2.6
DFTLD17	16±1.5	27±1.4	22±5.0	NR	22±2.6
DFTLD20	16±2.2	25±3.4	22±3.7	NR	21±3.1
DFTLD21	17±1.6	24±1.6	20±3.4	NR	20±2.2
DFTLD22	17±1.7	24±1.6	18±0.8	NR	20±1.4
DFTLD23	15±1.3	25±3.0	23±8.7	NR	21±4.3
DFTLD37	16±1.6	24±2.2	23±5.1	NR	21±3.0
DFTLD41	14±0.4	22±1.4	17±3.4	NR	18±1.7

NR = These results have not been reported because the data validation process indicated that the data were not reliable.

** Off-site locations are shown on Figures 2-14, A-7, and A-9. Background measurements are provided by off-site TLDs 17, 23, 37, and 41.*

Table C - 4.2
Summary of 1996 Quarterly Averages of On-site TLD Measurements
(mR ± 3 SD/Quarter)

Location Number*	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Location Average
DNTLD18	34±2.1	42±1.3	42±7.6	NR	39±3.7
DNTLD19	18±1.7	27±3.1	25±6.2	NR	23±3.7
DNTLD24	934±55.6	769±20.6	776±27.8	NR	826±34.7
DNTLD25	24±3.0	32±4.4	29±6.3	NR	28±4.6
DNTLD26	21±3.2	30±6.2	25±3.3	NR	25±4.2
DNTLD27	16±1.1	30±3.1	24±6.0	NR	23±3.4
DNTLD28	18±2.7	29±3.9	27±3.6	NR	25±3.4
DNTLD29	16±1.7	27±4.9	23±3.8	NR	22±3.5
DNTLD30	20±0.7	29±2.4	25±3.7	NR	25±2.3
DNTLD31	17±1.6	21±2.1	23±1.7	NR	20±1.8
DNTLD32	26±0.5	37±1.3	37±5.4	NR	33±2.4
DNTLD33	29±2.2	40±1.7	37±3.1	NR	35±2.3
DNTLD34	59±2.4	65±2.9	65±6.6	NR	63±4.0
DNTLD35	89±6.3	97±6.7	90±4.4	NR	92±5.8
DNTLD36	44±1.9	49±3.3	47±7.2	NR	47±4.1
DNTLD38	31±5.1	38±1.3	37±2.8	NR	35±3.1
DNTLD39	55±2.3	79±8.4	62±4.8	NR	65±5.2
DNTLD40	170±5.2	173±11.4	199±7.7	NR	181±8.1
DNTLD42	83±3.7	93±3.8	88±7.1	NR	88±4.9
DNTLD43	33±2.2	42±3.8	37±4.4	NR	37±3.5

NR = These results have not been reported because the data validation process indicated that the data were not reliable.
** On-site locations are shown on Figures 2-13 and A-8.*

Table C - 4.3

3rd Quarter 1996 TLD Results and Instantaneous Dose Readings with a High-pressure Ion Chamber (HPIC) at Each Monitoring Location

Off-site Location Number	***3rd Quarter TLD Result*** (μR/hr)	***August 1996 HPIC Results*** (μR/hr)	***On-site Location Number***	***3rd Quarter TLD Result*** (μR/hr)	***August 1996 HPIC Results*** (μR/hr)
DFTLD01	8.87	11.2	DNTLD18	18.6	18.4
DFTLD02	8.42	11.8	DNTLD19	11.1	10.6
DFTLD03	8.42	10.6	DNTLD24	344.0	354.8
DFTLD04	10.64	9.5	DNTLD25	12.9	12.9
DFTLD05	8.42	10.7	DNTLD26	11.1	11.6
DFTLD06	8.42	9.0	DNTLD27	10.6	9.9
DFTLD07	8.87	8.6	DNTLD28	12.0	10.6
DFTLD08	9.75	8.1	DNTLD29	10.2	9.8
DFTLD09	8.87	8.8	DNTLD30	11.1	12.3
DFTLD10	9.31	8.8	DNTLD31	10.2	9.8
DFTLD11	10.20	9.9	DNTLD32	16.4	14.9
DFTLD12	9.75	9.3	DNTLD33	16.4	17.2
DFTLD13	10.20	9.5	DNTLD34	28.8	32.6
DFTLD14	9.31	9.8	DNTLD35	39.9	44.2
DFTLD15	7.98	8.9	DNTLD36	20.8	23.9
DFTLD16	9.31	9.0	DNTLD38	16.4	17.0
DFTLD17	9.75	8.8	DNTLD39	27.5	29.7
DFTLD20	9.75	9.5	DNTLD40	88.2	100.0
DFTLD21	8.87	8.4	DNTLD42	39.0	33.2
DFTLD22	7.98	9.0	DNTLD43	16.4	18.4
DFTLD23	10.20	9.0			
DFTLD37	10.20	9.7			
DFTLD41	7.54	8.4			

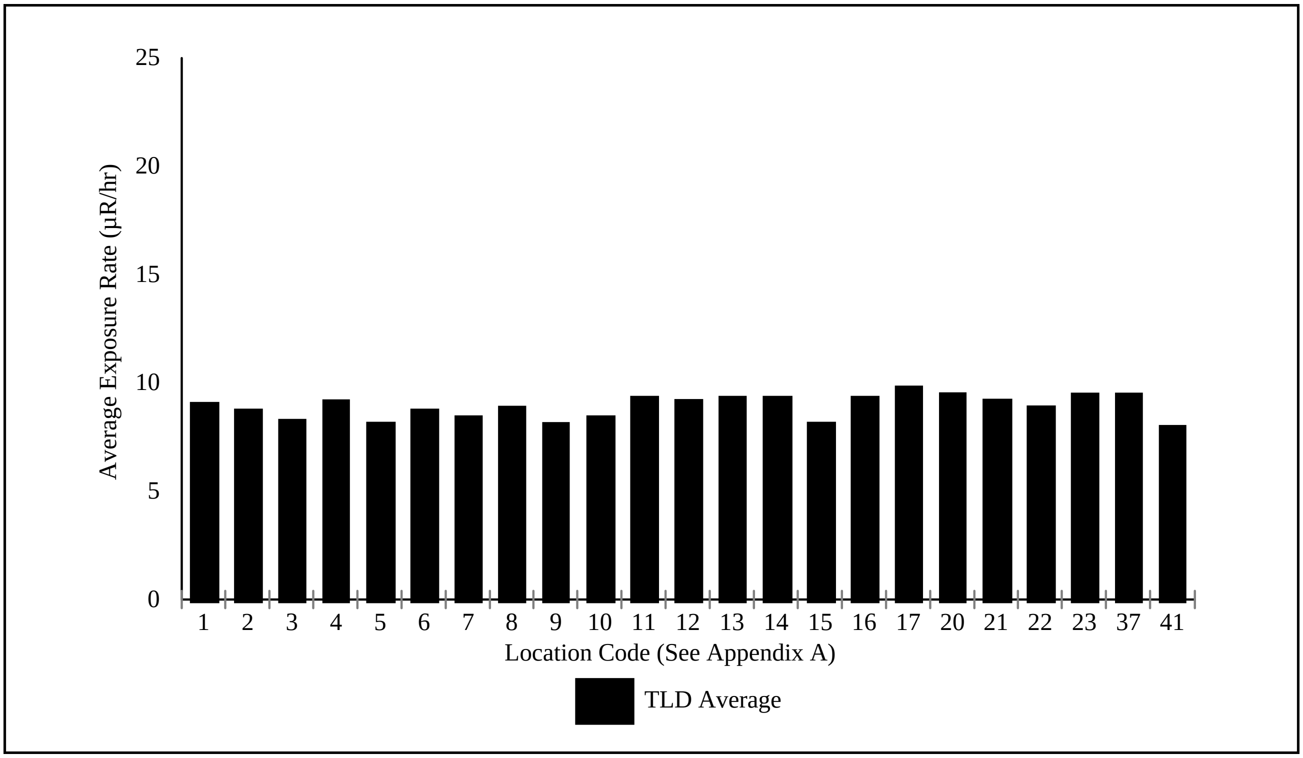

Figure C - 4.1

1996 Average Quarterly Gamma Exposure Rates around the West Valley Demonstration Project Site

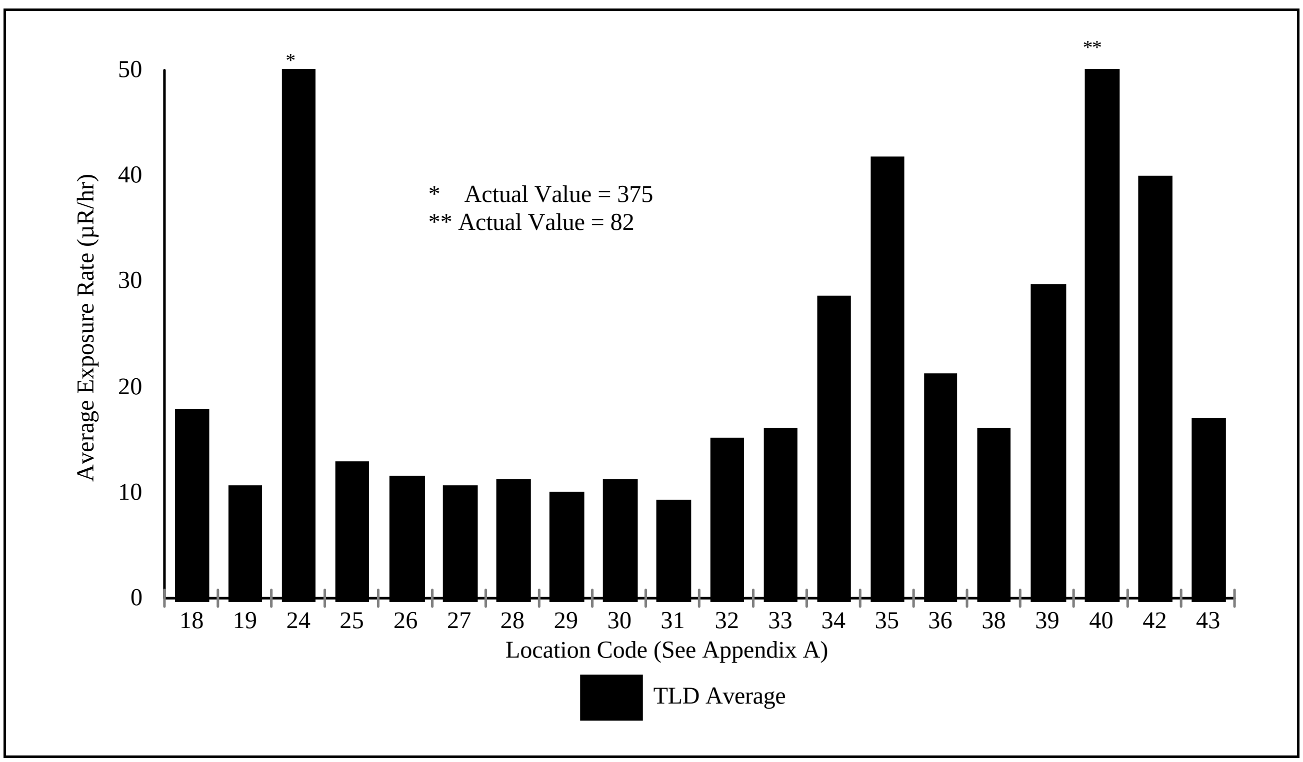

Figure C - 4.2

1996 Average Quarterly Gamma Exposure Rates on the West Valley Demonstration Project Site

Appendix C - 5

Summary of Nonradiological Monitoring Data

Shipping Water Samples to Off-site Laboratories for Analysis

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Table C - 5.1
West Valley Demonstration Project State Pollutant Discharge Elimination System (SPDES) Sampling Program

Outfall	**Parameter**	**Daily Maximum* Limit**	**Sample Frequency**
001 (Process and Storm Wastewater)	Flow	Monitor	2 per discharge
	Aluminum, total	14 mg/L	2 per discharge
	Ammonia (NH_3)	Monitor	2 per discharge
	Arsenic, dissolved	0.15 mg/L	2 per discharge
	BOD-5	10.0 mg/L	2 per discharge
	Iron, total	Monitor	2 per discharge
	Zinc, total recoverable	0.48 mg/L	2 per discharge
	Suspended solids	45 mg/L	2 per discharge
	Cyanide, amenable to chlorination	0.022 mg/L	2 per discharge
	Settleable solids	0.30 mL/L	2 per discharge
	pH (range)	6.5 - 8.5	2 per discharge
	Oil and grease	15 mg/L	2 per discharge
	Sulfate	Monitor	2 per discharge
	Sulfide, dissolved	0.4 mg/L	2 per discharge
	Manganese, total	2.0 mg/L	2 per discharge
	Nitrate	Monitor	2 per discharge
	Nitrite	0.1 mg/L	2 per discharge
	Chromium, total recoverable	0.3 mg/L	2 per discharge
	Chromium (hexavalent)	0.011 mg/L	2 per discharge
	Cadmium, total recoverable	0.002 mg/L	2 per discharge
	Copper, total recoverable	0.03 mg/L	2 per discharge
	Copper, dissolved	Monitor	2 per discharge
	Lead, total recoverable	0.006 mg/L	2 per discharge
	Nickel, total recoverable	0.14 mg/L	2 per discharge
	Dichlordifluoromethane	0.01 mg/L	2 per discharge
	Trichlorofluoromethane	0.01 mg/L	2 per discharge
	3,3-dichlorobenzidine	0.01 mg/L	2 per discharge
	Tributyl phosphate	32 mg/L	2 per discharge
	Vanadium, total recoverable	0.014 mg/L	2 per discharge
	Cobalt, total recoverable	0.005 mg/L	2 per discharge
	Selenium, total recoverable	0.004 mg/L	2 per discharge
	Hexachlorobenzene	0.02 mg/L	2 per discharge
	Alpha - BHC	0.00001 mg/L	2 per discharge
	Heptachlor	0.00001 mg/L	2 per discharge
	Surfactant (as LAS)	0.4 mg/L	2 per discharge
	Xylene	0.05 mg/L	2 per discharge
	2-butanone	0.5 mg/L	2 per discharge
	Total Dissolved Solids	Monitor	2 per discharge
	Barium	0.5 mg/L	annual
	Antimony	1.0 mg/L	annual
	Chloroform	0.3 mg/L	annual
	Bis(2-ethylhexyl)phthalate	1.6 mg/L	semiannual
	4-Dodecene	0.6 mg/L	semiannual
	Titanium	0.65 mg/L	semiannual

** Daily average limitations are also identified in the permit but require monitoring only for all parameters except aluminum, total (daily average limit - 7.0 mg/L); solids, suspended (daily average limit - 30.0 mg/L); BOD-5 for the sum of outfalls 001, 007, and 008 (daily average limit - 5.0 mg.L); and ammonia for the sum of outfalls 001 and 007 (daily average limit - 1.49 mg/L).*

Table C - 5.1 (concluded)
West Valley Demonstration Project State Pollutant Discharge Elimination System (SPDES) Sampling Program

Outfall	Parameter	Daily Maximum* Limit	Sample Frequency
007 (Sanitary and Utility Wastewater)	Flow	Monitor	3 per month
	Ammonia (as NH_3)	Monitor	3 per month
	BOD-5	10.0 mg/L	3 per month
	Iron, total	Monitor	3 per month
	Solids, suspended	45 mg/L	3 per month
	Solids, settleable	0.30 mL/L	weekly
	pH (range)	6.5 - 8.5	weekly
	Nitrite (as N)	0.1 mg/L	3 per month
	Oil and grease	15 mg/L	3 per month
	Chlorine, total residual	0.1 mg/L	weekly
	Chloroform	0.20 mg/L	annual
008 (French Drain Wastewater)	Flow	Monitor	3 per month
	BOD-5	5.0 mg/L	3 per month
	Iron, total	Monitor	3 per month
	pH (range)	6.5 - 8.5	3 per month
	Cadmium, total recoverable	0.002 mg/L	3 per month
	Lead, total recoverable	0.006 mg/L	3 per month
	Silver, total	0.008 mg/L	annual
	Zinc, total	0.100 mg/L	annual
	Arsenic	0.17 mg/L	annual
	Chromium	0.13 mg/L	annual
Sum of Outfalls 001, 007, and 008	Iron, total	0.30 mg/L	3 per month
	BOD-5	Monitor	3 per month
Sum of Outfalls 001, and 007	Ammonia (NH_3)	2.1 mg/L	3 per month
	Solids, total dissolved	500 mg/L	2 per discharge
Pseudo monitoring point (116)	Solids, total dissolved	500 mg/L	2 per discharge

** Daily average limitations are also identified in the permit but require monitoring only for all parameters except aluminum, total (daily average limit - 7.0 mg/L); solids, suspended (daily average limit - 30.0 mg/L); BOD-5 for the sum of outfalls 001, 007, and 008 (daily average limit - 5.0 mg.L); and ammonia for the sum of outfalls 001 and 007 (daily average limit - 1.49 mg/L).*

Table C - 5.2
West Valley Demonstration Project 1996 SPDES Noncompliance Episodes

Date	Outfall	Parameters	Limit	Value	Comments
Aug 22	001	NO_2-N	0.10 mg/L	0.24 mg/L	Low pH maintained in the lagoon inhibited the nitrification process
Aug 27	001	pH	6.5 - 8.5	5.2	Over-compensated for rising pH during discharge

JEB: 97: W: \DWG\INACTIVE\SER\SER96\SR96C5-1.DWG

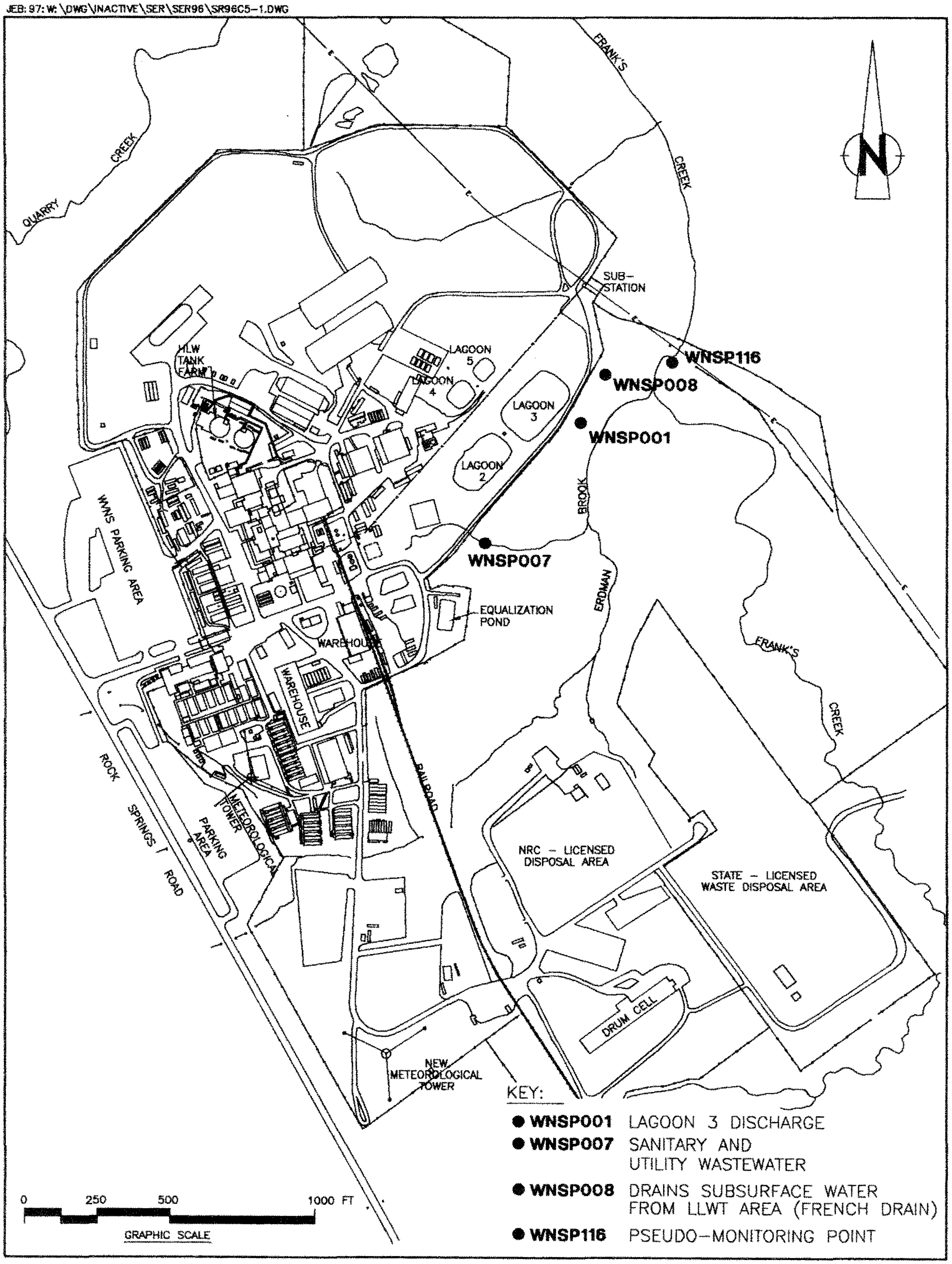


Figure C-5.1. SPDES Monitoring Points.

Figure C - 5.2

WATER QUALITY

BIOCHEMICAL OXYGEN DEMAND-5 (mg/L)

Outfall 001

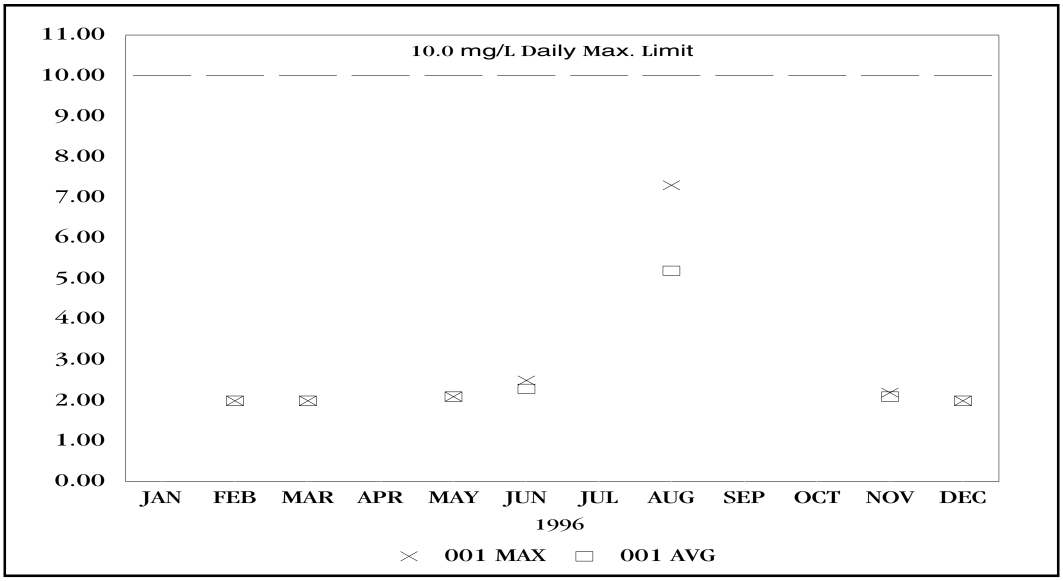


Figure C - 5.3

WATER QUALITY

BIOCHEMICAL OXYGEN DEMAND-5 (mg/L)

Outfalls 007 and 008

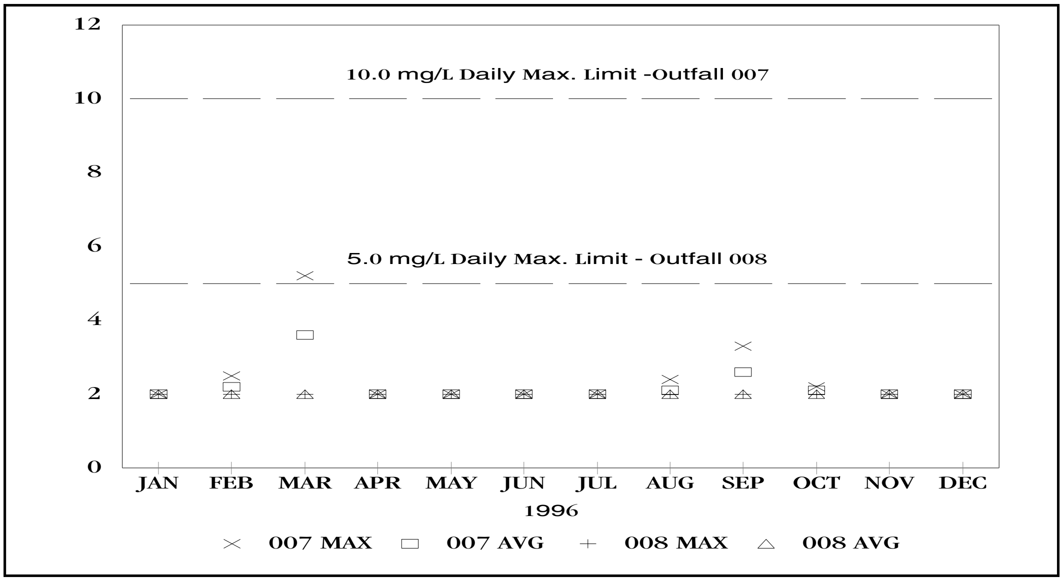


Figure C - 5.4

WATER QUALITY

BIOCHEMICAL OXYGEN DEMAND-5 (mg/L)

Sum of Outfalls 001, 007, and 008

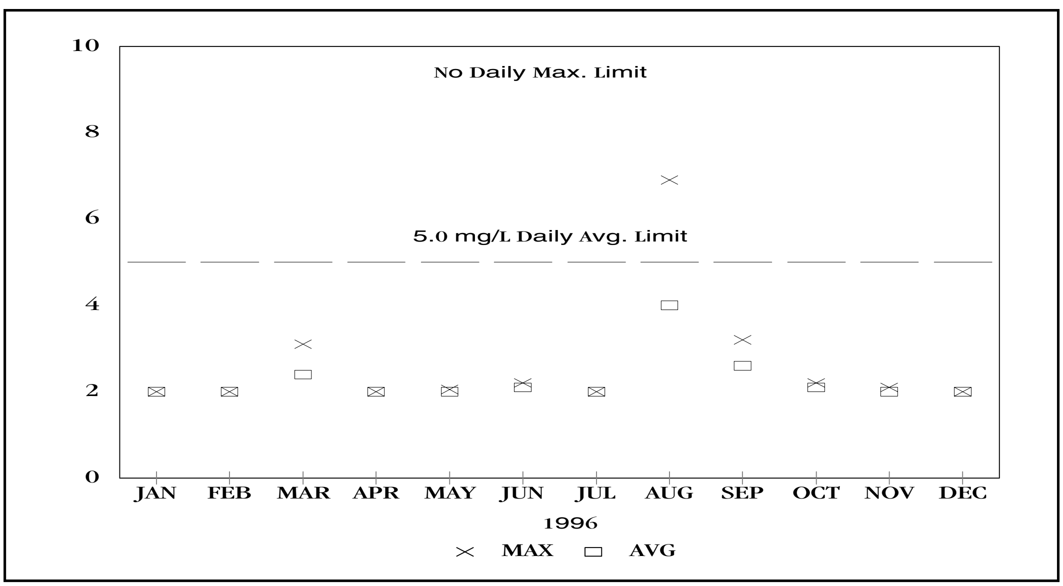


Figure C - 5.5

WATER QUALITY

SUSPENDED SOLIDS (mg/L)

Outfall 001

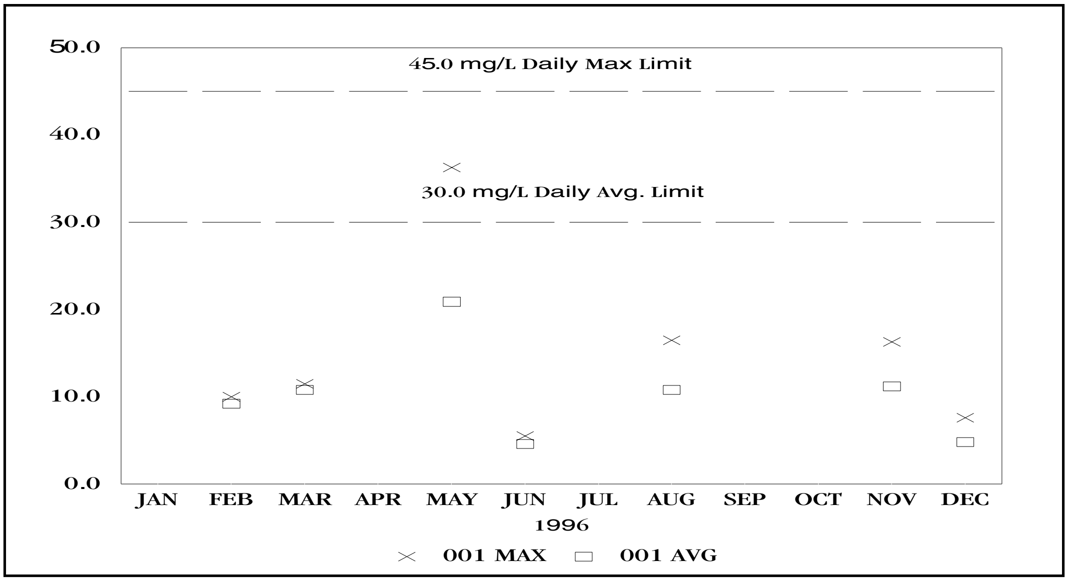


Figure C - 5.6

WATER QUALITY

SUSPENDED SOLIDS (mg/L)

Outfall 007

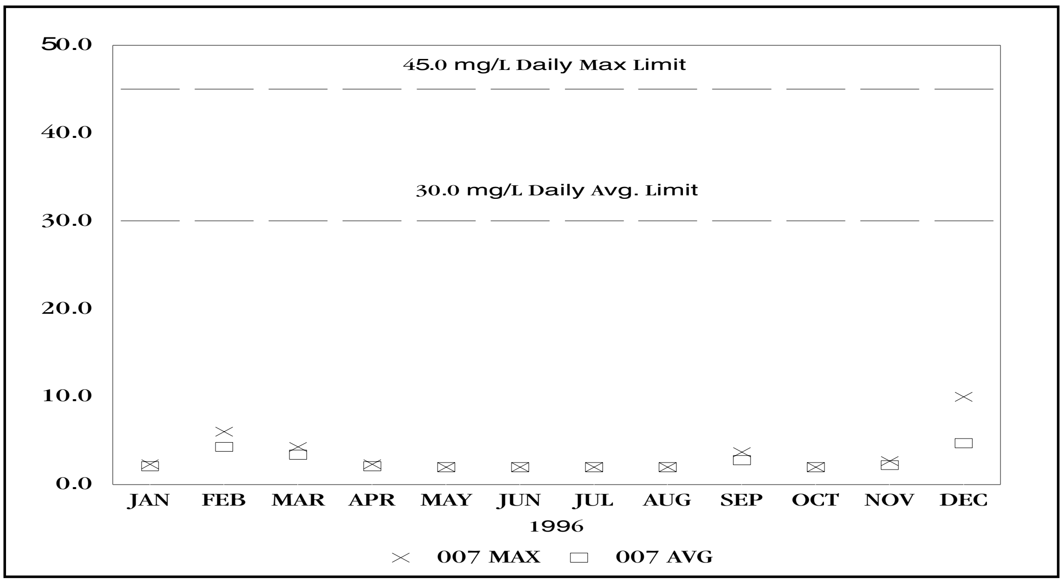


Figure C - 5.7

WATER QUALITY

SETTLEABLE SOLIDS mL/L

Outfall 001

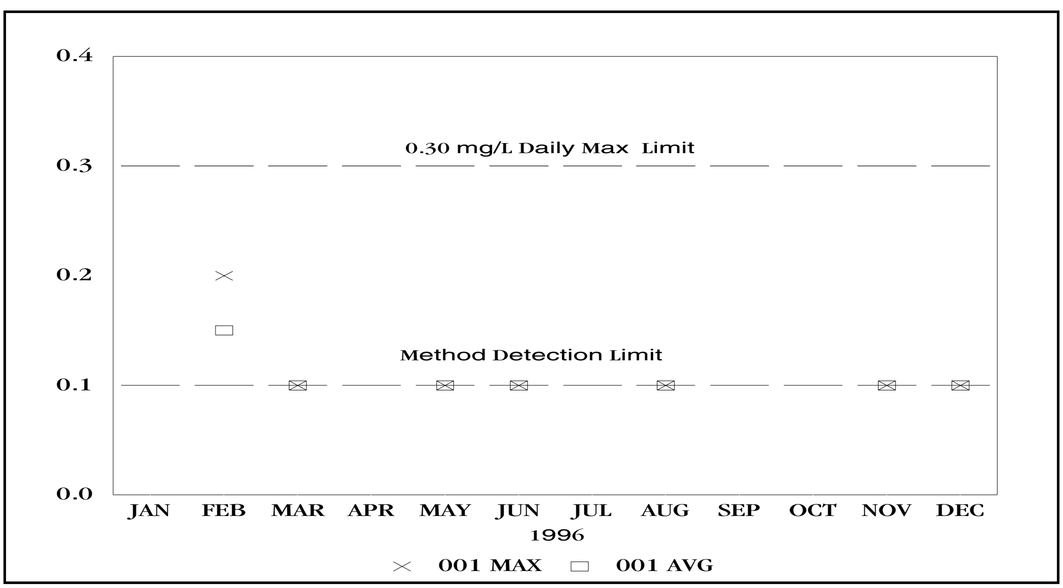


Figure C - 5.8

WATER QUALITY

SETTLEABLE SOLIDS (mL/L)

Outfall 007

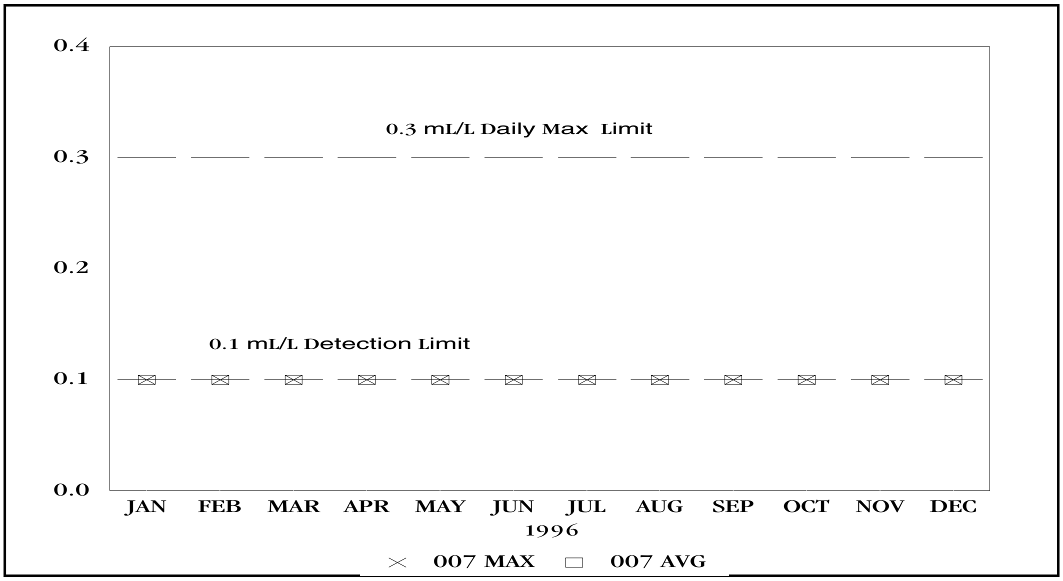


Figure C - 5.9

WATER QUALITY

AMMONIA (mg/L)

Outfall 001

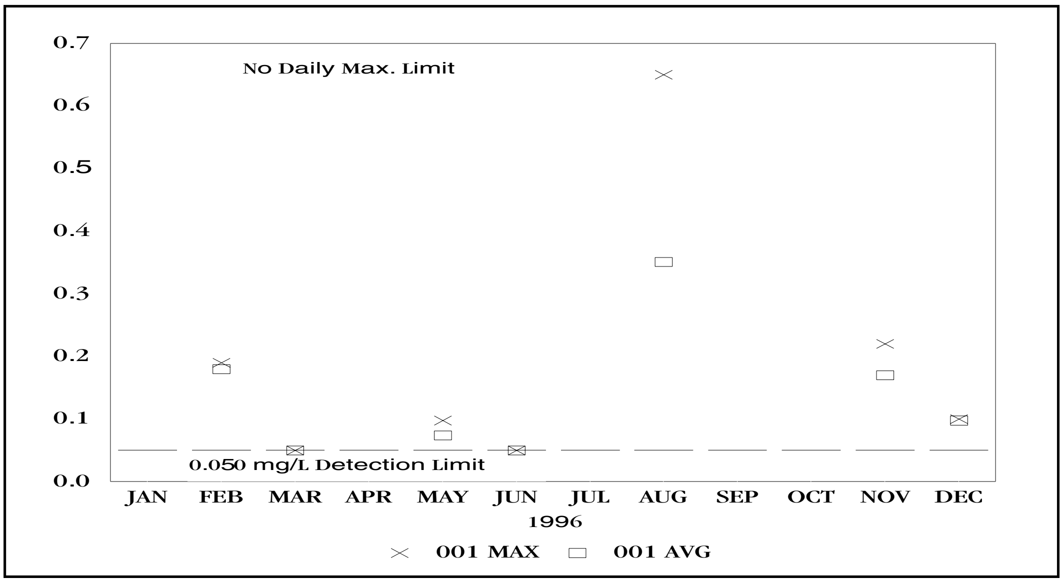


Figure C - 5.10

WATER QUALITY

AMMONIA (mg/L)

Outfall 007

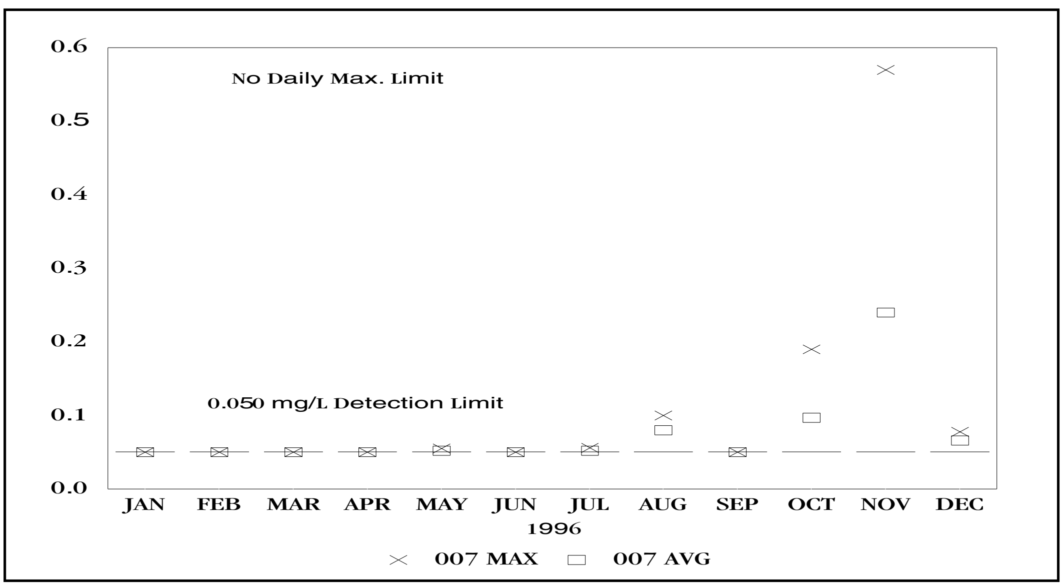


Figure C - 5.11

WATER QUALITY

FLOW-WEIGHTED AVERAGES

AMMONIA (mg/L)

Sum of Outfalls 001 and 007

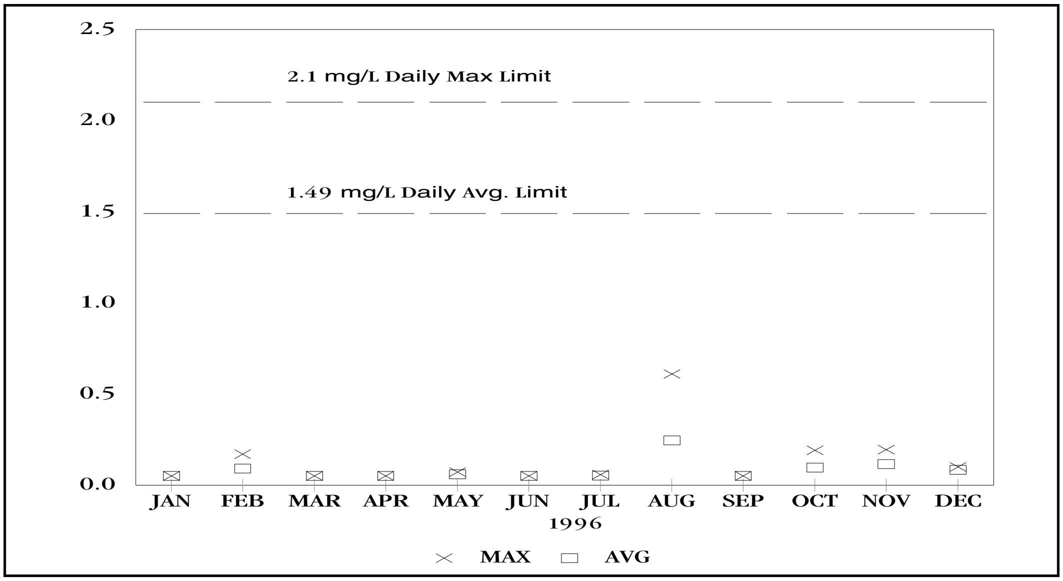


Figure C - 5.12

WATER QUALITY

CYANIDE (mg/L)

Outfall 001

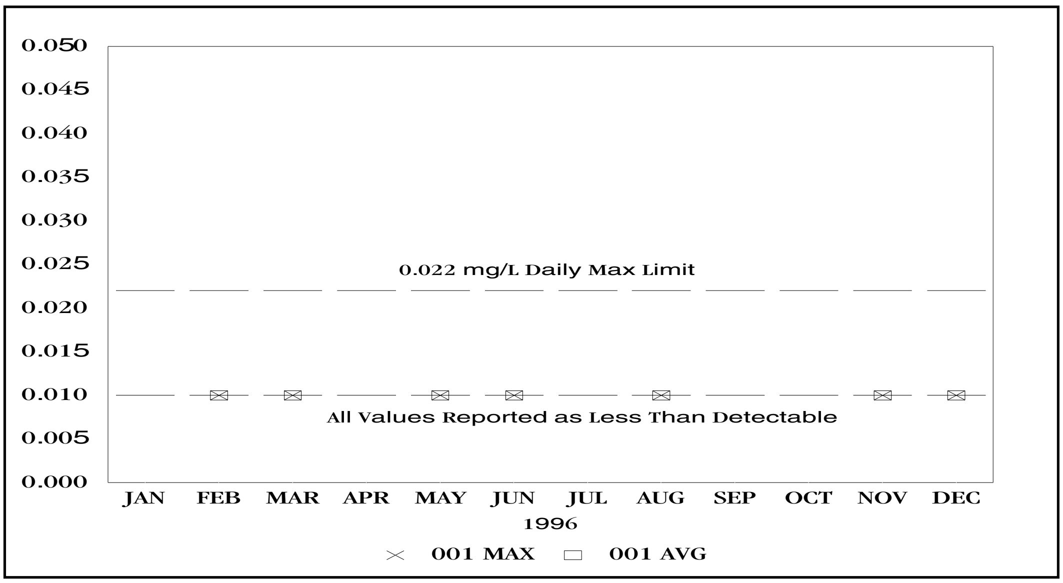


Figure C - 5.13

WATER QUALITY

NITRATE (NO_3-N) (mg/L)

Outfall 001

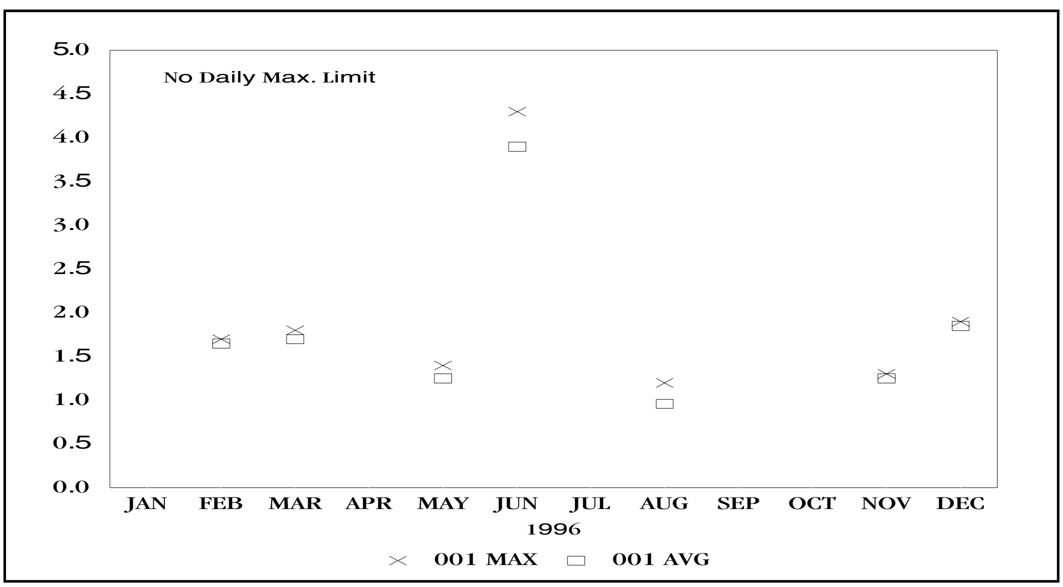


Figure C - 5.14

WATER QUALITY

NITRITE (NO_2-N) (mg/L)

Outfall 001

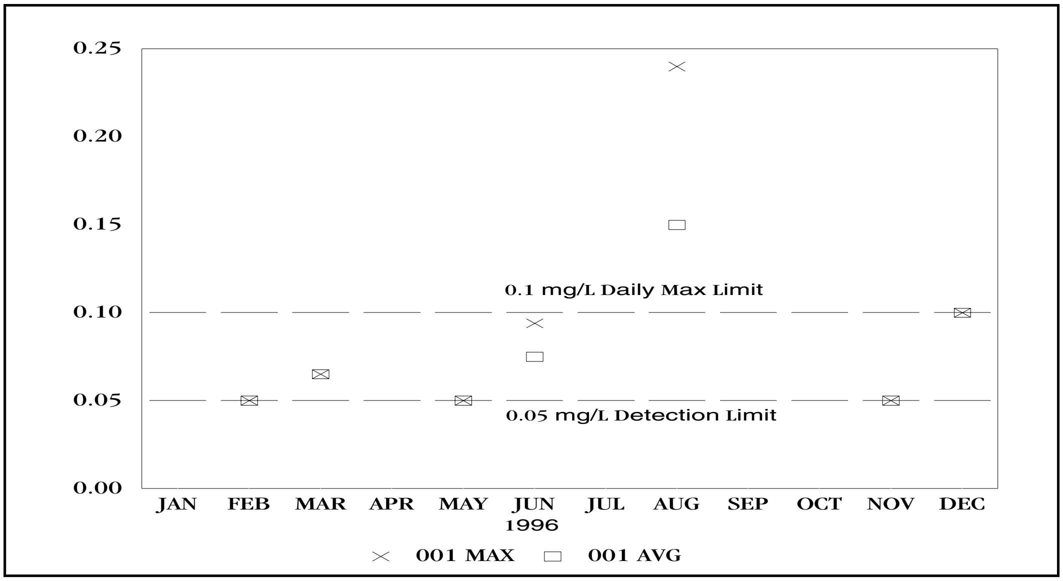


Figure C - 5.15

WATER QUALITY

NITRITE (NO_2-N) (mg/L)

Outfall 007

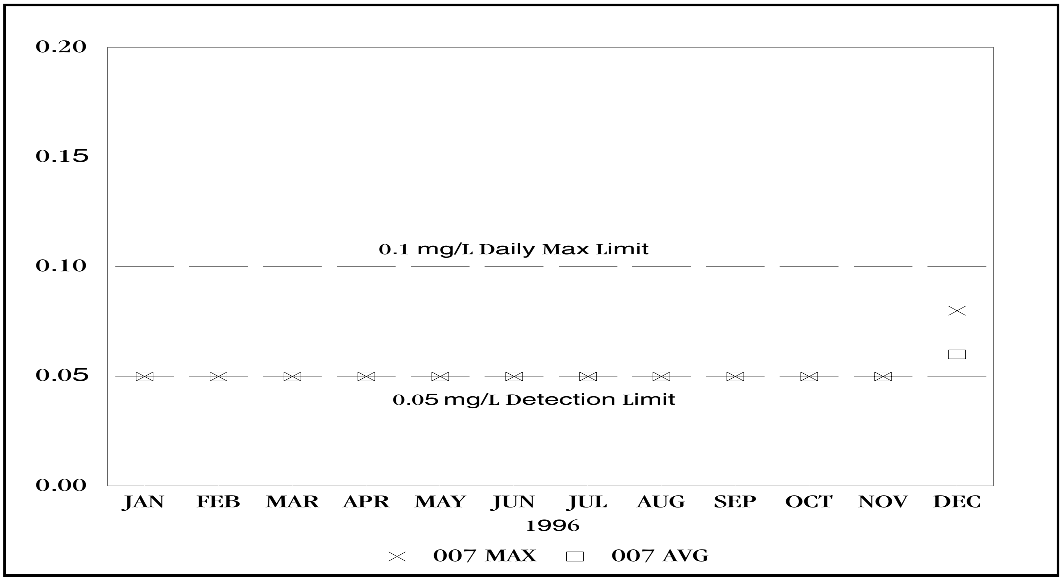


Figure C - 5.16

WATER QUALITY

SULFATE-S (mg/L)

Outfall 001

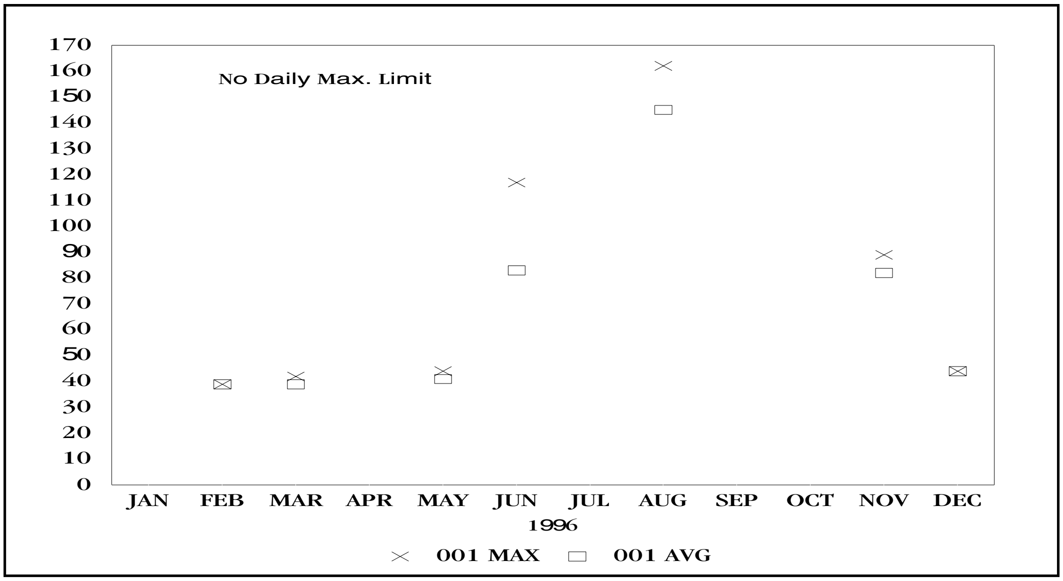


Figure C - 5.17

WATER QUALITY

OIL & GREASE
(mg/L)

Outfall 001

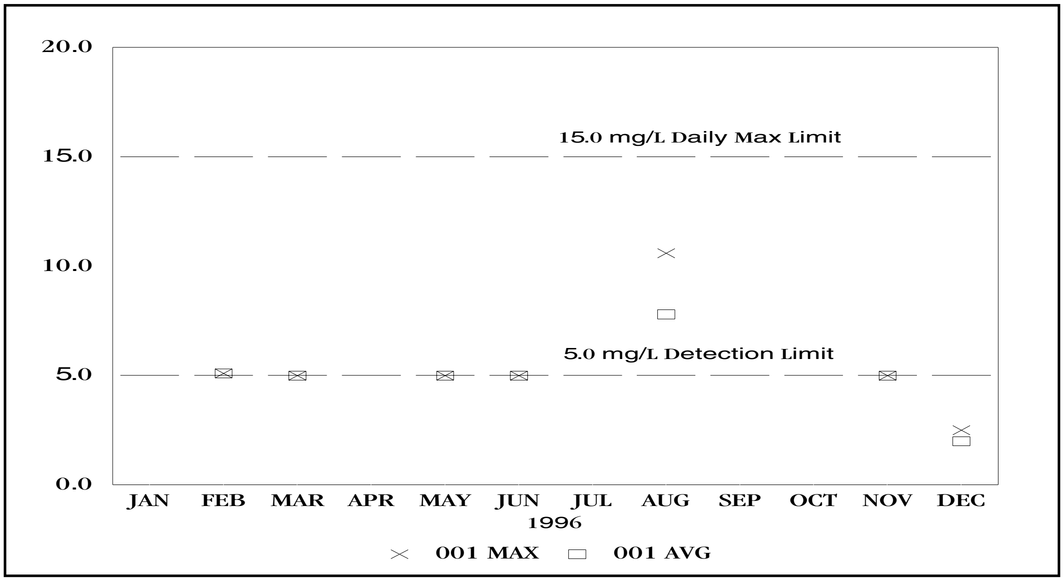


Figure C - 5.18

WATER QUALITY

OIL & GREASE
(mg/L)

Outfall 007

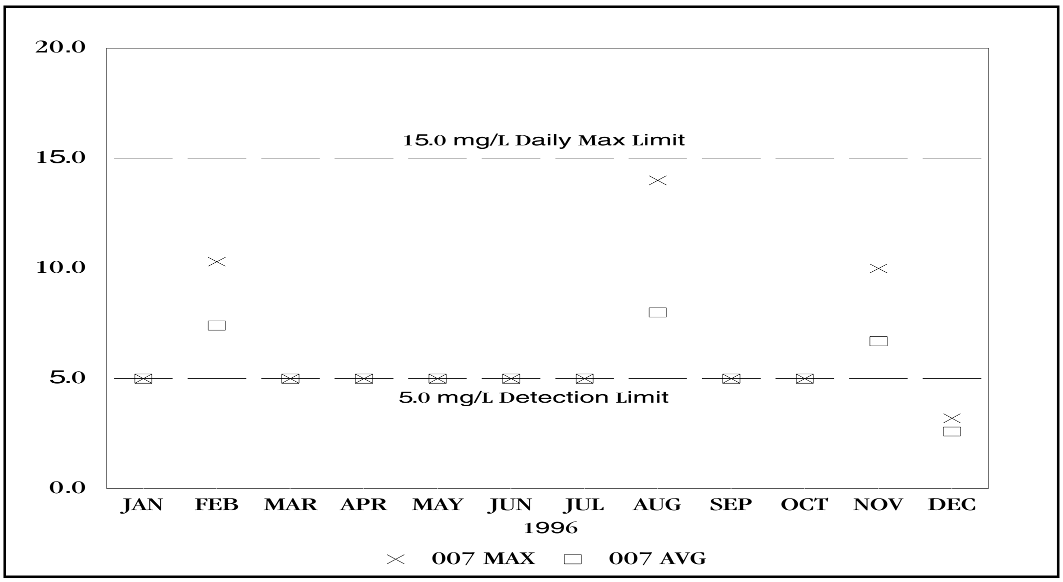


Figure C - 5.19

WATER QUALITY

pH
(standard units)

Outfall 001

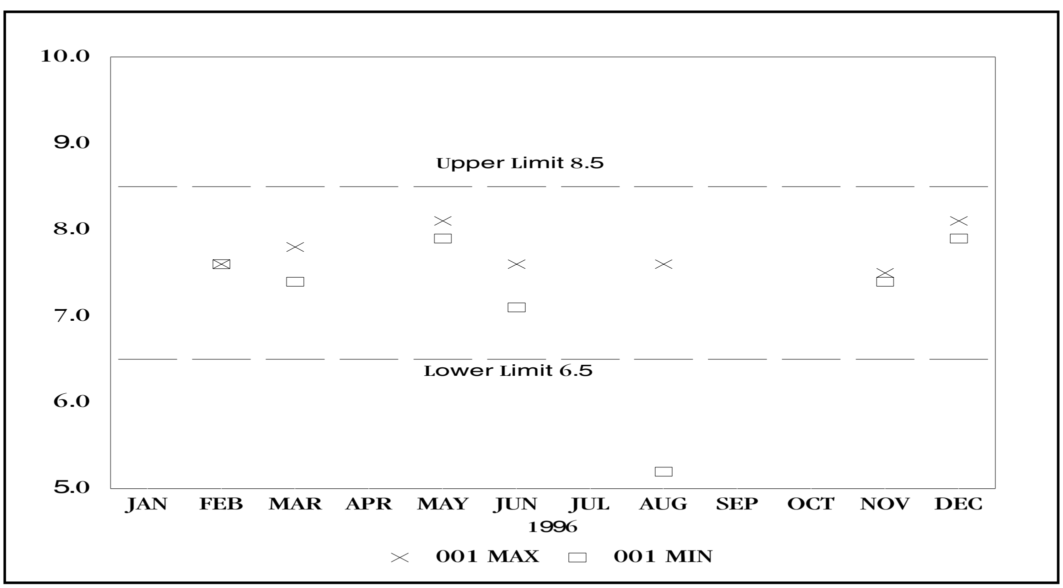


Figure C - 5.20

WATER QUALITY

pH
(standard units)

Outfalls 007 and 008

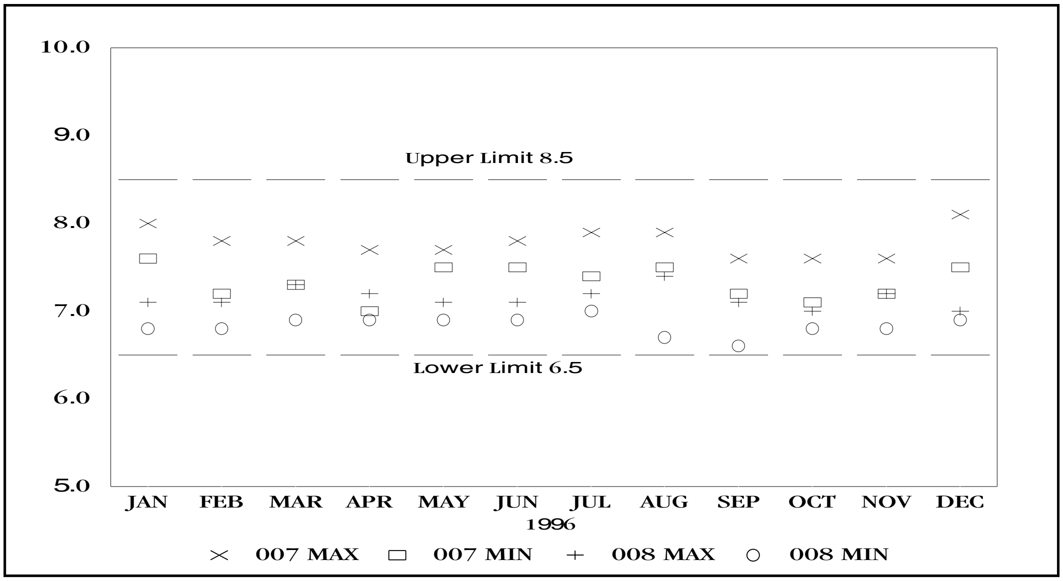


Figure C - 5.21

WATER QUALITY

SURFACTANTS (as LAS)
(mg/L)

Outfall 001

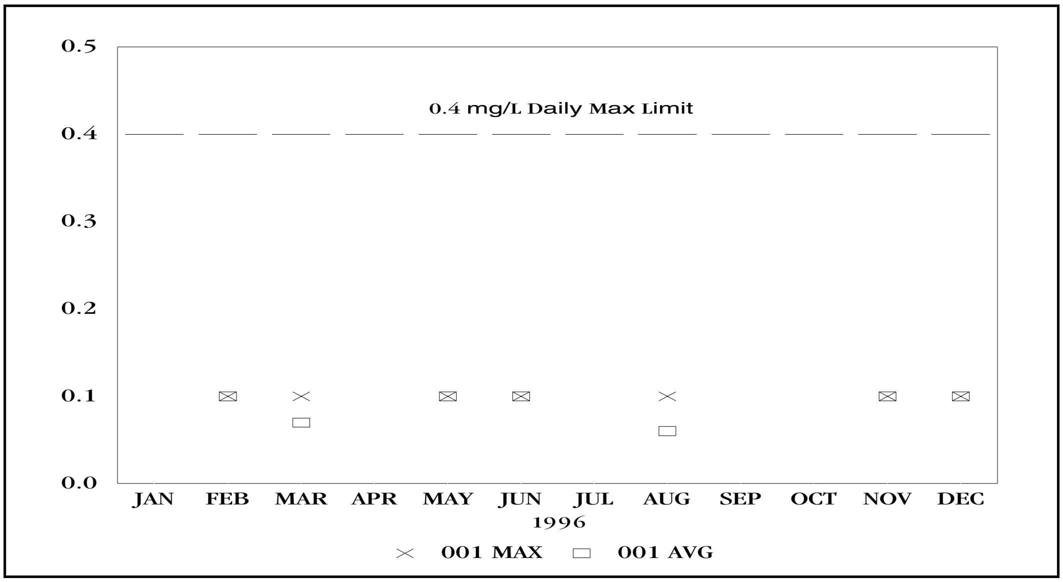


Figure C - 5.22

WATER QUALITY

CHLORINE
TOTAL RESIDUAL
(mg/L)

Outfall 007

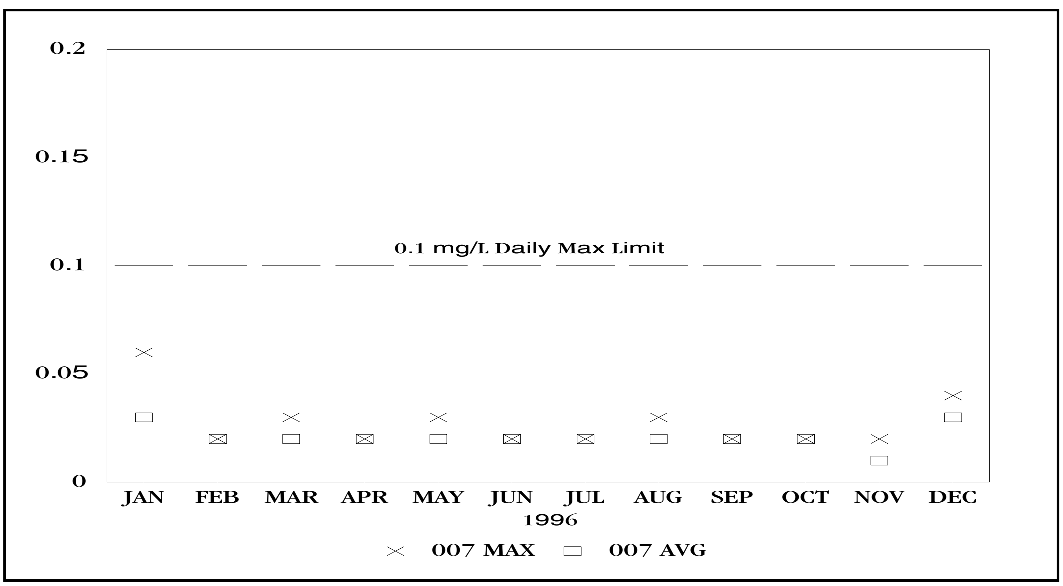


Figure C - 5.23

WATER QUALITY

DISCHARGE RATE (MGD)

Outfall 001

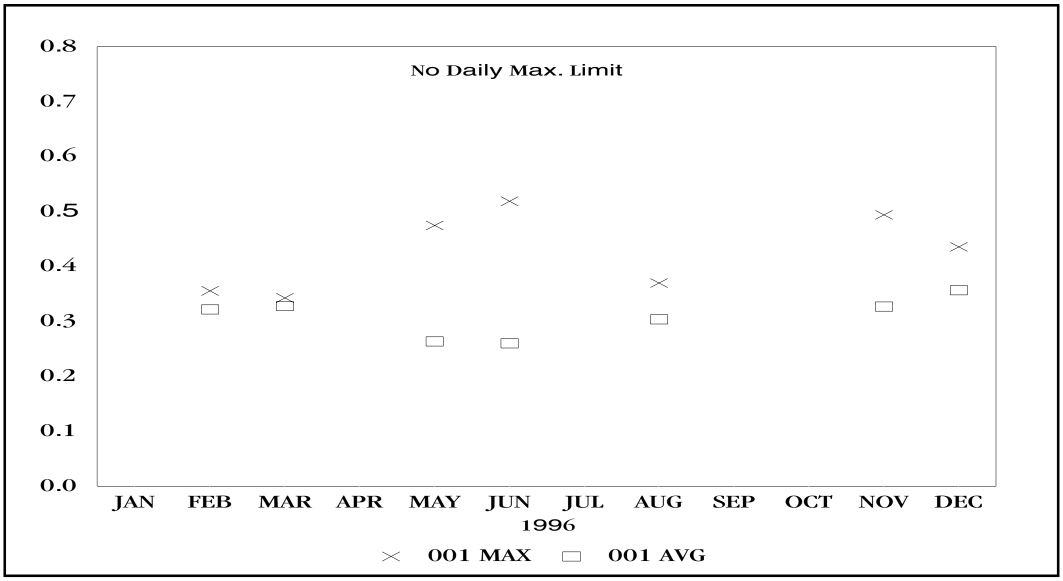


Figure C - 5.24

WATER QUALITY

DISCHARGE RATE (GPD x 1,000)

Outfall 007

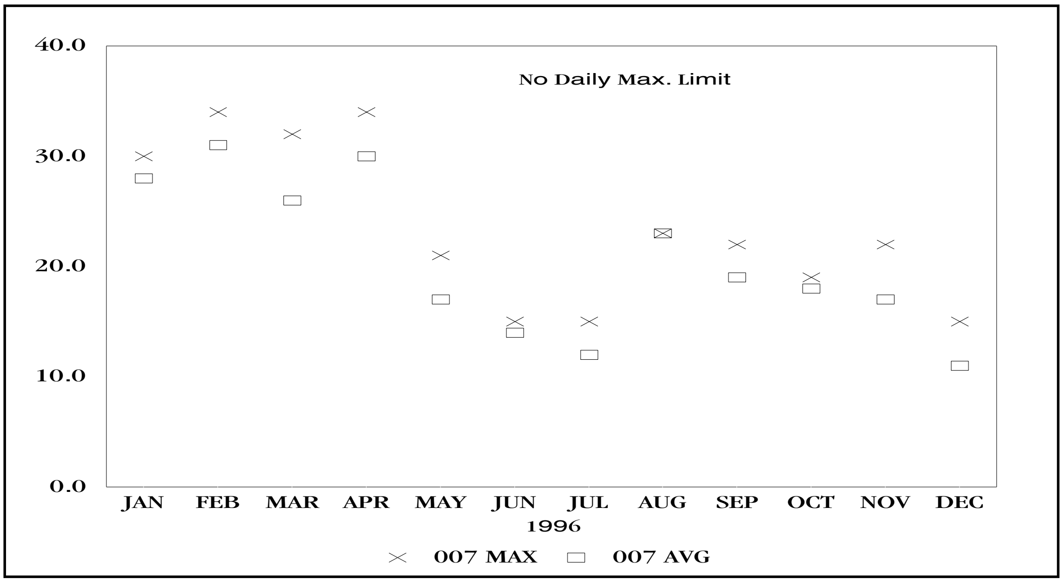


Figure C - 5.25

WATER QUALITY

DISCHARGE RATE (GPD x 1,000)

Outfall 008

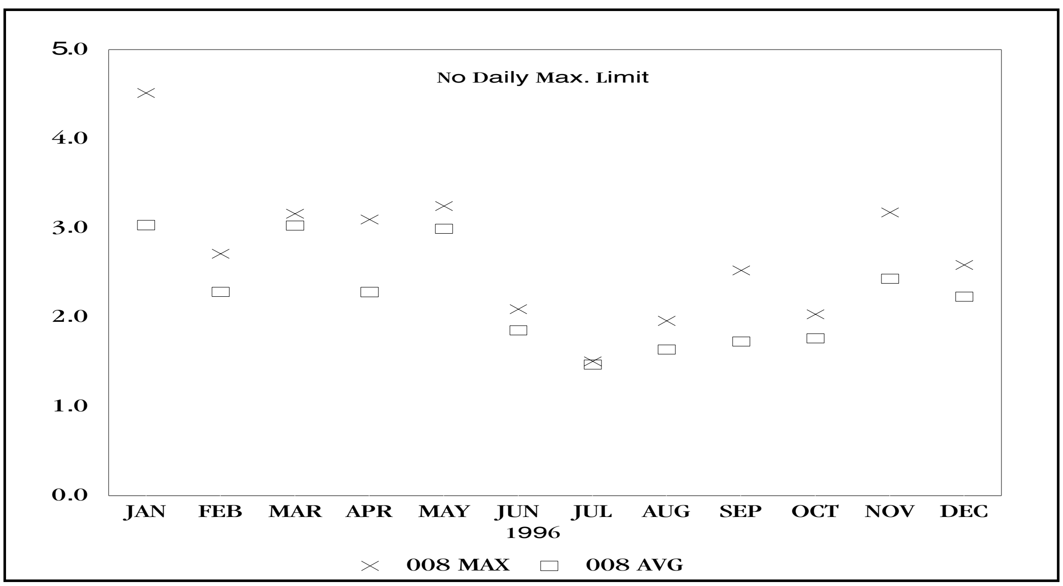


Figure C - 5.26

METALS

ALUMINUM, TOTAL (mg/L)

Outfall 001

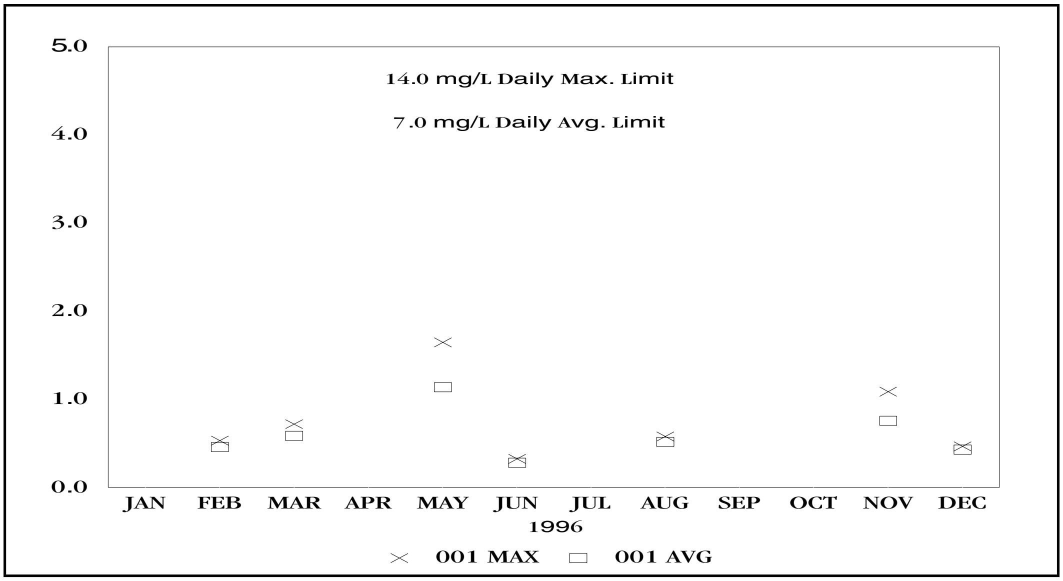


Figure C - 5.27

METALS

ARSENIC, DISSOLVED (mg/L)

Outfall 001

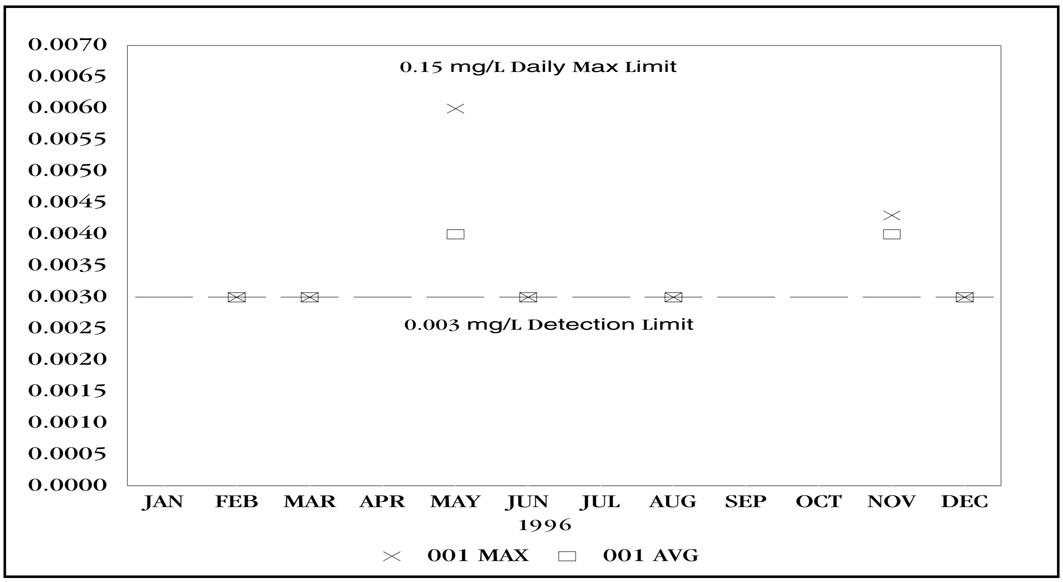


Figure C - 5.28

METALS

CADMIUM, TOTAL RECOVERABLE (mg/L)

Outfall 001

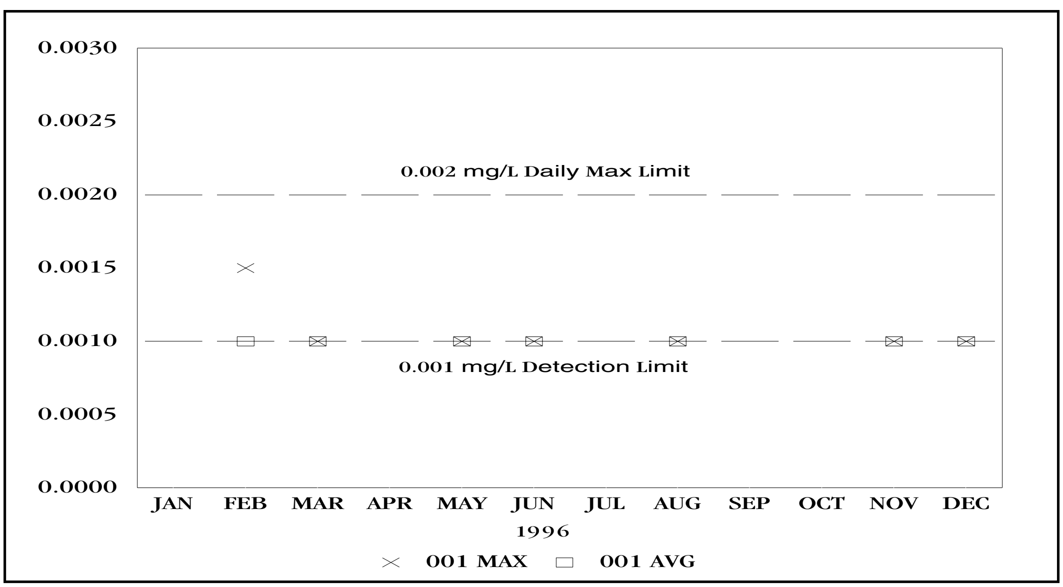


Figure C - 5.29

METALS

CADMIUM,
TOTAL RECOVERABLE
(mg/L)

Outfall 008

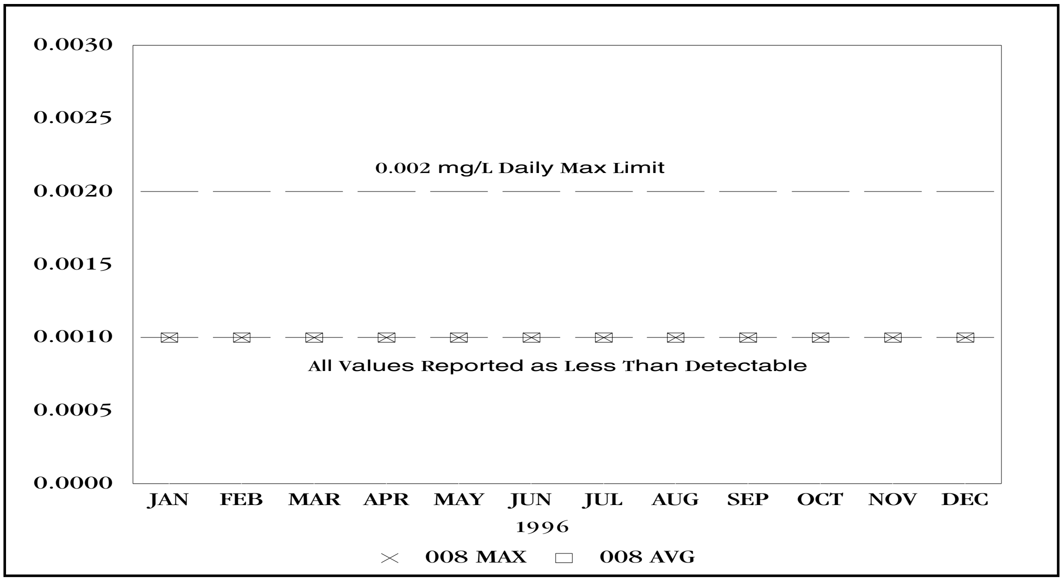


Figure C - 5.30

METALS

COBALT,
TOTAL RECOVERABLE
(mg/L)

Outfall 001

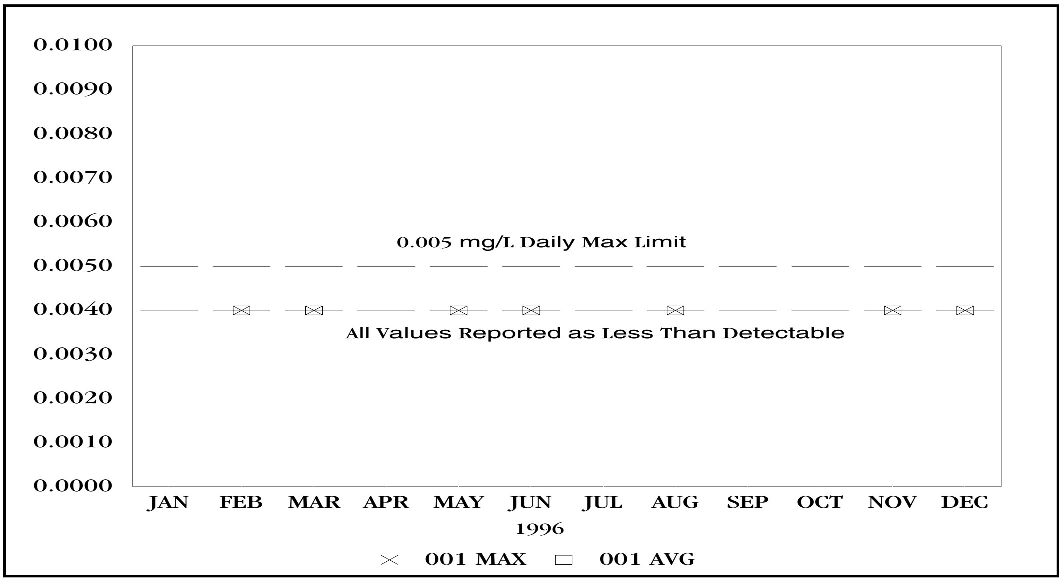


Figure C - 5.31

METALS

CHROMIUM,
TOTAL RECOVERABLE
(mg/L)

Outfall 001

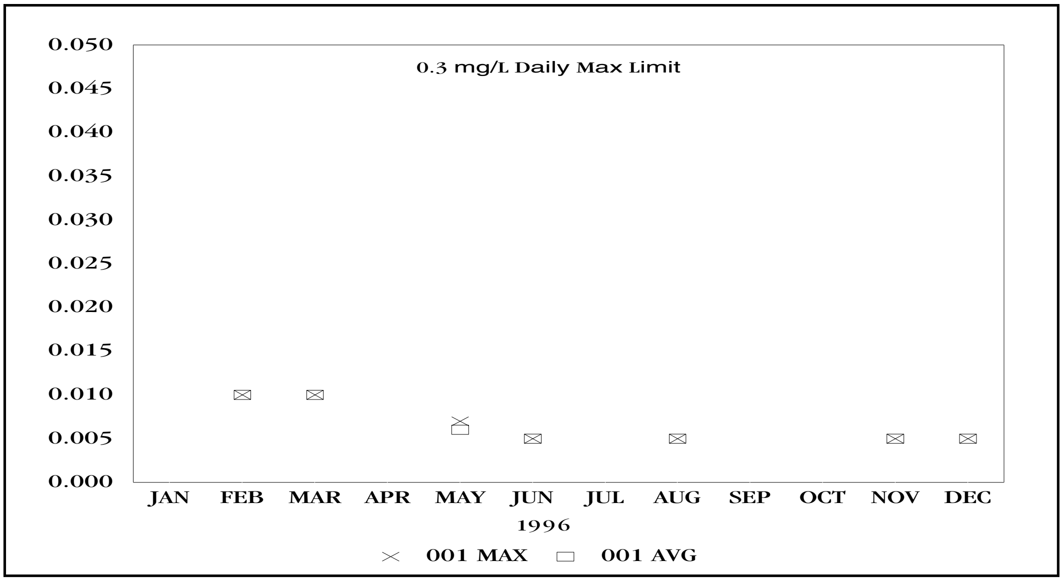


Figure C - 5.32

METALS

CHROMIUM, VI (mg/L)

Outfall 001

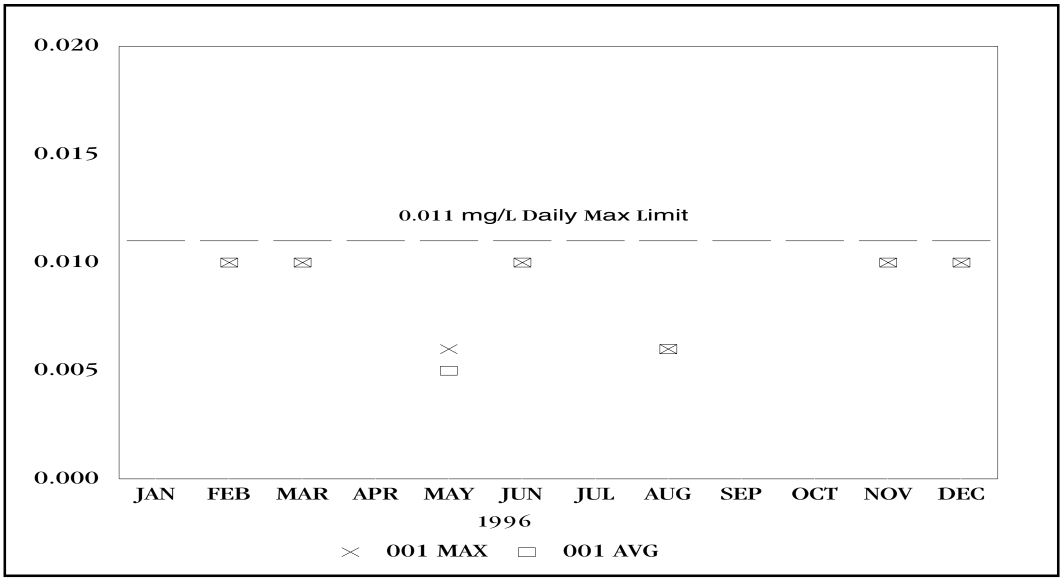


Figure C - 5.33

METALS

COPPER, DISSOLVED (mg/L)

Outfall 001

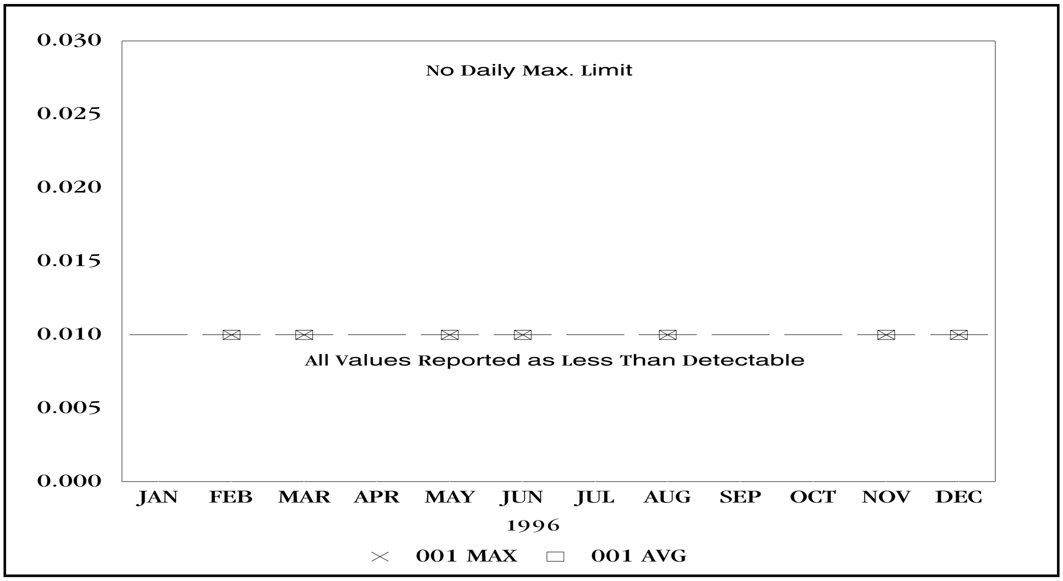


Figure C - 5.34

METALS

COPPER, TOTAL RECOVERABLE (mg/L)

Outfall 001

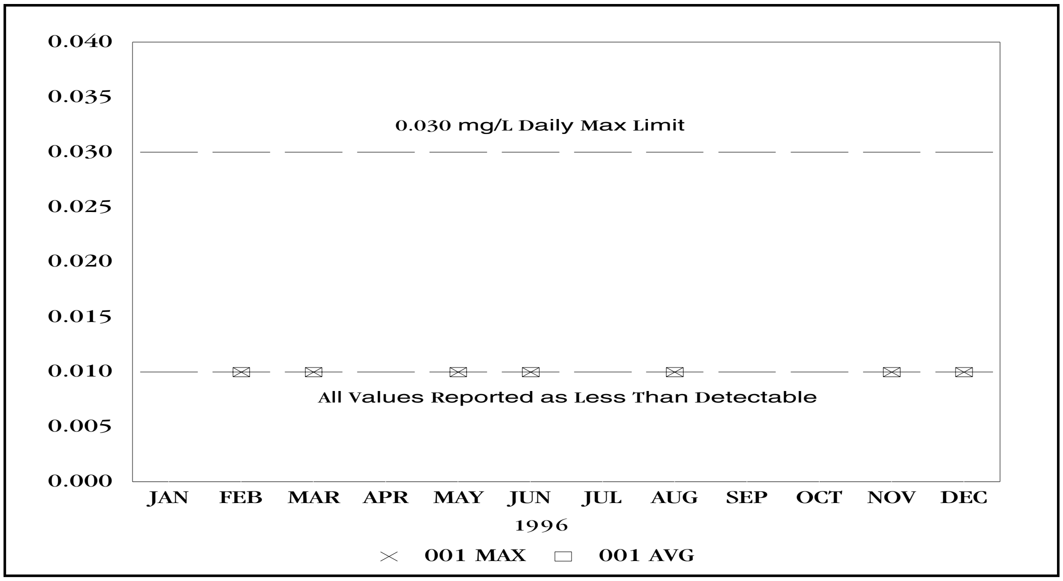


Figure C - 5.35

METALS

IRON, TOTAL (mg/L)

Outfall 001

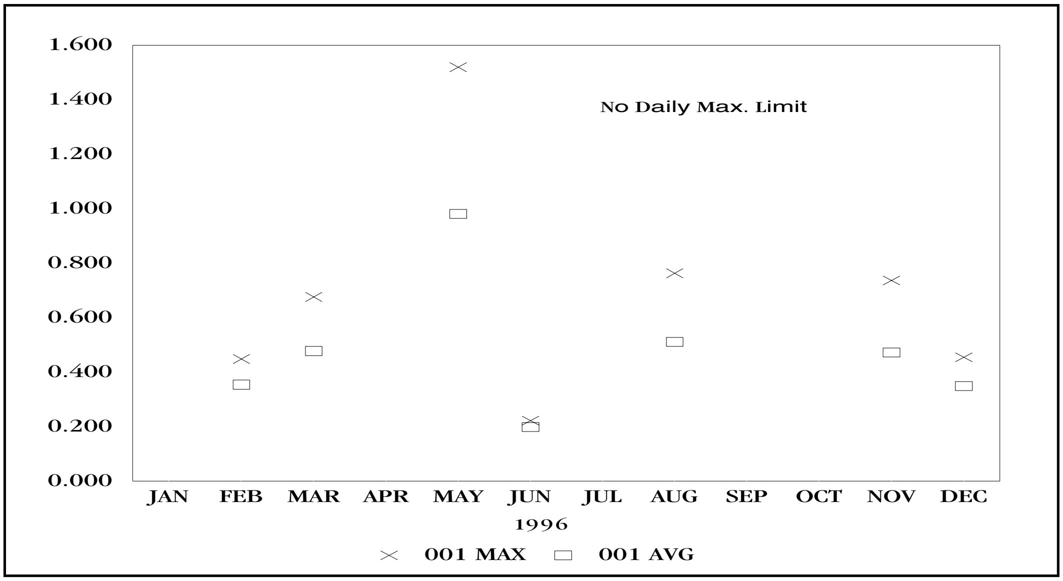


Figure C - 5.36

METALS

IRON, TOTAL (mg/L)

Outfalls 007 and 008

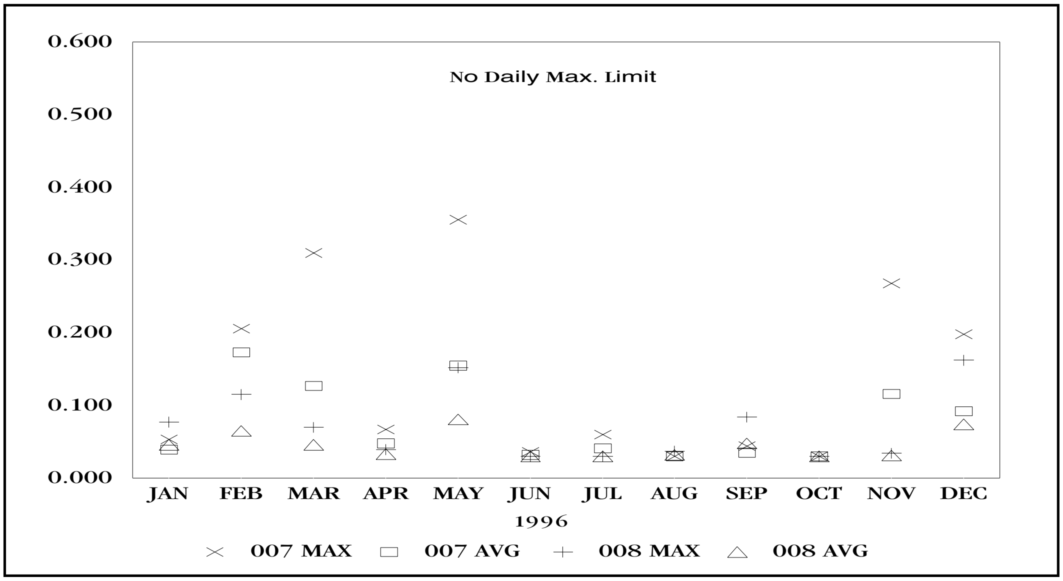


Figure C - 5.37

METALS

FLOW-WEIGHTED AVERAGE

IRON (mg/L)

Sum of Outfalls 001, 007, and 008

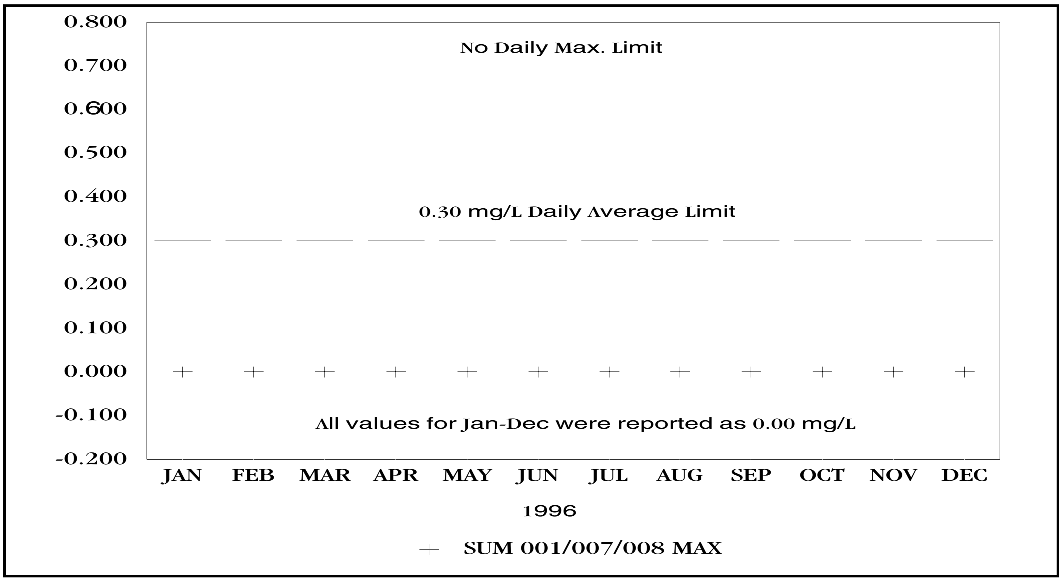


Figure C - 5.38

METALS

LEAD, TOTAL RECOVERABLE (mg/L)

Outfall 001

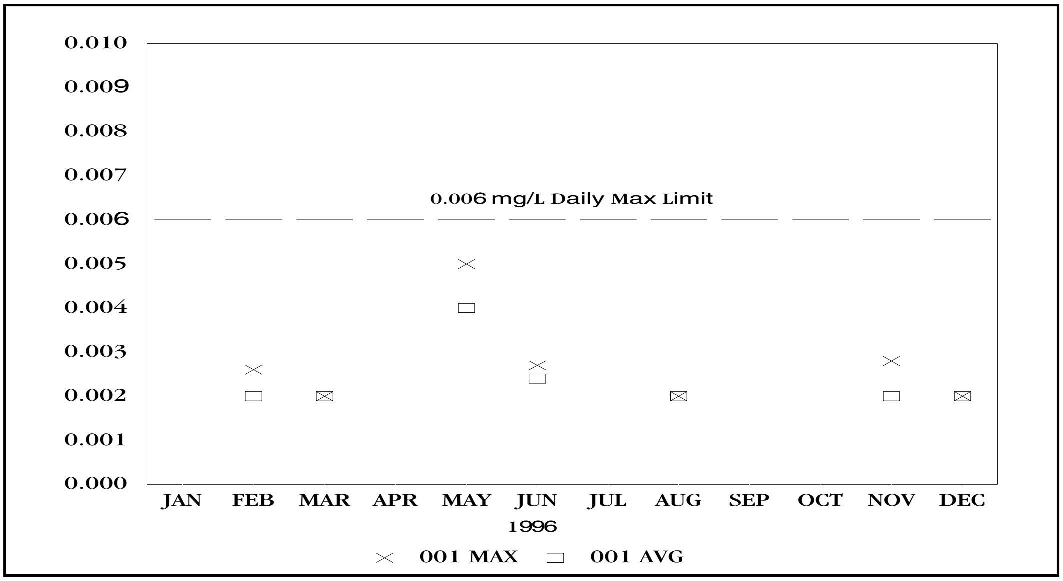


Figure C - 5.39

METALS

LEAD, TOTAL RECOVERABLE (mg/L)

Outfall 008

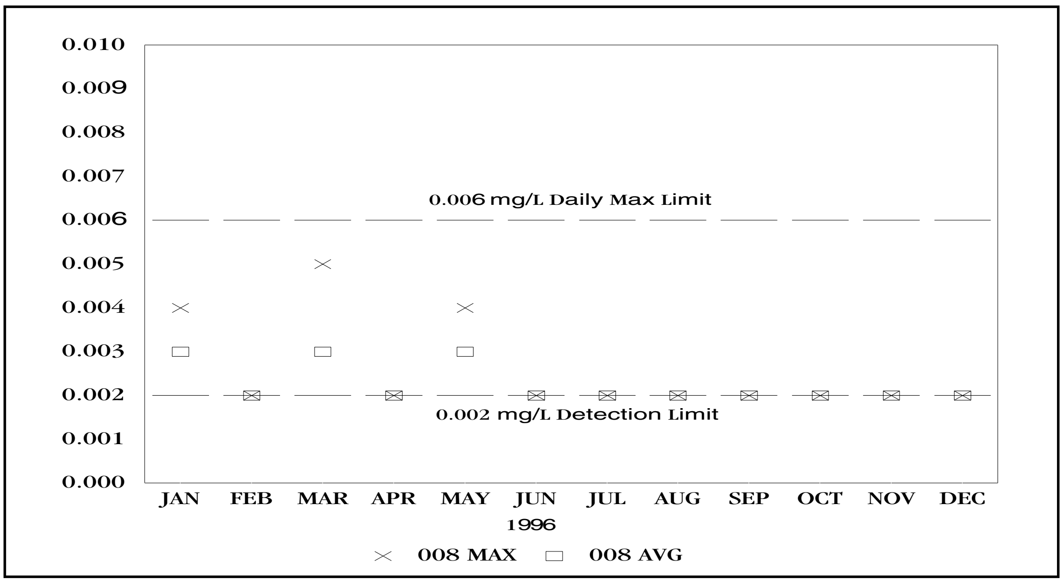


Figure C - 5.40

METALS

NICKEL, TOTAL RECOVERABLE (mg/L)

Outfall 008

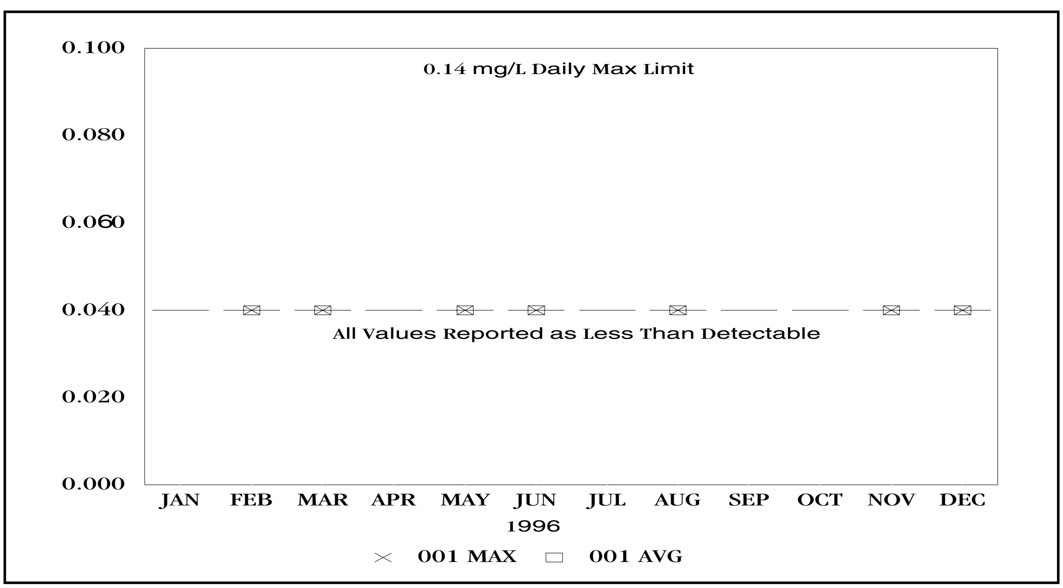


Figure C - 5.41

WATER QUALITY

SELENIUM,
TOTAL RECOVERABLE
(mg/L)

Outfall 001

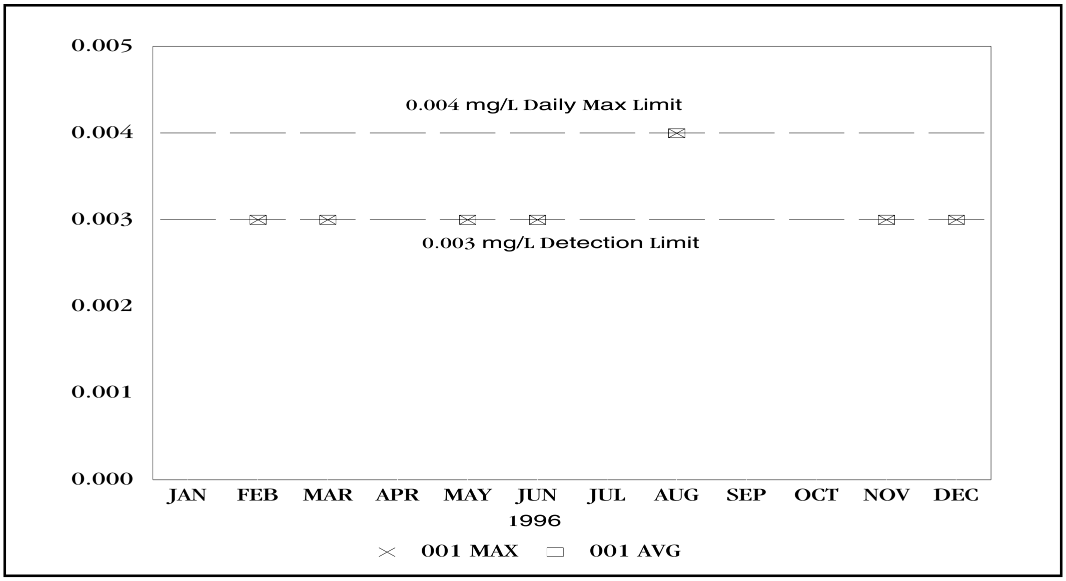


Figure C - 5.42

METALS

VANADIUM,
TOTAL RECOVERABLE
(mg/L)

Outfall 001

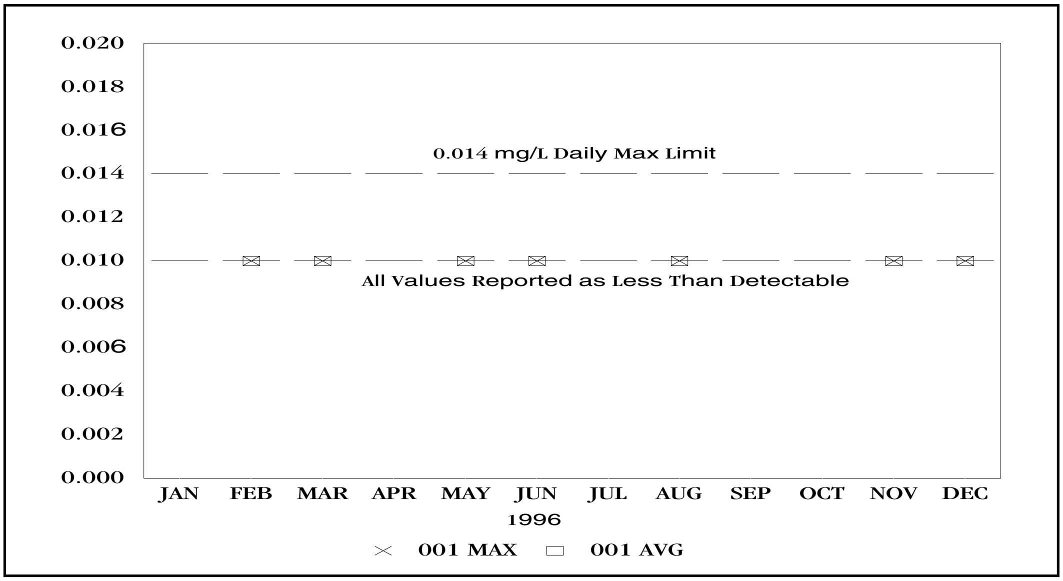


Figure C - 5.43

METALS

ZINC,
TOTAL RECOVERABLE
(mg/L)

Outfall 001

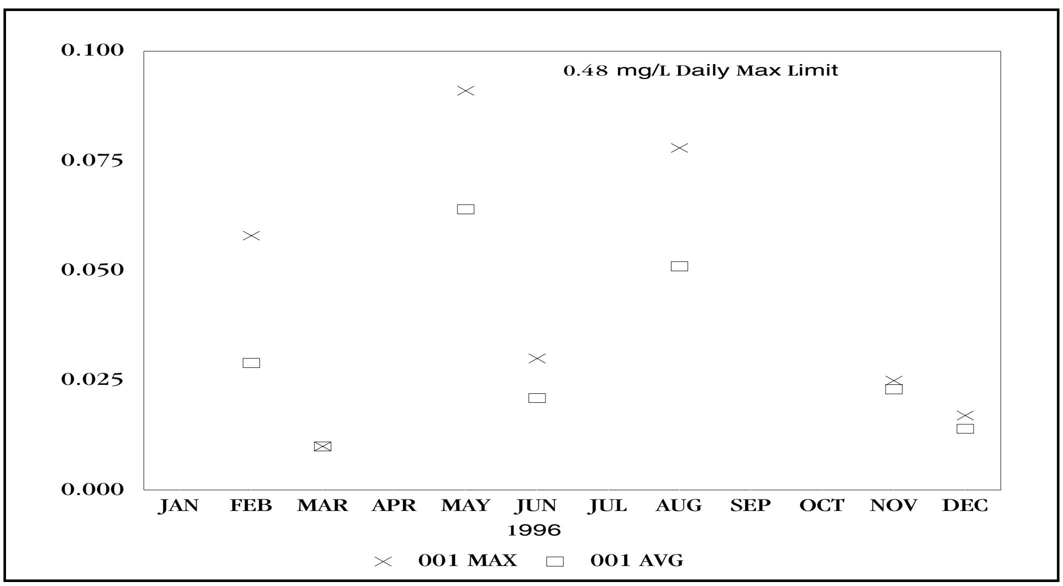


Figure C - 5.44

VOLATILE ORGANIC ANALYSIS

2-BUTANONE (mg/L)

Outfall 001

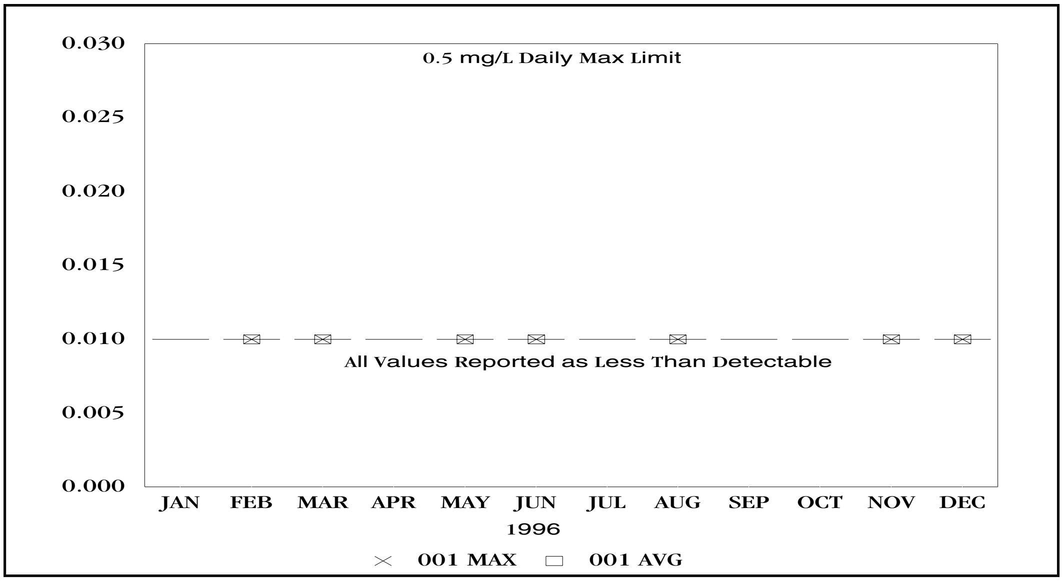


Figure C - 5.45

VOLATILE ORGANIC ANALYSIS

DICHLORODIFLUOROMETHANE (mg/L)

Outfall 001

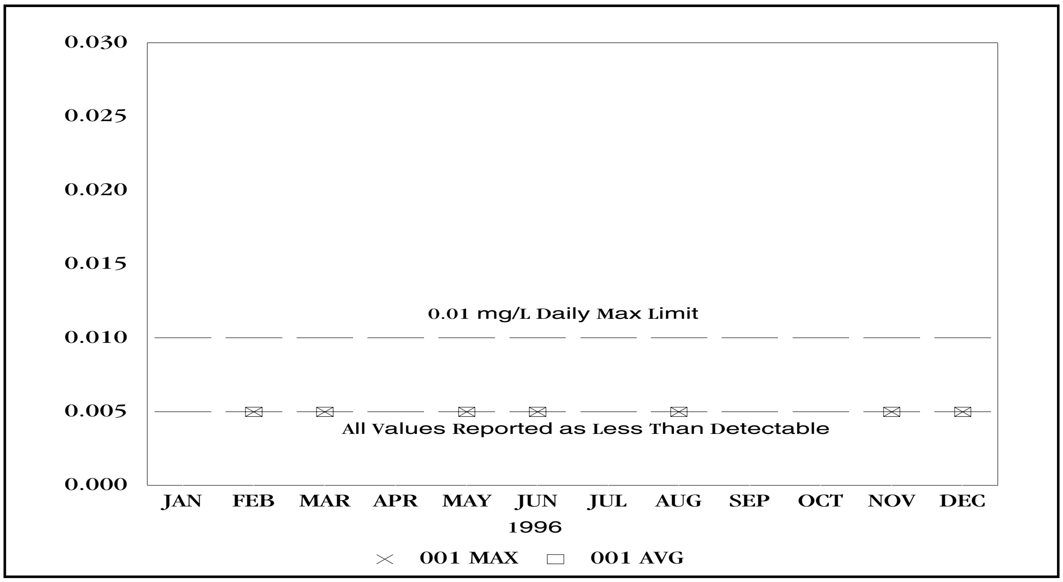


Figure C - 5.46

VOLATILE ORGANIC ANALYSIS

TRICHLOROFLUOROMETHANE (mg/L)

Outfall 001

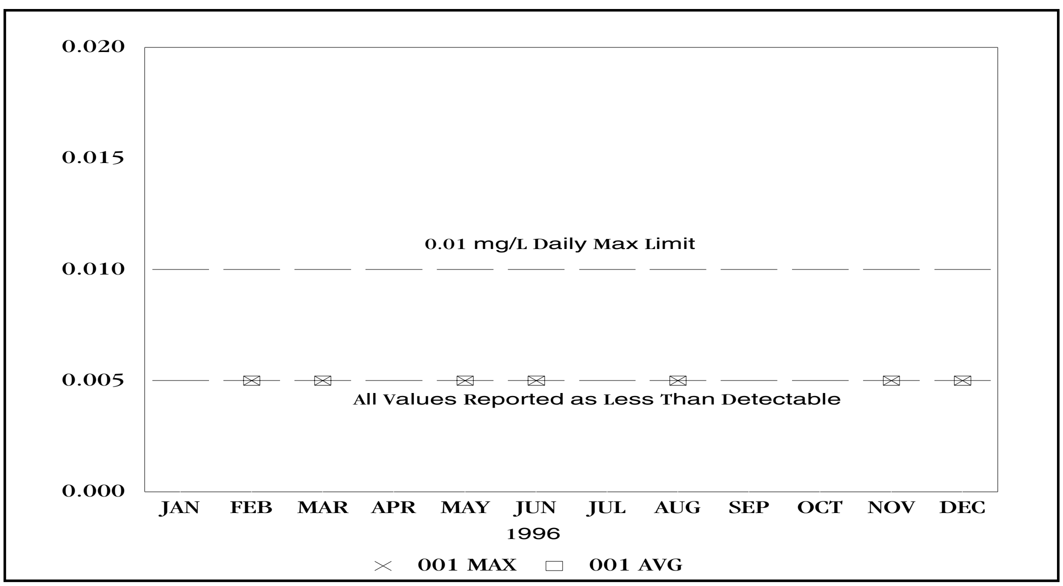


Figure C - 5.47

VOLATILE ORGANIC ANALYSIS

XYLENE, TOTAL (mg/L)

Outfall 001

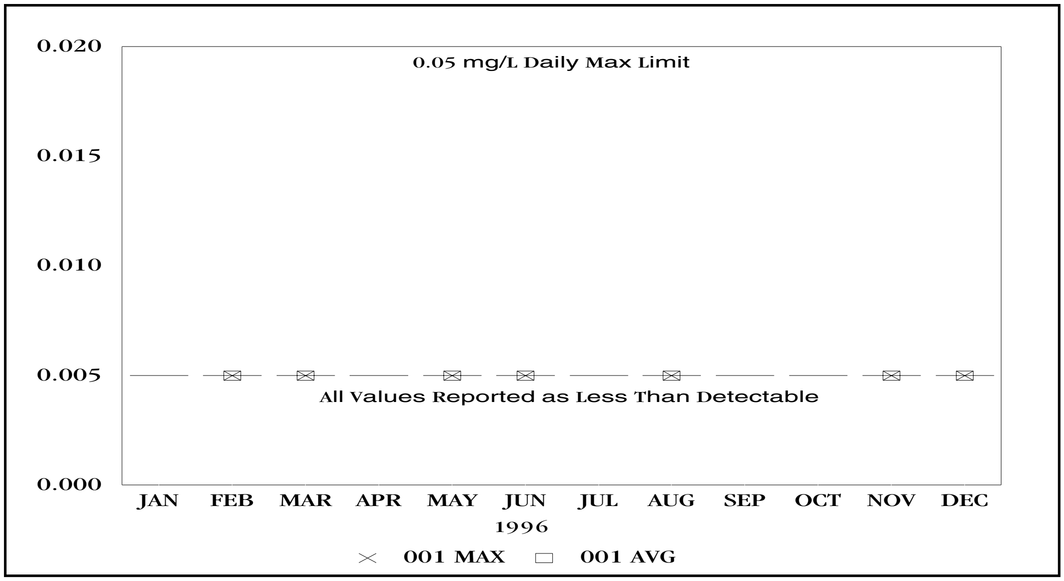


Figure C - 5.48

SEMIVOLATILE ORGANIC ANALYSIS

ALPHA-BHC (mg/L)

Outfall 001

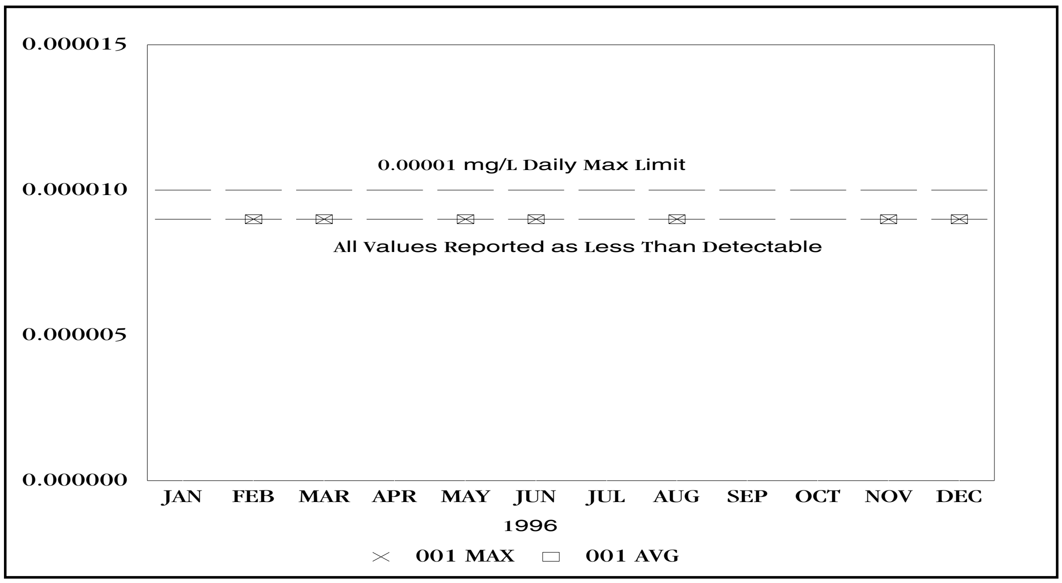


Figure C - 5.49

SEMIVOLATILE ORGANIC ANALYSIS

3,3-DICHLOROBENZIDINE (mg/L)

Outfall 001

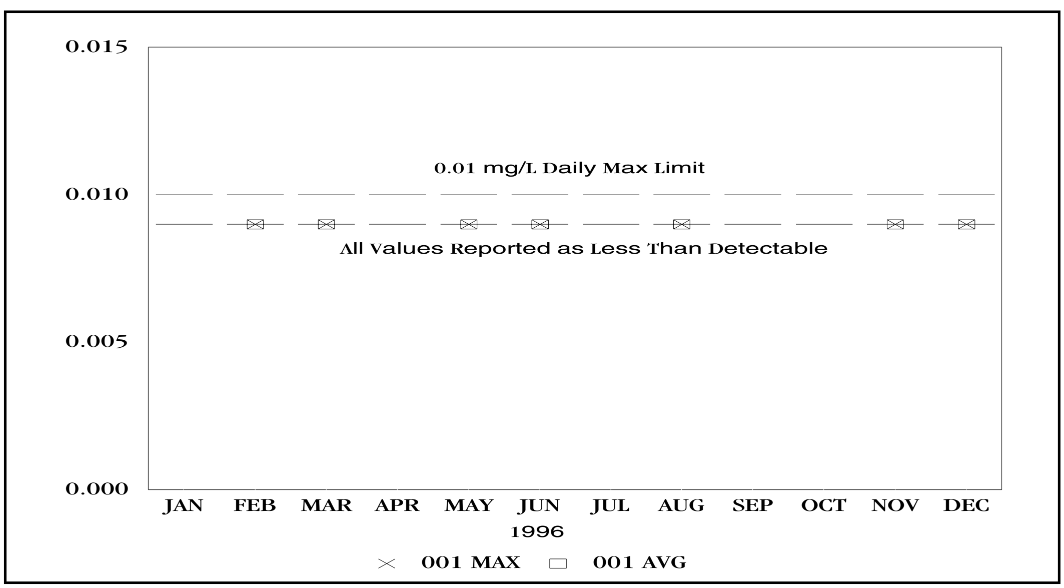


Figure C - 5.50

SEMIVOLATILE ORGANIC ANALYSIS

HEPTACHLOR (mg/L)

Outfall 001

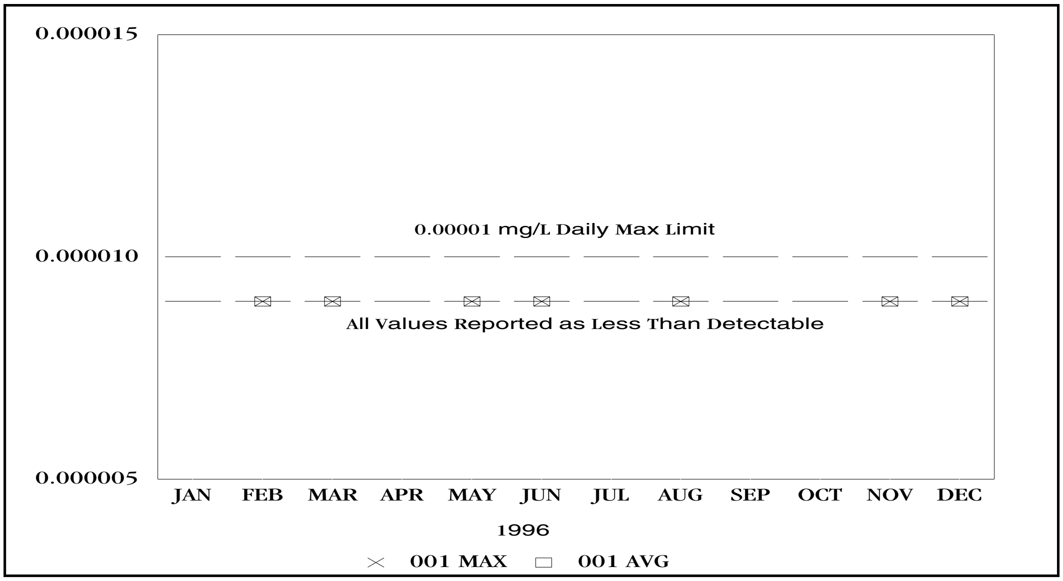


Figure C - 5.51

SEMIVOLATILE ORGANIC ANALYSIS

HEXACHLOROBENZENE (mg/L)

Outfall 001

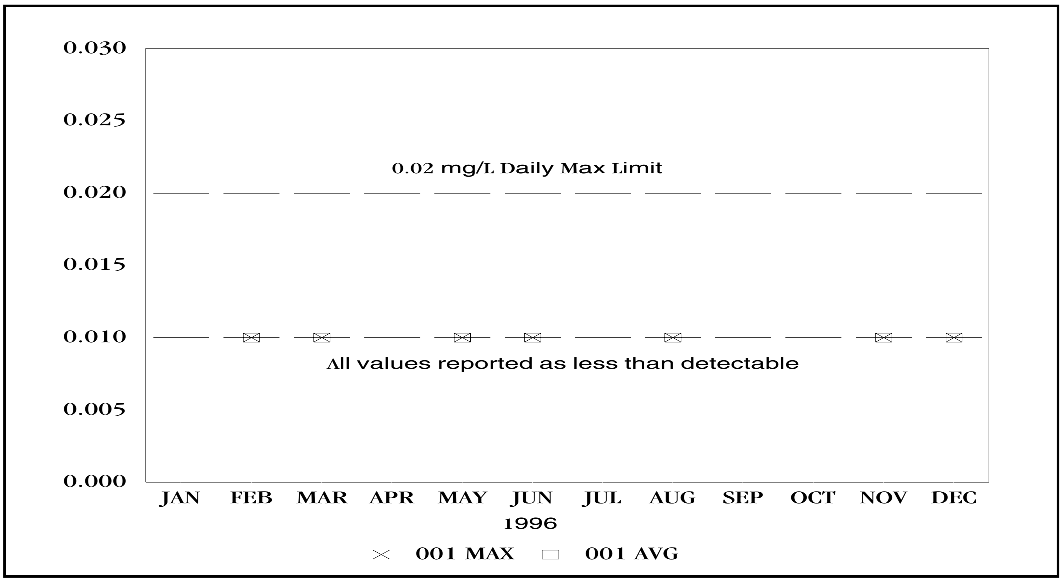


Figure C - 5.52

SEMIVOLATILE ORGANIC ANALYSIS

TRIBUTYL PHOSPHATE (mg/L)

Outfall 001

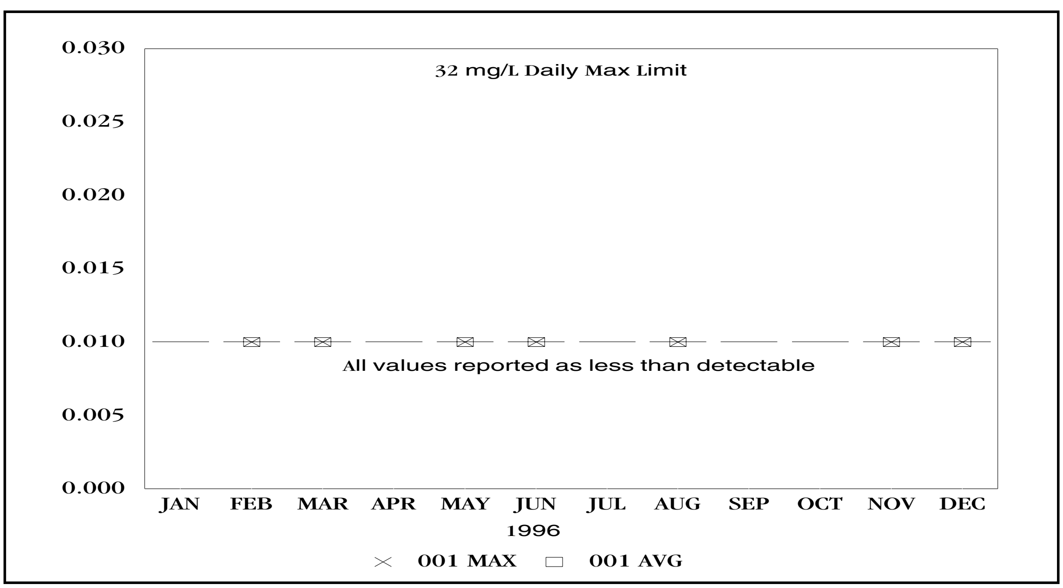


Figure C - 5.53

WATER QUALITY

TOTAL DISSOLVED SOLIDS (mg/L)

Outfall 001

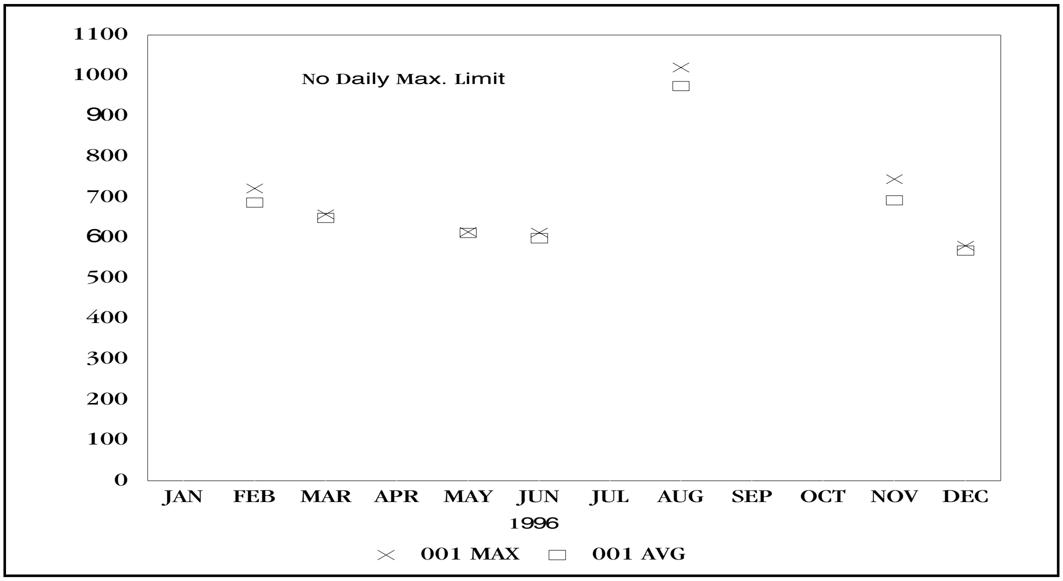
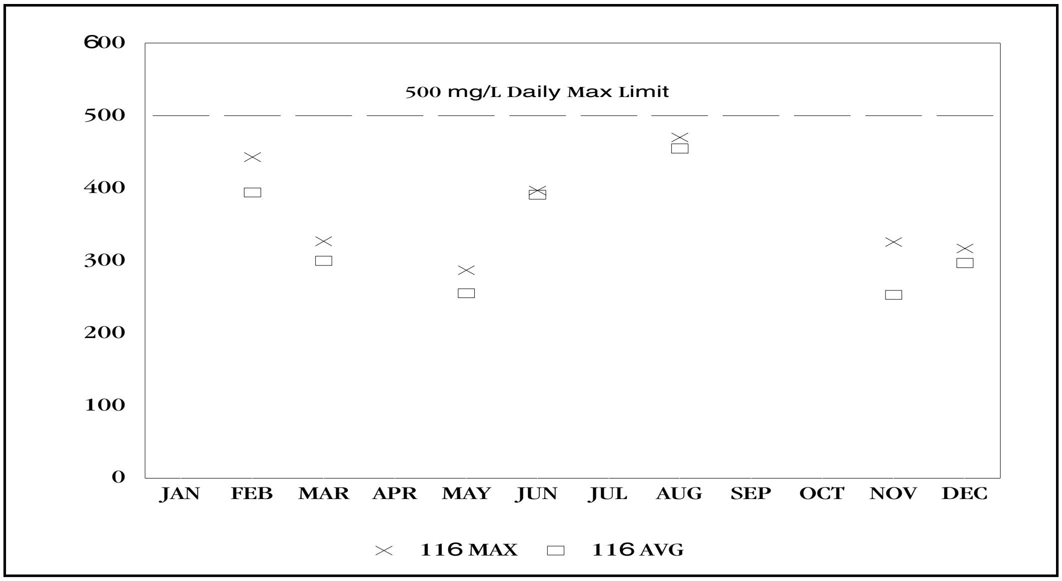


Figure C - 5.54

WATER QUALITY

TOTAL DISSOLVED SOLIDS (mg/L)

Outfall 116
(pseudo monitoring point)



Appendix C - 6

Summary of Meteorological Data

On-site Meteorological Tower and Rain Gauge

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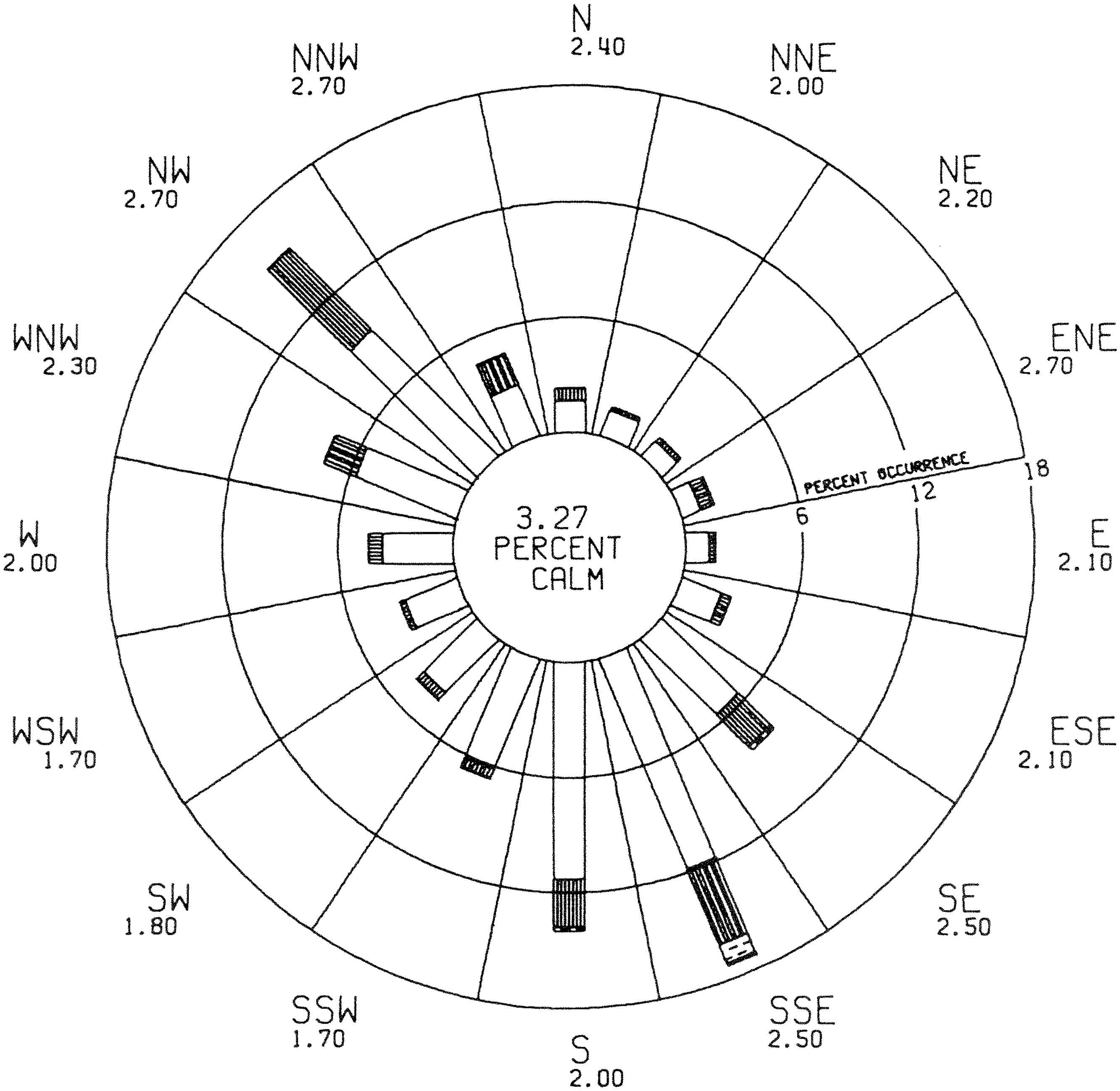


NUMBERS INDICATE SECTOR MEAN WIND SPEED

SECTORS ARE DIRECTIONS FROM WHICH THE WIND IS BLOWING

WIND SPEED RANGE

0.5 - 3	M/SEC
› 3 - 6	
› 6 - 9	
› 9 - 12	
› 12	

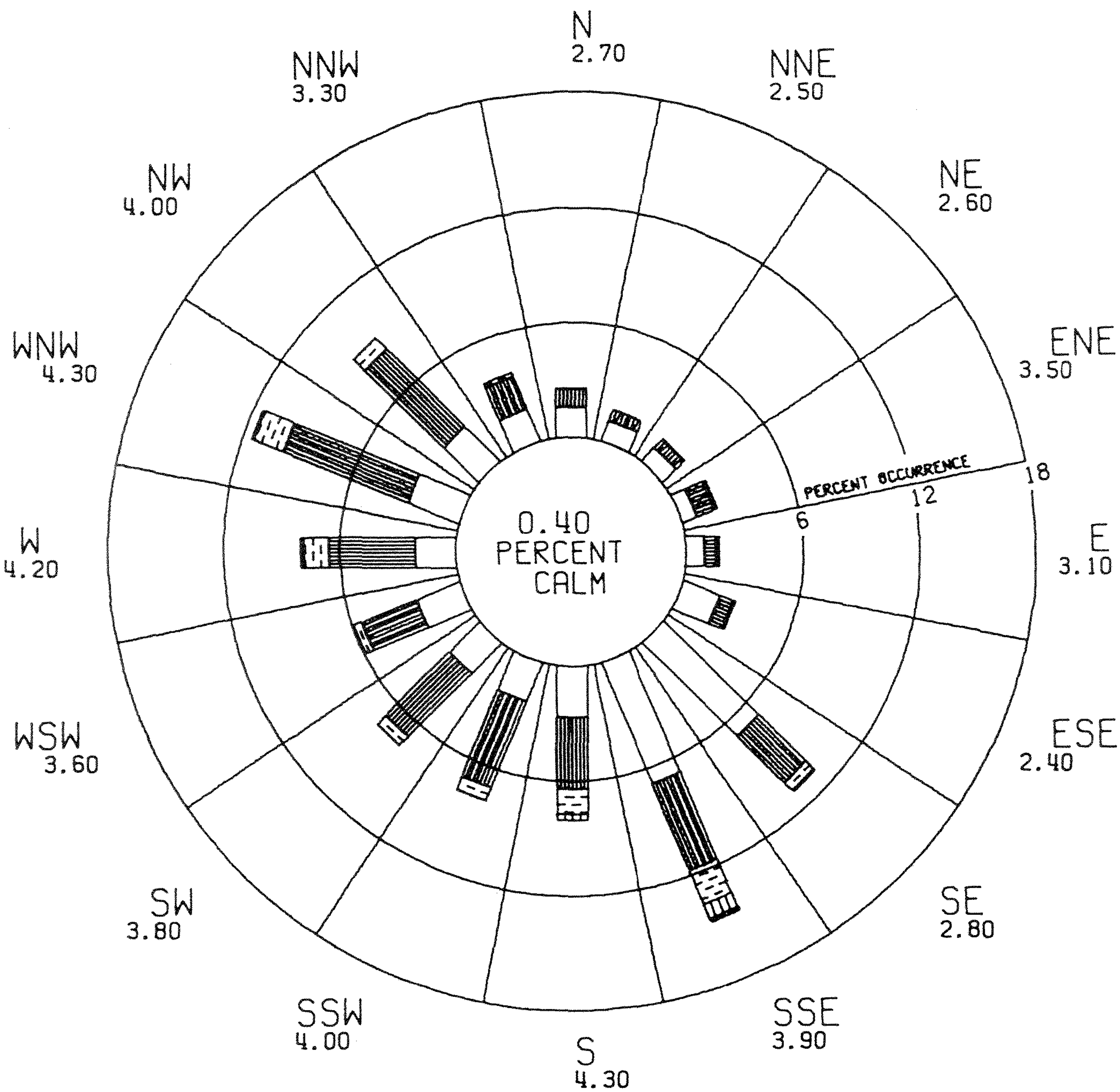
CALM ‹ 0.5

WEST VALLEY NUCLEAR SERVICES
PRIMARY MONITORING STATION
WEST VALLEY, NEW YORK

Figure C-6.1

10.0-METER WIND FREQUENCY ROSE

JANUARY 1, 1996 - DECEMBER 31, 1996



NUMBERS INDICATE SECTOR MEAN WIND SPEED

SECTORS ARE DIRECTIONS FROM WHICH THE WIND IS BLOWING

WIND SPEED RANGE

0.5 - 3 M/SEC

› 3 - 6

› 6 - 9

› 9 - 12

› 12

CALM ‹ 0.5

WEST VALLEY NUCLEAR SERVICES

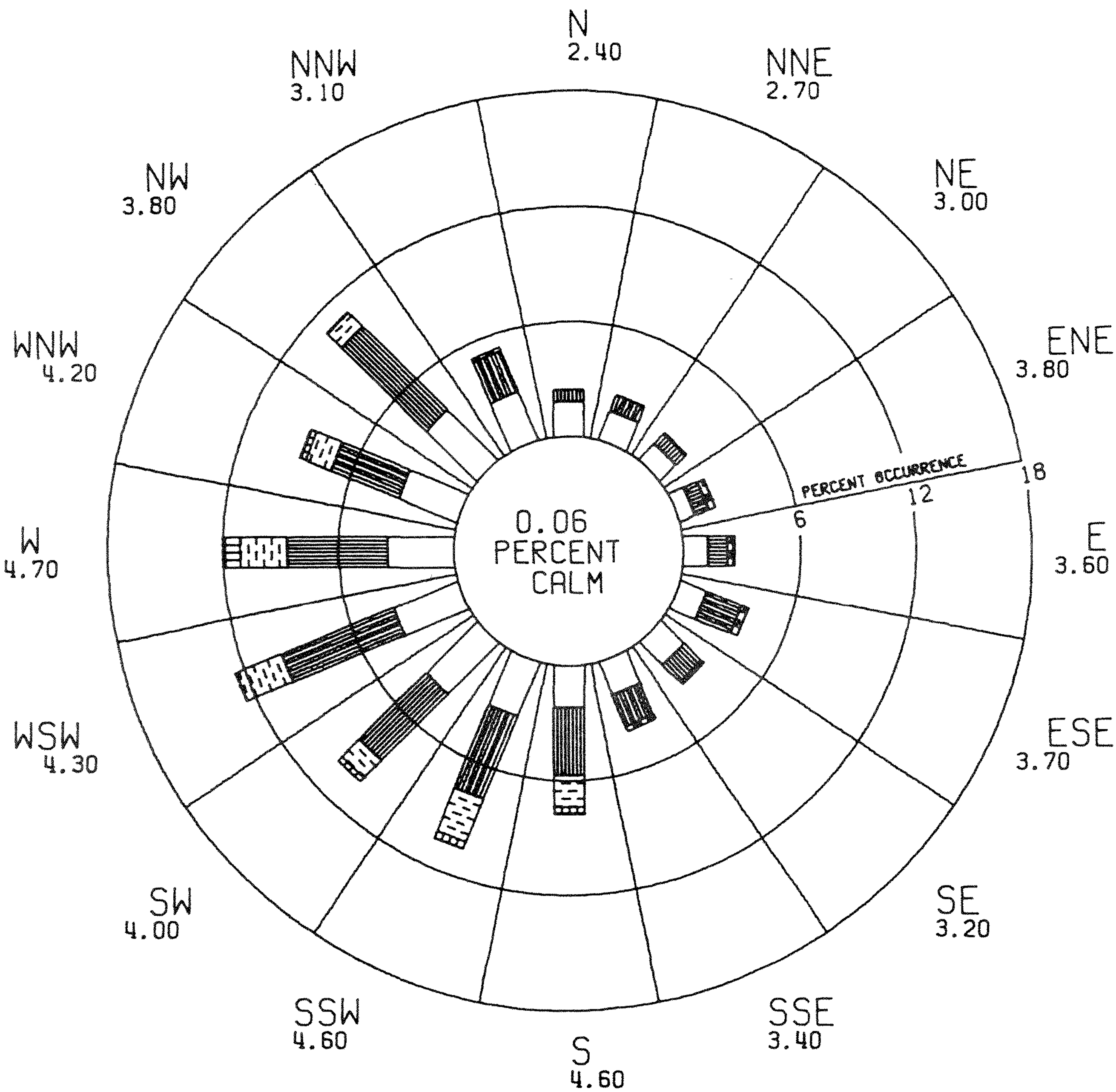
PRIMARY MONITORING STATION

WEST VALLEY, NEW YORK

Figure C-6.2

60.0-METER WIND FREQUENCY ROSE

JANUARY 1, 1996 - DECEMBER 31, 1996



NUMBERS INDICATE SECTOR MEAN WIND SPEED

SECTORS ARE DIRECTIONS FROM WHICH THE WIND IS BLOWING

WIND SPEED RANGE

- 0.5 - 3 M/SEC
- › 3 - 6
- › 6 - 9
- › 9 - 12
- › 12

CALM ‹ 0.5

WEST VALLEY NUCLEAR SERVICES

REGIONAL MONITORING STATION

WEST VALLEY, NEW YORK

Figure C-6.3

10.0-METER WIND FREQUENCY ROSE

JANUARY 1, 1996 - DECEMBER 31, 1996

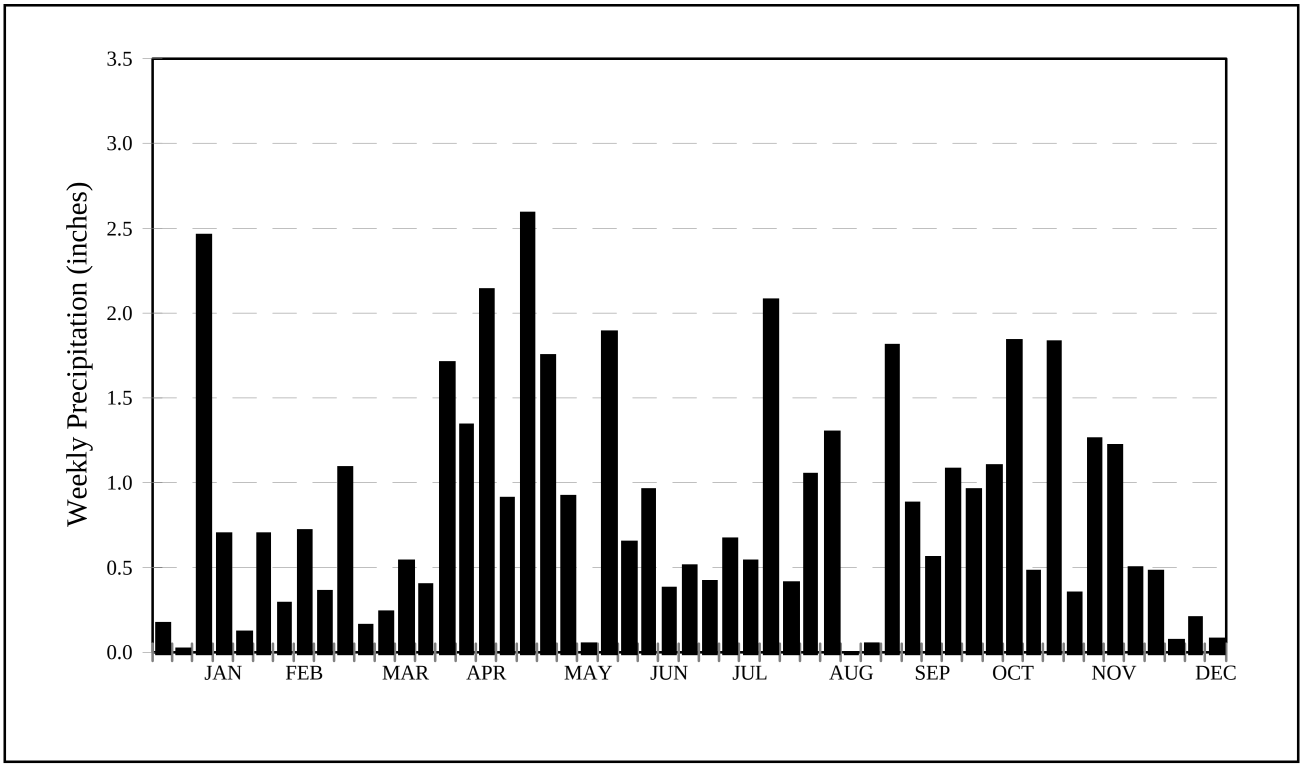


Figure C - 6.4. 1996 Weekly Precipitation

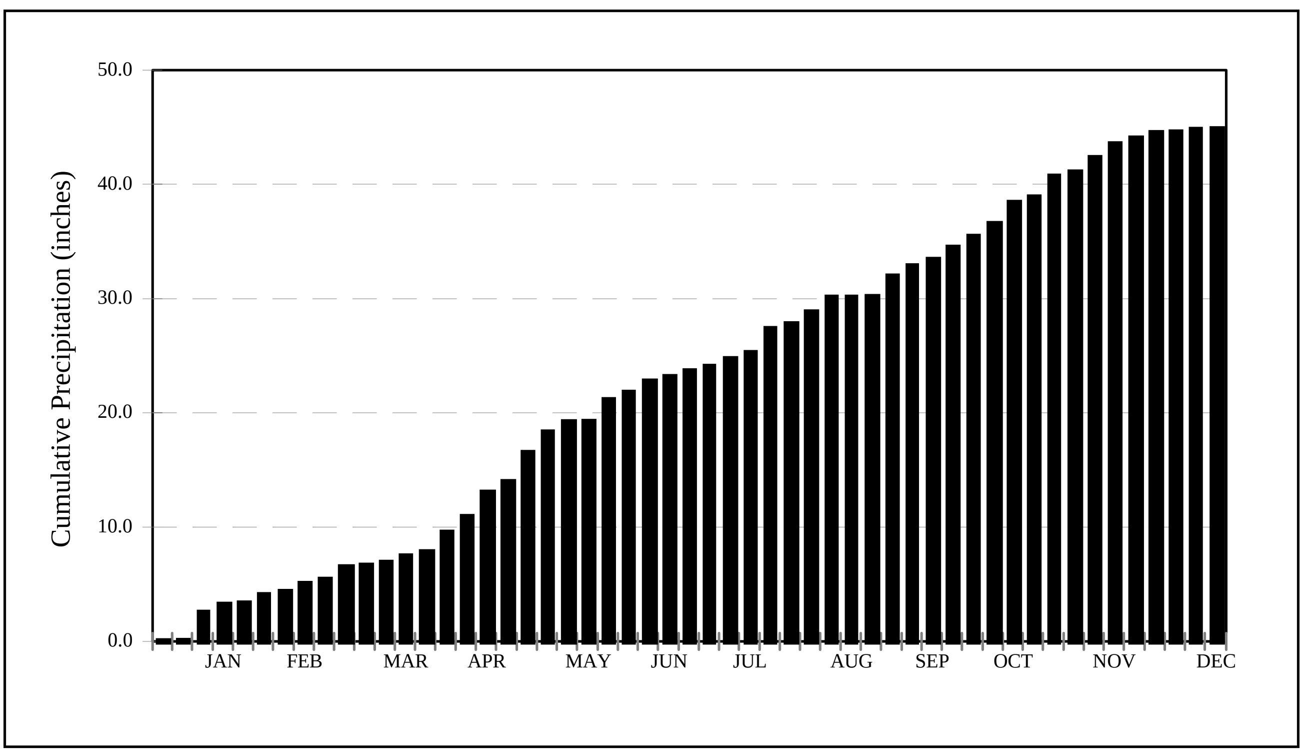


Figure C - 6.5. 1996 Cumulative Precipitation

Table C - 6.1

1996 Site Precipitation Collection Data

Week Ending	Weekly (inches)	Cumulative (inches)	Week Ending	Weekly (inches)	Cumulative (inches)
January 5	0.17	0.17	*July 5*	0.51	23.77
January 12	0.02	0.19	*July 12*	0.42	24.19
January 19	2.46	2.65	*July 19*	0.67	24.86
January 26	0.70	3.35	*July 26*	0.54	25.40
February 2	0.12	3.47	*August 2*	2.08	27.48
February 9	0.70	4.17	*August 9*	0.41	27.89
February 16	0.29	4.46	*August 16*	1.05	28.94
February 23	0.72	5.18	*August 23*	1.30	30.24
March 1	0.36	5.54	*August 30*	0.00	30.24
March 8	1.09	6.63	*September 6*	0.05	30.29
March 15	0.16	6.79	*September 13*	1.81	32.10
March 22	0.24	7.03	*September 20*	0.88	32.98
March 29	0.54	7.57	*September 27*	0.56	33.54
April 5	0.40	7.97	*October 4*	1.08	34.62
April 12	1.71	9.68	*October 11*	0.96	35.58
April 19	1.34	11.02	*October 18*	1.10	36.68
April 26	2.14	13.16	*October 25*	1.84	38.52
May 3	0.91	14.07	*November 1*	0.48	39.00
May 10	2.59	16.66	*November 8*	1.83	40.83
May 17	1.75	18.41	*November 15*	0.35	41.18
May 24	0.92	19.33	*November 22*	1.26	42.44
May 31	0.05	19.38	*November 29*	1.22	43.66
June 7	1.89	21.27	*December 6*	0.50	44.16
June 14	0.65	21.92	*December 13*	0.48	44.64
June 21	0.96	22.88	*December 20*	0.07	44.71
June 28	0.38	23.26	*December 27*	0.27	44.98
			December 31	0.08	45.06

Table C - 6.2

1996 Annual Temperature Summary at tbe 10-meter Primary Meteorological Tower

Month	Average Temperature °C	Average Temperature °F	Maximum Temperature °C	Maximum Temperature °F	Minimum Temperature °C	Minimum Temperature °F
January	-5.9	21.4	14.4	57.9	-25.9	-14.6
February	-5.0	23.0	11.9	53.4	-25.8	-14.4
March	-2.0	28.4	18.8	65.8	-16.3	2.7
April	5.2	41.4	23.7	74.7	-6.7	19.9
May	11.8	53.2	30.6	87.1	-2.0	28.4
June	18.5	65.3	28.0	82.4	3.8	38.8
July	18.0	64.4	27.1	80.8	7.8	46.0
August	18.9	66.0	28.6	83.5	9.1	48.4
September	14.9	58.8	25.8	78.4	3.3	37.9
October	9.6	49.3	23.7	74.7	-1.7	28.9
November	0.7	33.3	19.6	67.3	-11.7	10.9
December	0.2	32.4	14.0	57.2	-13.6	7.5
Annual	7.1	44.7	30.6	87.1	-25.9	-14.6

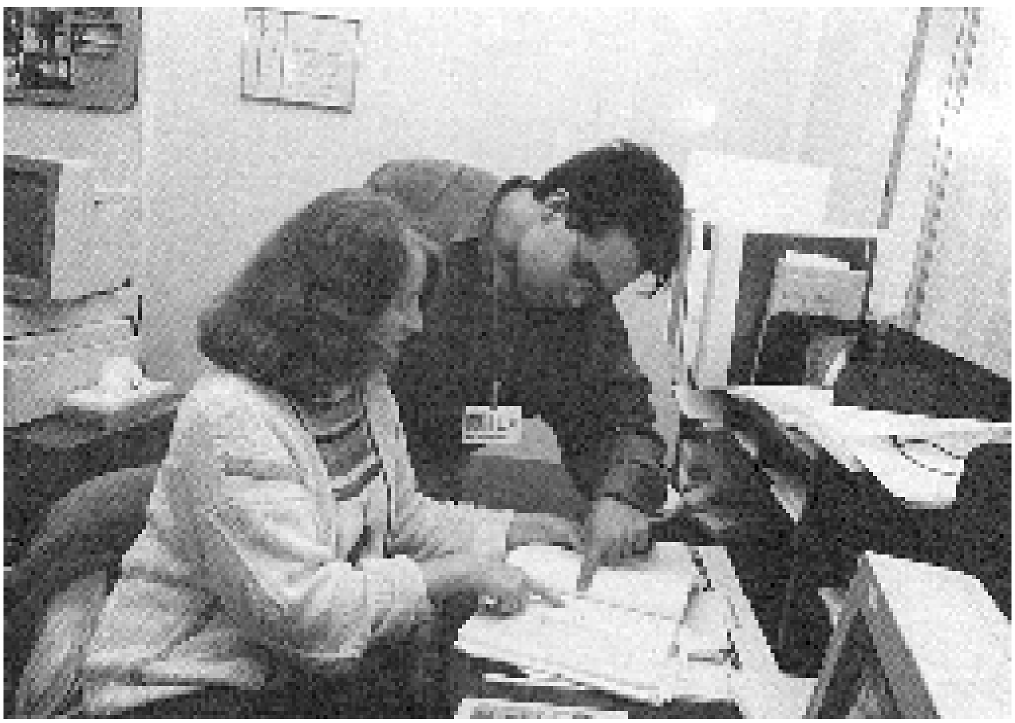
Table C - 6.3

1996 Annual Barometric Pressure Summary
(station pressure - inches of mercury)

	Average Pressure	**Maximum Pressure**	**Minimum Pressure**
January	28.47	29.00	27.80
February	28.39	28.92	27.84
March	28.46	29.22	27.68
April	28.34	28.69	27.85
May	28.47	28.86	28.06
June	28.46	28.77	28.17
July	28.43	30.55	28.06
August	28.58	28.82	28.40
September	28.41	28.82	28.04
October	28.47	29.23	27.84
November	28.56	29.21	28.03
December	28.43	29.62	27.88
Annual	28.46	30.55	27.68

Appendix D

Summary of Quality Assurance Crossback Analyses



Keeping Up With Regulatory Changes

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Table D - 1

Comparison of Radiological Results with Known Results of Crosscheck Samples from the DOE Environmental Measurements Laboratory (EML) Quality Assessment Program (QAP) 44

Isotope	Matrix	Actual	Reported	Ratio	Accept?	Analyzed by:
Co-60	Air	2.95E+01	2.63E+01	0.89	Yes	EPI
Sr-90	Air	1.06E+00	7.88E-01	0.74	Pass	EPI
Sb-125	Air	9.78E+00	9.03E+00	0.92	Yes	EPI
Cs-137	Air	6.64E+00	5.90E+00	0.89	Yes	EPI
Cs-134	Air	1.47E+01	1.36E+01	0.93	Yes	EPI
Ru-106	Air	1.16E+01	9.89E+00	0.85	Yes	EPI
Pu-238	Air	9.60E-02	8.80E-02	0.92	Yes	EPI
Pu-239	Air	9.30E-02	9.30E-02	1.00	Yes	EPI
Am-241	Air	1.89E-01	2.06E-01	1.09	Yes	EPI
U-234	Air	5.20E-02	6.70E-02	1.29	Yes	EPI
U-238	Air	5.30E-02	5.50E-02	1.04	Yes	EPI
U (µg)	Air	4.31E+00	4.36E+00	1.01	Yes	EPI
Gross Alpha	Air	1.62E+00	1.50E+00	0.93	Yes	EL
Gross Beta	Air	1.77E+00	1.87E+00	1.06	Yes	EL
K-40	Soil	4.65E+02	5.40E+02	1.16	Yes	EPI
Sr-90	Soil	1.34E+03	9.77E+02	0.73	Pass	EPI
Cs-137	Soil	3.59E+02	3.74E+02	1.04	Yes	EPI
Pu-238	Soil	4.30E+01	5.03E+01	1.17	Yes	EPI
Pu-239	Soil	9.23E+00	1.12E+01	1.21	Yes	EPI
Am-241	Soil	3.69E+00	4.37E+00	1.18	Yes	EPI
U-234	Soil	3.42E+01	3.52E+01	1.03	Yes	EPI
U-238	Soil	3.59E+01	3.32E+01	0.92	Yes	EPI
U (µg)	Soil	2.90E+00	2.65E+00	0.91	Yes	EPI
K-40	Veg	1.03E+03	1.21E+03	1.17	Yes	EPI
Co-60	Veg	5.97E+01	6.36E+01	1.07	Yes	EPI
Sr-90	Veg	1.30E+03	9.77E+02	0.75	Yes	EPI
Cs-137	Veg	9.44E+02	1.05E+03	1.11	Yes	EPI
Pu-239	Veg	9.82E+00	8.03E+00	0.82	Yes	EPI
Am-241	Veg	5.60E+00	6.44E+00	1.15	Yes	EPI

Units for air filters: Bq/filter; units for soil and vegetation: Bq/kg; units for water: Bq/L. Values for elemental uranium listed in the table reported in µg/filter, µg/g, or µg/mL. Samples analyzed by the WVDP Environmental Laboratory (EL) or Environmental Physics, Inc. (EPI).

Acceptance is based on reported-to-actual ratio, assigned statistically on a case-by-case basis. ***Yes*** *indicates a ratio within warning limits;* ***Pass*** *indicates a ratio within control limits but outside warning limits;* ***No*** *indicates a ratio outside control limits.*

Table D - 1 *(concluded)*

Comparison of Radiological Results with Known Results of Crosscheck Samples from the DOE Environmental Measurements Laboratory (EML) Quality Assessment Program (QAP) 44

Isotope	Matrix	Actual	Reported	Ratio	Accept?	Analyzed by:
H-3	Water	2.51E+02	1.97E+02	0.78	Pass	EPI
Co-60	Water	3.28E+01	3.49E+01	1.06	Yes	EPI
Sr-90	Water	1.45E+00	1.17E+00	0.81	Pass	EPI
Cs-137	Water	3.83E+01	4.64E+01	1.21	Pass	EPI
Mn-54	Water	3.84E+01	4.63E+01	1.21	Pass	EPI
Pu-238	Water	9.82E-01	8.90E-01	0.91	Yes	EPI
Pu-239	Water	7.72E-01	6.88E-01	0.89	Yes	EPI
Am-241	Water	7.66E-01	1.13E+00	1.48	Pass	EPI
U-234	Water	2.74E-01	3.35E-01	1.22	Pass	EPI
U-238	Water	2.75E-01	3.15E-01	1.15	Pass	EPI
U (µg)	Water	2.20E-02	NR	NA	NA	EPI
Gross Alpha	Water	1.85E+03	1.70E+03	0.92	Yes	EPI
Gross Beta	Water	7.44E+02	7.33E+02	0.99	Yes	EPI
H-3	Water	2.51E+02	2.18E+02	0.87	Yes	EL
Co-60	Water	3.28E+01	3.29E+01	1.00	Yes	EL
Sr-90	Water	1.45E+00	1.90E+00	1.31	Pass	EL
Cs-137	Water	3.83E+01	4.09E+01	1.07	Yes	EL
Mn-54	Water	3.84E+01	4.27E+01	1.11	Yes	EL
Gross Alpha	Water	1.85E+03	1.80E+03	0.97	Yes	EL
Gross Beta	Water	7.44E+02	7.03E+02	0.94	Yes	EL

Units for air filters: Bq/filter; units for soil and vegetation: Bq/kg; units for water: Bq/L. Values for elemental uranium listed in the table reported in µg/filter, µg/g, or µg/mL. Samples analyzed by the WVDP Environmental Laboratory (EL) or Environmental Physics, Inc. (EPI).

Acceptance is based on reported-to-actual ratio, assigned statistically on a case-by-case basis. ***Yes*** *indicates a ratio within warning limits;* ***Pass*** *indicates a ratio within control limits but outside warning limits;* ***No*** *indicates a ratio outside control limits.*

NA = Not available.

NR = Not reported.

Table D - 2

Comparison of Radiological Results with Known Results of Crosscheck Samples from the DOE Environmental Measurements Laboratory (EML) Quality Assessment Program (QAP) 45

Isotope	Matrix	Actual	Reported	Ratio	Accept?	Analyzed by:
Am-241	Air	2.22E-01	2.07E-01	0.93	Yes	EPI
Co-57	Air	1.48E+01	1.59E+01	1.07	Pass	EPI
Co-60	Air	8.64E+00	9.62E+00	1.11	Pass	EPI
Cs-134	Air	1.08E+01	1.03E+01	0.95	Yes	EPI
Cs-137	Air	8.52E+00	9.07E+00	1.06	Yes	EPI
Gross Alpha	Air	1.15E+00	1.22E+00	1.06	Yes	EPI
Gross Beta	Air	5.00E-01	5.29E-01	1.06	Yes	EPI
Mn-54	Air	6.35E+00	7.51E+00	1.18	Pass	EPI
Pu-238	Air	1.18E-01	1.34E-01	1.14	Yes	EPI
Ru-106	Air	1.08E+01	9.95E+00	0.92	Yes	EPI
Sb-125	Air	1.08E+01	1.15E+01	1.06	Yes	EPI
Sr-90	Air	5.26E-01	5.99E-01	1.14	Yes	EPI
U-234	Air	8.00E-02	8.20E-02	1.02	Yes	EPI
U-238	Air	7.80E-02	8.00E-02	1.03	Yes	EPI
U (µg)	Air	6.40E+00	6.68E+00	1.04	Yes	EPI
Gross Alpha	Air	1.15E+00	1.36E+00	1.18	Yes	EL
Gross Beta	Air	5.00E-01	7.71E-01	1.54	Pass	EL
Am-241	Soil	1.35E+01	1.21E+01	0.90	Yes	EPI
Co-60	Soil	2.92E+00	2.66E+00	0.91	Yes	EPI
Cs-137	Soil	1.55E+03	1.77E+03	1.14	Yes	EPI
K-40	Soil	3.00E+02	3.93E+02	1.31	Pass	EPI
Pu-238	Soil	1.13E+00	3.74E+00	3.31	No	EPI
Pu-239	Soil	2.18E+01	4.59E+01	2.11	No	EPI
Sr-90	Soil	6.99E+01	6.14E+01	0.88	Yes	EPI
U-234	Soil	3.92E+01	4.22E+01	1.08	Yes	EPI
U-238	Soil	4.16E+01	3.63E+01	0.87	Yes	EPI
U (Bq)	Soil	8.22E+01	2.86E+00	0.03	No	EPI
Am-241	Veg	1.23E+00	1.79E+00	1.46	Yes	EPI
Co-60	Veg	1.09E+01	1.14E+01	1.05	Yes	EPI
Cs-137	Veg	1.90E+02	2.17E+02	1.14	Yes	EPI
K-40	Veg	9.92E+02	1.33E+03	1.34	Pass	EPI
Pu-239	Veg	1.96E+00	1.97E+00	1.01	Yes	EPI
Sr-90	Veg	1.39E+03	1.03E+03	0.74	Yes	EPI

Units for air filters: Bq/filter; units for soil and vegetation: Bq/kg; units for water: Bq/L. Values for elemental uranium listed in the table reported in µg/filter, µg/g, or µg/mL. Samples analyzed by the WVDP Environmental Laboratory (EL) or Environmental Physics, Inc. (EPI).

Acceptance is based on reported-to-actual ratio, assigned statistically on a case-by-case basis. ***Yes*** *indicates a ratio within warning limits;* ***Pass*** *indicates a ratio within control limits but outside warning limits;* ***No*** *indicates a ratio outside control limits.*

Table D - 2 (concluded)

Comparison of Radiological Results with Known Results of Crosscheck Samples from the DOE Environmental Measurements Laboratory (EML) Quality Assessment Program (QAP) 45

Isotope	Matrix	Actual	Reported	Ratio	Accept?	Analyzed by:
Am-241	Water	1.08E+00	5.10E-01	0.47	No	EPI
Co-60	Water	6.11E+01	7.30E+01	1.19	No	EPI
Cs-137	Water	8.95E+01	1.12E+02	1.25	Pass	EPI
Gross Alpha	Water	1.21E+03	1.12E+03	0.93	Yes	EPI
Gross Beta	Water	5.40E+02	5.55E+02	1.03	Yes	EPI
H-3	Water	5.87E+02	4.65E+02	0.79	Pass	EPI
Mn-54	Water	6.05E+01	7.65E+01	1.26	No	EPI
Pu-238	Water	1.91E+00	1.04E+00	0.54	No	EPI
Pu-239	Water	8.40E-01	4.55E-01	0.54	No	EPI
Sr-90	Water	2.71E+00	2.23E+00	0.82	Pass	EPI
U-234	Water	4.80E-01	2.90E-01	0.60	No	EPI
U-238	Water	4.80E-01	2.50E-01	0.52	No	EPI
U (µg)	Water	3.90E-02	3.30E-02	0.85	Pass	EPI
Co-60	Water	6.11E+01	6.73E+01	1.10	Yes	EL
Cs-137	Water	8.95E+01	9.80E+01	1.09	Yes	EL
Gross Alpha	Water	1.21E+03	1.07E+03	0.88	Yes	EL
Gross Beta	Water	5.40E+02	6.03E+02	1.12	Yes	EL
H-3	Water	5.87E+02	4.82E+02	0.82	Yes	EL
Mn-54	Water	6.05E+01	6.79E+01	1.12	Yes	EL
Sr-90	Water	2.71E+00	2.97E+00	1.10	Yes	EL

Units for air filters: Bq/filter; soil and vegetation: Bq/kg; water: Bq/L. Values for elemental uranium listed in the table reported in µg/filter, µg/g, or µg/mL. Samples analyzed by the WVDP Environmental Laboratory (EL) or Environmental Physics, Inc. (EPI).

Acceptance is based on reported-to-actual ratio, assigned statistically on a case-by-case basis. ***Yes*** *indicates a ratio within warning limits;* ***Pass*** *indicates a ratio within control limits but outside warning limits;* ***No*** *indicates a ratio outside control limits.*

Table D-3

Comparison of Radiological Results with Known Results of Crosscheck Samples from the EPA National Exposure Research Laboratory, Characterization Research Division (NERL-CRD)

Sample	Analyte	Matrix	Actual	Reported	Accept?	Analyzed By
ABW (January 1996)	Alpha	Water	12.1	13.40	Yes	EL
	Beta	Water	7.0	10.20	Yes	EL
ABW (July 1996)	Alpha	Water	24.4	19.83	Yes	EL
	Beta	Water	44.8	48.13	Yes	EL
ABW (October 1996)	Alpha	Water	10.3	9.93	Yes	EL
	Beta	Water	34.6	38.63	Yes	EL
TRW (March 1996)	H-3	Water	22,002.0	21,466.67	Yes	EL
TRW (August 1996)	H-3	Water	10,879.0	10,623.33	Yes	EL
PE-A (April 1996)	Alpha	Water	74.8	62.47	Yes	EL
	Ra-226	Water	3.0	3.33	Yes	EPI
	Ra-228	Water	5.0	5.07	Yes	EPI
	U(Nat)	Water	58.4	56.53	Yes	EPI
PE-B (April 1996)	Beta	Water	166.9	156.23	Yes	EL
	Sr-89	Water	43.0	43.67	Yes	EPI
	Sr-90	Water	16.0	13.00	Yes	EPI
	Co-60	Water	31.0	31.33	Yes	EL
	Cs-134	Water	46.0	39.67	Pass	EL
	Cs-137	Water	50.0	48.67	Yes	EL

Units are in pCi/L.

Samples were analyzed by the WVDP Environmental Laboratory (EL) or Environmental Physics, Inc. (EPI) as indicated.

Explanation of code(s): PE-A = performance evaluation (alpha); PE-B = performance evaluation (beta); GAM = gamma in water; TRW = tritium in water; ABW = alpha and beta in water.

*Acceptance limits are statistically defined by NERL-CRD for individual analytes and matrices. **Yes** indicates a ratio within warning limits; **Pass** indicates a ratio within control limits but outside warning limits; **No** indicates a ratio outside control limits.*

Table D-3 (*concluded*)

Comparison of Radiological Results with Known Results for Crosscheck Samples from the EPA National Exposure Research Laboratory, Characterization Research Division (NERL-CRD)

Sample	Analyte	Matrix	Actual	Reported	Accept?	Analyzed By
PE-A	Alpha	Water	59.1	47.50	Yes	EL
(October 1996)	Ra-226	Water	9.9	9.40	Yes	EPI
	Ra-228	Water	5.1	4.67	Yes	EPI
	U(Nat)	Water	40.9	37.33	Yes	EPI
PE-B	Beta	Water	111.8	112.93	Yes	EL
(October 1996)	Sr-89	Water	10.0	11.67	Yes	EPI
	Sr-90	Water	25.0	24.67	Yes	EPI
	Co-60	Water	15.0	14.67	Yes	EL
	Cs-134	Water	20.0	16.33	Yes	EL
	Cs-137	Water	30.0	32.67	Yes	EL
GAM	Co-60	Water	99.0	100.67	Yes	EL
(June 1996)	Zn-65	Water	300.0	328.00	Yes	EL
	Cs-134	Water	79.0	70.33	Pass	EL
	Cs-137	Water	197.0	200.00	Yes	EL
	Ba-133	Water	745.0	684.33	Yes	EL
GAM	Co-60	Water	44.0	45.33	Yes	EL
(November 1996)	Zn-65	Water	35.0	36.67	Yes	EL
	Cs-134	Water	11.0	10.0	Yes	EL
	Cs-137	Water	19.0	20.33	Yes	EL
	Ba-133	Water	64.0	58.0	Yes	EL

Units are in pCi/L.

Samples were analyzed by the WVDP Environmental Laboratory (EL) or Environmental Physics, Inc. (EPI), as indicated.

Explanation of code(s): PE-A = performance evaluation (alpha); PE-B = performance evaluation (beta); GAM = gamma in water; TRW = tritium in water; ABW = alpha and beta in water.

Acceptance limits are statistically defined by NERL-CRD for individual analytes and matrices. ***Yes*** *indicates a ratio within warning limits;* ***Pass*** *indicates a ratio within control limits but outside warning limits;* ***No*** *indicates a ratio outside control limits.*

Table D-4

Comparison of the West Valley Demonstration Project's Thermoluminescent Dosimeters (TLDs) with the Co-located Nuclear Regulatory Commission (NRC) TLDs

NRC TLD#	WVDP TLD#	NRC mR/90days	WVDP* mR/Qtr	WVDP/NRC Ratio
1st Quarter 1996				
2	22	14.5	17	1.17
3	5	14.2	13	0.92
4	7	13.9	14	1.01
5	9	14.1	15	1.06
7	14	15.1	17	1.13
8	15	15.4	15	0.97
9	25	24.0	24	1.00
11	24	847.0	934	1.10
2nd Quarter 1996				
2	22	18.3	24	1.31
3	5	17.7	22	1.24
4	7	17.1	22	1.29
5	9	22.0	19	0.86
7	14	Missing	24	NA
8	15	18.2	21	1.15
9	25	29.3	32	1.09
11	24	732.0	769	1.05
3rd Quarter 1996				
2	22	17.6	18	1.02
3	5	18.5	19	1.03
4	7	17.7	20	1.13
5	9	16.5	20	1.21
7	14	20.0	21	1.05
8	15	18.7	18	0.96
9	25	27.3	29	1.06
11	24	798.0	776	0.97
4th Quarter 1996				
2	22	17.7	NA	NA
3	5	16.4	NA	NA
4	7	17.0	NA	NA
5	9	Missing	NA	NA
7	14	18.3	NA	NA
8	15	16.1	NA	NA
9	25	29.6	NA	NA
11	24	778	NA	NA

Ratios of results are listed for each set of co-located TLDs.

"Missing" indicates that a TLD was no longer in place at the time of collection so no analysis could be performed . NA = not available.

No control or warning limits are applicable to these results. Ratios of the duplicate measurements are presented for comparison purposes.

** WVDP results produced under contract by Lockheed Martin Idaho Technologies Co. (LMITCO)*

Table D-5

Comparison of Water Quality Parameters in Crosscheck Samples between the West Valley Demonstration Project and the EPA's 1996 Discharge Monitoring Report-Quality Assurance (DMR-QA) Study 16 for the National Pollutant Discharge Elimination System (NPDES)

Analyte	Units	Actual	Reported	Accept?	Analyzed by
Aluminum	µg/L	3609	3710	Yes	Recra
Arsenic	µg/L	250	246	Yes	Recra
Cadmium	µg/L	131	128	Yes	Recra
Cobalt	µg/L	433	440	Yes	Recra
Chromium	µg/L	250	252	Yes	Recra
Copper	µg/L	552	563	Yes	Recra
Iron	µg/L	790	845	Yes	Recra
Mercury	µg/L	4.70	4.53	Yes	Recra
Manganese	µg/L	750	734	Yes	Recra
Nickel	µg/L	1812	1840	Yes	Recra
Lead	µg/L	375	370	Yes	Recra
Selenium	µg/L	310	306	Yes	Recra
Vanadium	µg/L	6662	6770	Yes	Recra
Zinc	µg/L	1203	1220	Yes	Recra
pH	SU	8.73	8.89	Yes	WVNS
Total Cyanide	mg/L	0.921	0.920	Yes	Recra
Non-filterable Residue	mg/L	30.0	25.5	Yes	Recra
Oil and Grease	mg/L	19.5	15.4	Yes	Recra
Total Phenolics	mg/L	0.483	0.464	Yes	Recra
Total Residual Chlorine	mg/L	0.690	0.757	Yes	WVNS
Ammonia-Nitrogen	mg/L	10.0	10.3	Yes	Recra
Nitrate-Nitrogen	mg/L	2.10	2.24	Yes	Recra
BOD-5	mg/L	13.0	13.4	Yes	Recra

Analyses were conducted by Recra Environmental, Inc. or WVNS, as indicated..

Acceptance limits determined by the EPA: ***Yes*** *indicates a result within warning limits;* ***Pass*** *indicates a result within control limits but outside warning limits;* ***No*** *indicates a result outside control limits.*

Appendix E

Summary of Groundwater Monitoring Data

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Table E - 1
1996 Contamination Indicator and Radiological Indicator Results for the Sand and Gravel Unit

Location Code	Hydraulic Position	pH	Conductivity µmhos/cm@25°C	Gross Alpha µCi/mL	Gross Beta µCi/mL	H-3 µCi/mL
301	UP(1)	7.14	660	0.85±1.45E-09	0.86±2.47E-09	7.90±7.68E-08
301	UP(2)	7.23	1090	0.04±1.92E-09	3.17±2.62E-09	-6.70±5.64E-08
301	UP(3)	7.04	927	1.87±2.37E-09	2.65±1.07E-09	2.88±7.78E-08
301	UP(4)	7.17	930	-1.83±1.48E-09	3.30±2.82E-09	-6.13±8.01E-08
401	UP(1)	7.01	2785	3.01±5.62E-09	4.80±4.62E-09	3.20±6.32E-08
401	UP(2)	6.92	2110	1.65±3.56E-09	-1.06±3.59E-09	-1.53±7.90E-08
401	UP(3)	7.23	2945	9.58±3.80E-09	1.30±0.36E-08	7.34±5.60E-08
401	UP(4)	6.76	2480	4.71±4.18E-09	1.33±0.52E-08	-8.93±8.29E-08
403	UP(1)	7.08	1186	-0.77±2.06E-09	3.09±2.47E-09	6.32±7.66E-08
403	UP(2)	7.08	1935	2.16±4.10E-09	3.29±2.83E-09	-8.30±8.00E-08
403	UP(3)	6.76	1628	-1.39±3.07E-09	1.15±0.27E-08	-1.21±7.94E-08
403	UP(4)	7.14	1614	4.13±3.91E-09	7.86±2.81E-09	-3.86±8.20E-08
706	UP(1)	7.39	738	1.05±1.25E-09	1.45±0.21E-08	6.67±7.76E-08
706	UP(2)	7.07	611	0.83±1.04E-09	7.10±1.96E-09	1.58±7.93E-08
706	UP(3)	6.69	706	-1.21±1.58E-09	1.05±0.21E-08	-1.55±7.85E-08
706	UP(4)	6.62	634	0.85±1.87E-09	7.85±2.04E-09	6.68±8.17E-08
NB1S	UP(1)	6.02	383	4.59±4.26E-10	2.54±0.91E-09	1.04±0.76E-07
NB1S	UP(2)	6.37	472	2.63±7.34E-10	0.32±1.36E-09	-0.48±8.02E-08
NB1S	UP(3)	6.72	755	0.79±1.35E-09	1.37±1.41E-09	8.03±7.90E-08
NB1S	UP(4)	6.76	668	3.51±8.58E-10	2.65±1.02E-09	9.27±8.30E-08
201	DOWN - B(1)	6.34	1594	0.35±2.31E-09	5.03±0.31E-08	0.00±1.00E-07
201	DOWN - B(2)	6.42	2040	-0.09±3.49E-09	5.17±0.49E-08	7.93±0.93E-07
201	DOWN - B(3)	6.44	2200	-1.53±3.10E-09	5.42±0.34E-08	1.38±8.05E-08
201	DOWN - B(4)	6.70	2335	3.50±3.56E-09	2.57±0.30E-08	-1.05±0.82E-07
103	DOWN - C(1)	10.79	3785	3.04±0.63E-08	6.48±0.56E-08	2.05±0.79E-07
103	DOWN - C(2)	10.32	5730	-0.03±1.01E-08	9.75±1.32E-08	-1.27±8.03E-08
103	DOWN - C(3)	10.35	4465	8.89±6.72E-09	5.44±0.65E-08	-3.05±8.15E-08
103	DOWN - C(4)	10.45	3355	-1.27±5.80E-09	4.32±0.64E-08	-2.98±7.96E-08
104	DOWN - C(1)	7.35	1287	-0.56±1.09E-08	1.19±0.01E-05	6.01±0.83E-07
104	DOWN - C(2)	7.48	1298	-1.64±3.22E-09	1.27±0.01E-05	6.33±0.88E-07
104	DOWN - C(3)	7.24	1275	2.12±7.33E-09	1.33±0.02E-05	6.05±0.88E-07
104	DOWN - C(4)	7.08	1313	-0.96±1.14E-08	1.48±0.02E-05	6.93±0.89E-07

Sample collection period (rep) noted in parenthesis next to hydraulic position.

Table E - 1 (*continued*)
1996 Contamination Indicator and Radiological Indicator Results for the Sand and Gravel Unit

Location Code	Hydraulic Position	pH	Conductivity µmhos/cm@25°C	Gross Alpha µCi/mL	Gross Beta µCi/mL	H-3 µCi/mL
111	DOWN - C(1)	6.59	575	-2.20±6.80E-09	4.55±0.09E-06	7.09±0.84E-07
111	DOWN - C(2)	6.40	509	-0.98±1.93E-09	3.38±0.07E-06	5.56±0.87E-07
111	DOWN - C(3)	6.66	627	5.13±6.16E-09	4.87±0.09E-06	1.47±0.11E-06
111	DOWN - C(4)	6.49	848	9.16±6.02E-09	8.69±0.09E-06	8.02±0.88E-07
205	DOWN - C(1)	6.56	1995	2.29±3.70E-09	9.14±2.77E-09	7.38±7.83E-08
205	DOWN - C(2)	6.82	2055	-1.60±2.73E-09	4.49±2.77E-09	-1.12±0.80E-07
205	DOWN - C(3)	6.73	2930	0.61±4.43E-09	1.57±0.29E-08	-2.88±7.84E-08
205	DOWN - C(4)	6.68	2065	1.93±3.66E-09	1.20±0.30E-08	-9.80±8.23E-08
406	DOWN - C(1)	7.26	585	0.87±1.31E-09	1.38±0.25E-08	5.81±0.92E-07
406	DOWN - C(2)	7.51	635	-0.40±1.16E-09	1.25±0.24E-08	3.30±0.86E-07
406	DOWN - C(3)	7.14	595	-8.82±9.98E-10	8.14±1.62E-09	3.78±0.86E-07
406	DOWN - C(4)	7.21	583	0.84±1.60E-09	1.60±0.27E-08	4.41±0.88E-07
408	DOWN - C(1)	7.27	1652	NR	5.56±0.01E-04	1.18±0.95E-07
408	DOWN - C(2)	7.53	1578	1.10±1.20E-09	5.10±0.00E-04	5.35±1.25E-07
408	DOWN - C(3)	7.45	1875	-0.40±4.60E-09	5.38±0.01E-04	3.80±1.52E-07
408	DOWN - C(4)	7.29	1873	7.00±7.00E-10	7.06±0.01E-04	-1.32±1.08E-07
501	DOWN - C(1)	7.10	1257	0.00±1.09E-08	1.62±0.01E-04	4.99±0.82E-07
501	DOWN - C(2)	7.53	1154	8.09±8.39E-09	1.30±0.00E-04	1.20±0.82E-07
501	DOWN - C(3)	7.41	1319	0.84±1.23E-08	1.40±0.00E-04	1.66±0.82E-07
501	DOWN - C(4)	7.30	1574	-4.11±5.70E-09	2.00±0.01E-04	5.13±0.87E-07
502	DOWN - C(1)	7.35	1230	-6.15±7.09E-09	1.30±0.00E-04	4.56±0.81E-07
502	DOWN - C(2)	7.45	1245	3.18±6.24E-09	1.03±0.00E-04	3.73±0.85E-07
502	DOWN - C(3)	7.34	1314	2.76±9.37E-09	1.37±0.00E-04	2.79±0.84E-07
502	DOWN - C(4)	7.37	1423	-2.01±6.68E-09	1.59±0.01E-04	5.08±0.85E-07
602	DOWN - C(1)	6.60	823	1.47±1.68E-09	3.70±0.40E-08	3.62±0.17E-06
602	DOWN - C(2)	6.57	713	1.61±1.08E-09	3.25±0.23E-08	4.62±0.20E-06
602	DOWN - C(3)	6.46	707	0.38±1.36E-09	1.91±0.12E-08	3.62±0.16E-06
602	DOWN - C(4)	6.59	668	-0.88±1.88E-09	3.85±0.42E-08	5.35±0.15E-06
604	DOWN - C(1)	6.22	831	0.91±1.56E-09	6.54±2.21E-09	0.00±1.00E-07
604	DOWN - C(2)	6.33	707	1.12±1.39E-09	4.26±2.04E-09	-2.08±0.91E-07
604	DOWN - C(3)	6.44	669	-0.21±1.40E-09	1.73±1.99E-09	-7.77±1.43E-07
604	DOWN - C(4)	6.32	792	-0.74±1.88E-09	3.25±2.21E-09	-2.08±0.93E-07

Sample collection period (rep) noted in parenthesis next to hydraulic position.

NR - Not reported. These results have not been reported because the data validation process indicated the data were not reliable.

Table E - 1 (continued)
1996 Contamination Indicator and Radiological Indicator Results for the Sand and Gravel Unit

Location Code	Hydraulic Position	pH	Conductivity µmhos/cm@25°C	Gross Alpha µCi/mL	Gross Beta µCi/mL	H-3 µCi/mL
8605	DOWN - C(1)	6.88	990	-2.85±8.82E-09	1.89±0.02E-05	2.01±0.11E-06
8605	DOWN - C(2)	6.99	852	7.34±7.17E-09	1.99±0.02E-05	2.81±0.14E-06
8605	DOWN - C(3)	6.82	1130	1.90±1.35E-08	2.03±0.02E-05	2.36±0.13E-06
8605	DOWN - C(4)	6.71	1226	1.62±7.08E-09	1.76±0.02E-05	1.19±0.10E-06
8607	DOWN - C(1)	6.04	854	1.11±1.52E-09	1.60±0.32E-08	1.45±0.78E-07
8607	DOWN - C(2)	6.58	1084	1.25±1.90E-09	2.91±0.37E-08	9.04±8.08E-08
8607	DOWN - C(3)	6.62	1054	-0.22±2.27E-09	6.27±1.26E-09	1.41±0.79E-07
8607	DOWN - C(4)	6.71	1213	0.05±2.39E-09	1.27±0.33E-08	-2.98±8.26E-08
8609	DOWN - C(1)	7.21	741	0.28±1.51E-09	3.45±0.10E-07	1.15±0.09E-06
8609	DOWN - C(2)	7.40	738	0.49±1.51E-09	3.45±0.10E-07	8.88±0.92E-07
8609	DOWN - C(3)	7.27	751	1.46±2.23E-09	1.34±0.04E-07	9.93±0.95E-07
8609	DOWN - C(4)	7.18	786	-0.77±2.57E-09	3.80±0.11E-07	1.18±0.10E-06
GSEEP	DOWN - D(1)	6.65	762	-0.23±1.33E-09	6.88±2.79E-09	1.02±0.09E-06
GSEEP	DOWN - D(2)	6.95	711	1.00±1.01E-09	6.39±1.91E-09	6.55±0.88E-07
GSEEP	DOWN - D(3)	6.52	781	0.78±1.91E-09	2.75±1.06E-09	7.56±0.89E-07
GSEEP	DOWN - D(4)	6.50	971	-1.89±2.28E-09	5.10±2.93E-09	9.10±0.93E-07
105	DOWN - D(1)	7.06	1408	0.27±1.95E-09	1.99±0.21E-08	7.74±0.64E-07
105	DOWN - D(2)	7.12	1452	0.89±2.60E-09	2.16±0.32E-08	5.79±0.87E-07
105	DOWN - D(3)	7.09	1463	-1.71±2.77E-09	3.17±0.40E-08	5.31±0.87E-07
105	DOWN - D(4)	7.05	1397	0.47±2.66E-09	3.18±0.34E-08	6.19±0.62E-07
106	DOWN - D(1)	6.63	1283	3.32±2.83E-09	2.34±2.47E-09	2.50±0.14E-06
106	DOWN - D(2)	7.06	1242	-1.11±2.85E-09	-7.42±4.63E-09	2.14±0.13E-06
106	DOWN - D(3)	6.86	1238	-0.39±2.72E-09	5.02±2.41E-09	1.79±0.12E-06
106	DOWN - D(4)	6.87	1198	1.05±2.38E-09	3.90±2.58E-09	3.09±0.15E-06
116	DOWN - D(1)	6.96	1150	2.72±2.14E-09	9.96±0.59E-08	4.28±0.86E-07
116	DOWN - D(2)	7.08	1764	-0.36±3.18E-09	2.66±0.07E-07	3.90±0.86E-07
116	DOWN - D(3)	7.20	1121	0.15±2.19E-09	1.42±0.05E-07	5.25±0.87E-07
116	DOWN - D(4)	7.06	1179	1.79±2.60E-09	2.02±0.06E-07	7.00±0.92E-07
605	DOWN - D(1)	7.04	566	5.54±6.16E-10	1.12±0.03E-07	5.67±7.84E-08
605	DOWN - D(2)	6.74	680	-0.42±1.01E-09	1.04±0.04E-07	2.51±8.04E-08
605	DOWN - D(3)	7.02	718	1.78±1.38E-09	3.85±0.21E-08	2.69±8.14E-08
605	DOWN - D(4)	7.23	748	1.06±1.80E-09	3.32±0.30E-08	4.26±5.91E-08

Sample collection period (rep) noted in parenthesis next to hydraulic position.

Table E - 1 (concluded)
1996 Contamination Indicator and Radiological Indicator Results for the Sand and Gravel Unit

Location Code	Hydraulic Position	pH	Conductivity µmhos/cm@25°C	Gross Alpha µCi/mL	Gross Beta µCi/mL	H-3 µCi/mL
801	DOWN - D(1)	6.70	1311	-6.77±9.38E-09	7.26±0.11E-06	1.39±0.77E-07
801	DOWN - D(2)	6.87	1322	3.25±6.38E-09	6.05±0.10E-06	3.72±0.84E-07
801	DOWN - D(3)	6.75	1293	0.65±1.08E-08	6.31±0.10E-06	4.27±0.85E-07
801	DOWN - D(4)	6.61	1299	-0.78±1.21E-08	7.36±0.11E-06	5.75±0.85E-07
802	DOWN - D(1)	6.75	643	1.63±1.20E-09	1.32±1.30E-09	3.14±0.80E-07
802	DOWN - D(2)	6.93	242	-0.78±5.54E-10	-0.60±1.29E-09	8.98±8.08E-08
802	DOWN - D(3)	7.19	391	-2.95±6.29E-10	1.62±1.35E-09	2.03±0.57E-07
802	DOWN - D(4)	7.10	853	1.46±1.44E-09	3.38±1.50E-09	3.24±0.85E-07
803	DOWN - D(1)	6.92	1409	0.81±2.77E-09	1.34±0.28E-08	8.04±0.86E-07
803	DOWN - D(2)	6.98	1372	-0.28±2.48E-09	6.44±2.78E-09	4.55±0.60E-07
803	DOWN - D(3)	6.90	1371	0.75±3.10E-09	9.01±2.58E-09	4.34±0.84E-07
803	DOWN - D(4)	6.73	1444	3.77±3.57E-09	1.63±0.30E-08	4.03±0.85E-07
804	DOWN - D(1)	6.75	828	1.14±1.56E-09	2.14±0.08E-07	1.62±0.11E-06
804	DOWN - D(2)	6.73	831	0.34±1.08E-09	2.17±0.05E-07	1.29±0.82E-07
804	DOWN - D(3)	6.58	823	0.63±2.13E-09	7.44±0.30E-08	8.89±8.04E-08
804	DOWN - D(4)	6.61	846	-1.58±2.14E-09	2.53±0.09E-07	1.74±0.82E-07
8603	DOWN - D(1)	7.27	1568	-0.08±2.90E-09	7.72±0.12E-07	6.30±0.84E-07
8603	DOWN - D(2)	7.24	1586	0.04±1.97E-09	1.14±0.01E-06	4.61±0.86E-07
8603	DOWN - D(3)	7.16	1516	3.35±6.04E-09	1.51±0.04E-06	3.65±0.85E-07
8603	DOWN - D(4)	7.33	1577	-2.08±7.05E-09	2.14±0.06E-06	8.13±0.90E-07
8604	DOWN - D(1)	7.24	1735	-1.07±1.11E-08	3.98±0.03E-05	5.58±0.82E-07
8604	DOWN - D(2)	7.36	1656	2.78±4.83E-09	3.86±0.02E-05	4.39±0.85E-07
8604	DOWN - D(3)	7.16	1604	6.02±6.22E-09	3.91±0.02E-05	3.75±0.85E-07
8604	DOWN - D(4)	7.25	1610	0.73±1.26E-08	4.14±0.03E-05	6.73±0.87E-07
8612	DOWN - D(1)	7.12	980	1.58±1.96E-09	1.54±2.57E-09	1.21±0.07E-06
8612	DOWN - D(2)	7.52	1034	0.55±2.00E-09	1.48±2.54E-09	9.73±0.94E-07
8612	DOWN - D(3)	7.36	1035	0.59±2.66E-09	7.95±9.92E-10	1.06±0.09E-06
8612	DOWN - D(4)	7.27	1040	0.06±2.92E-09	1.96±2.82E-09	1.10±0.10E-06

Sample collection period (rep) noted in parenthesis next to hydraulic position.

Table E-2
1996 Contamination Indicator and Radiological Indicator Results for the Till-Sand Unit

Location Code	Hydraulic Position	pH	Conductivity µmhos/cm25°C	Gross Alpha µCi/mL	Gross Beta µCi/mL	H-3 µCi/mL
302	UP(1)	7.07	2230	-0.65±4.43E-09	1.29±4.43E-09	1.53±7.35E-08
302	UP(2)	7.18	2165	2.12±4.02E-09	-1.06±3.43E-09	3.48±5.73E-08
302	UP(3)	7.11	1623	5.72±3.96E-09	1.72±0.51E-08	6.76±5.60E-08
302	UP(4)	7.10	1583	3.76±2.70E-09	1.34±0.37E-08	-8.17±8.19E-08
402	UP(1)	7.24	1939	1.26±4.32E-09	1.89±2.60E-09	0.00±1.00E-07
402	UP(2)	7.26	1944	5.71±5.32E-09	4.29±3.01E-09	-1.34±8.04E-08
402	UP(3)	7.23	1306	3.29±3.52E-09	2.73±2.36E-09	1.11±0.81E-07
402	UP(4)	7.23	1371	2.12±4.03E-09	5.31±2.77E-09	-1.43±0.83E-07
204	DOWN - B(1)	8.19	694	0.94±1.23E-09	1.94±1.34E-09	4.80±5.77E-08
204	DOWN - B(2)	8.22	709	1.43±1.53E-09	0.19±1.45E-09	-9.43±8.00E-08
204	DOWN - B(3)	8.09	456	3.47±7.93E-10	1.78±1.02E-09	1.69±0.80E-07
204	DOWN - B(4)	7.96	511	1.01±1.35E-09	2.58±1.41E-09	-5.40±8.30E-08
206	DOWN - C(1)	7.61	796	0.69±1.59E-09	1.00±1.94E-09	1.31±0.78E-07
206	DOWN - C(2)	7.74	811	1.74±1.72E-09	2.91±2.01E-09	5.78±8.13E-08
206	DOWN - C(3)	7.72	552	1.17±2.26E-09	1.27±2.01E-09	9.94±8.01E-08
206	DOWN - C(4)	7.55	562	1.39±2.37E-09	2.24±2.20E-09	-4.62±8.39E-08
208	DOWN - C(1)	8.21	309	6.90±6.44E-10	1.00±1.21E-09	3.95±7.62E-08
208	DOWN - C(2)	7.54	344	3.45±6.75E-10	0.07±1.34E-09	-1.62±0.79E-07
208	DOWN - C(3)	7.96	204	4.93±6.72E-10	0.07±1.25E-09	-4.32±7.81E-08
208	DOWN - C(4)	7.95	195	1.18±0.78E-09	0.77±1.26E-09	-1.85±0.81E-07

Sample collection period (rep) noted in parenthesis next to hydraulic position.

Table E-3
1996 Contamination Indicator and Radiological Indicator Results for the Weathered Lavery Till Unit

Location Code	Hydraulic Position	pH	Conductivity µmhos/cm25°C	Gross Alpha µCi/mL	Gross Beta µCi/mL	H-3 µCi/mL
908	UP(1)	7.15	1359	1.99±3.32E-09	1.51±0.34E-08	1.47±0.79E-07
908	UP(3)	6.98	1760	5.51±6.26E-09	2.05±0.52E-08	-3.67±8.03E-08
1005	UP(1)	7.25	835	2.39±1.98E-09	2.12±2.59E-09	0.64±9.21E-08
1005	UP(3)	7.19	517	4.25±2.81E-09	1.42±1.02E-09	-1.17±8.04E-08
1008	UP(1)	7.62	584	1.09±1.10E-09	-0.35±1.41E-09	1.53±7.35E-08
1008	UP(3)	7.51	381	-0.59±1.47E-09	0.44±1.56E-09	-7.10±7.83E-08
906	DOWN - B(1)	7.39	713	2.46±1.84E-09	3.40±2.07E-09	5.01±7.65E-08
906	DOWN - B(3)	7.52	420	2.85±1.84E-09	2.69±2.04E-09	1.01±7.89E-08
1006	DOWN - B(1)	6.94	2350	1.45±5.23E-09	7.23±3.76E-09	0.00±7.07E-08
1006	DOWN - B(3)	6.95	1574	1.31±0.63E-08	5.92±4.92E-09	-1.10±0.79E-07
1007	DOWN - B(1)	7.11	1092	3.70±2.18E-09	7.29±1.88E-09	1.82±0.78E-07
1007	DOWN - B(3)	7.05	776	2.34±2.02E-09	7.76±1.76E-09	6.39±7.94E-08
NDATR	DOWN - C(1)	7.86	812	0.93±1.20E-09	7.41±0.44E-08	5.89±0.22E-06
NDATR	DOWN - C(2)	7.89	1048	2.88±1.54E-09	8.55±0.39E-08	1.24±0.04E-05
NDATR	DOWN - C(3)	7.84	1026	5.87±3.62E-09	3.46±0.22E-08	2.29±0.07E-05
NDATR	DOWN - C(4)	7.41	491	0.78±1.45E-09	5.23±0.33E-08	1.26±0.04E-05
909	DOWN - C(1)	6.59	1548	0.18±3.28E-09	3.21±0.08E-07	1.65±0.11E-06
909	DOWN - C(3)	6.69	1014	3.50±3.98E-09	2.85±0.08E-07	2.94±0.10E-06

Sample collection period (rep) noted in parenthesis next to hydraulic position.

Table E-4
1996 Contamination Indicator and Radiological Indicator Results for the Unweathered Lavery Till Unit

Location Code	Hydraulic Position	pH	Conductivity µmhos/cm25°C	Gross Alpha µCi/mL	Gross Beta µCi/mL	H-3 µCi/mL
405	UP(1)	7.35	1322	1.62±2.46E-09	7.48±2.95E-09	0.00±1.00E-07
405	UP(2)	7.44	1083	0.83±1.93E-09	3.81±2.64E-09	4.24±8.00E-08
405	UP(3)	7.51	603	0.50±2.27E-09	1.01±0.98E-09	1.00±0.79E-07
405	UP(4)	7.12	960	0.78±3.24E-09	3.01±2.95E-09	0.76±8.35E-08
110	DOWN - B(1)	7.47	504	1.13±1.06E-09	3.51±1.61E-09	1.42±0.10E-06
110	DOWN - B(2)	7.27	547	0.13±1.13E-09	0.09±1.66E-09	1.31±0.10E-06
110	DOWN - B(3)	7.59	377	2.41±1.75E-09	1.31±1.61E-09	1.47±0.10E-06
110	DOWN - B(4)	7.38	354	2.04±1.70E-09	2.14±1.72E-09	1.60±0.11E-06
704	DOWN - B(1)	6.65	879	1.42±1.94E-09	1.58±0.33E-08	3.81±7.88E-08
704	DOWN - B(2)	6.51	865	0.47±1.72E-09	1.39±0.31E-08	-1.34±7.98E-08
704	DOWN - B(3)	6.73	556	-0.45±2.51E-09	6.69±1.29E-09	-9.27±7.88E-08
704	DOWN - B(4)	6.51	606	1.16±3.01E-09	1.38±0.34E-08	0.99±8.23E-08
707	DOWN - B(1)	6.57	292	5.58±6.06E-10	4.28±1.59E-09	2.39±7.67E-08
707	DOWN - B(2)	6.4	307	0.21±6.26E-10	2.77±1.71E-09	7.51±8.02E-08
707	DOWN - B(3)	6.92	507	0.64±1.23E-09	3.14±1.68E-09	8.63±5.63E-08
707	DOWN - B(4)	6.7	486	0.38±1.57E-09	1.85±1.73E-09	2.44±8.11E-08
107	DOWN - C(1)	7.2	848	3.50±1.38E-09	3.50±1.86E-09	1.32±0.10E-06
107	DOWN - C(2)	7.34	772	4.07±2.15E-09	2.32±2.54E-09	1.18±0.10E-06
107	DOWN - C(3)	7.29	471	1.50±1.40E-09	2.39±0.73E-09	1.03±0.09E-06
107	DOWN - C(4)	7.23	456	1.88±1.42E-09	0.69±1.87E-09	8.50±0.67E-07
108	DOWN - C(1)	7.52	601	5.37±1.53E-09	1.29±0.20E-08	1.10±0.83E-07
108	DOWN - C(2)	7.36	633	2.26±0.96E-09	-0.46±1.15E-09	-9.47±7.99E-08
108	DOWN - C(3)	7.55	402	1.90±1.57E-09	2.31±1.66E-09	1.67±0.79E-07
108	DOWN - C(4)	7.55	365	2.60±1.70E-09	1.96±1.71E-09	1.18±8.27E-08
409	DOWN - C(1)	8.25	340	2.14±0.82E-09	6.83±1.50E-09	0.00±1.00E-07
409	DOWN - C(2)	8.24	348	1.44±0.60E-09	3.25±1.06E-09	-1.26±0.79E-07
409	DOWN - C(3)	8.01	226	1.10±0.78E-09	2.11±1.37E-09	1.39±0.78E-07
409	DOWN - C(4)	7.78	261	1.48±0.84E-09	6.92±1.57E-09	1.29±8.03E-08
910	DOWN - C(1)	7.11	1609	2.04±3.48E-09	1.33±0.29E-08	0.47±6.76E-08
910	DOWN - C(3)	7.16	1009	2.20±3.12E-09	3.02±0.32E-08	-6.58±7.97E-08

Sample collection period (rep) noted in parenthesis next to hydraulic position.

Table E-5
1996 Contamination Indicator and Radiological Indicator Results for the Kent Recessional Sequence

Location Code	Hydraulic Position	pH	Conductivity µmhos/cm25°C	Gross Alpha µCi/mL	Gross Beta µCi/mL	H-3 µCi/mL
901	UP(1)	7.69	373	1.98±0.90E-09	5.06±1.44E-09	0.00±1.00E-07
901	UP(3)	7.79	372	1.55±1.11E-09	3.09±1.42E-09	-7.24±7.87E-08
902	UP(1)	7.86	452	3.22±1.14E-09	3.40±1.37E-09	0.00±1.00E-07
902	UP(3)	8.26	275	1.27±1.17E-09	5.34±1.53E-09	-1.38±0.78E-07
1008B	UP(1)	7.87	463	1.62±0.97E-09	1.87±1.29E-09	0.00±1.00E-07
1008B	UP(2)	7.89	433	6.46±8.10E-10	1.32±1.41E-09	-3.34±8.02E-08
903	DOWN - B(1)	7.55	433	2.25±1.96E-09	3.10±2.08E-09	0.00±1.00E-07
903	DOWN - B(3)	7.8	434	1.14±1.74E-09	3.49±2.10E-09	-9.41±7.85E-08
8610	DOWN - B(1)	8.39	926	0.82±1.60E-09	4.51±2.13E-09	0.00±1.00E-07
8610	DOWN - B(3)	8.35	552	-0.83±1.70E-09	3.81±2.14E-09	-1.62±0.78E-07
8611	DOWN - B(1)	7.79	973	0.93±1.29E-09	2.70±1.85E-09	4.60±7.84E-08
8611	DOWN - B(3)	7.96	850	1.50±2.08E-09	1.79±1.01E-09	-2.54±7.98E-08

Sample collection period (rep) noted in parenthesis next to hydraulic position.

.

Table E-6
1996 Groundwater Quality Results (mg/L)

Location Code	Hydraulic Position	Chloride	Sulfate	Nitrate + Nitrite-N	Ammonia	Bicarbonate Alkalinity*	Carbonate Alkalinity*	Phosphate	Silica	Sulfide
Sand and Gravel										
103	DOWN - C(2)	1600	52.0	0.03	NS	<1.0	250	1.7	280	NS
104	DOWN - C(2)	200	29.0	2.6	NS	190	<1.0	0.012	11	< 1.0
111	DOWN -C(2)	9.2	62.0	0.12	NS	160	<1.0	0.014	6.8	< 1.0
502	DOWN -C(2)	200	32.0	NS	<0.05	180	<1.0	0.1	NS	< 1.0
8605	DOWN -C(2)	87.5	87.0	0.03	NS	240	<1.0	0.088	7.7	< 1.0
GSEEP	DOWN -D(2)	99.0	42.9	1.1	NS	121	<10.0	<0.050	2.0	<0.10
105	DOWN -D(2)	280	35.2	1.7	NS	209	<10.0	<0.050	4.8	<0.10
106	DOWN -D(2)	196	53.6	0.19	NS	253	<10.0	0.91	3.4	<0.10
116	DOWN -D(2)	396	136	1.8	NS	154	<10.0	0.74	3.0	<0.10
801	DOWN -D(2)	220	37.0	1.6	NS	150	<5.0	0.024	6.8	< 1.0
802	DOWN -D(2)	20.4	25.8	< 0.05	NS	61.6	<4.0	<0.050	4.5	<0.10
803	DOWN -D(2)	72.7	131	< 0.05	NS	429	<10.0	<0.050	6.2	<0.10
804	DOWN -D(2)	133	140	0.52	NS	153	<5.0	0.11	2.0	<0.10
8603	DOWN -D(2)	343	34.1	2.5	NS	209	<10.0	<0.050	6.1	<0.10
8604	DOWN -D(2)	320	31	2.6	NS	200	<1.0	0.009	13	< 1.0
8612	DOWN -D(2)	128	64.6	< 0.05	NS	253	<10.0	<0.050	5.6	<0.10
Unweathered Lavery Till										
110	DOWN -B(2)	<1.0	67.6	0.06	NS	220	<10.0	<0.050	4.5	<0.10
107	DOWN - B(2)	5.3	171	0.08	NS	253	<10.0	<0.050	3.8	<0.10
108	DOWN - C(2)	1.5	149	0.25	NS	198	<10.0	<0.050	4.1	<0.10

** as mg $CaCO_3$/L*
NS - Not sampled
Sample collection period (rep) noted in parenthesis next to hydraulic position.

Table E-6 (concluded)
1996 Groundwater Quality Results (mg/L)

Location Code	Hydraulic Position	Calcium Total	Calcium Diss.	Magnesium Total	Magnesium Diss.	Sodium Total	Sodium Diss.	Potassium Total	Potassium Diss.	Iron Total	Iron Diss.	Manganese Total	Manganese Diss.	Aluminum Total	Aluminum Diss.
Sand and Gravel															
103	DOWN - C(2)	210	NS	6.30	NS	1300	NS	2.00	NS	2.10	NS	0.530	NS	0.660	NS
104	DOWN - C(2)	120	NS	17.0	NS	87.0	NS	2.60	NS	0.50	NS	0.140	NS	0.600	NS
111	DOWN - C(2)	67.0	NS	9.5	NS	11.0	NS	3.50	NS	0.20	NS	0.880	NS	<0.200	NS
502	DOWN - C(1)	NS	NS	NS	NS	NS	NS	NS	NS	13.0	NS	0.053	NS	0.041	NS
502	DOWN - C(2)	130	NS	17.0	17.0	73.0	NS	2.10	NS	21.0	0.11	0.062	0.004	0.170	0.043
502	DOWN - C(3)	NS	NS	NS	NS	NS	NS	NS	NS	4.60	NS	0.018	NS	0.016	NS
502	DOWN - C(4)	NS	NS	NS	NS	NS	NS	NS	NS	18.0	NS	0.026	NS	0.075	NS
8605	DOWN - C(2)	97.5	NS	14.5	NS	57.5	NS	5.55	NS	3.75	NS	7.50	NS	0.200	NS
GSEEP	DOWN - D(2)	82.6	NS	13.4	NS	29.6	NS	1.52	NS	0.114	NS	0.047	NS	<0.048	NS
105	DOWN - D(2)	162	NS	27.0	NS	73.7	NS	1.52	NS	4.30	NS	3.68	NS	0.064	NS
106	DOWN - D(2)	162	NS	28.2	NS	62.7	NS	1.71	NS	21.9	NS	9.25	NS	4.17	NS
116	DOWN - D(2)	234	NS	29.1	NS	54.7	NS	3.30	NS	22.4	NS	2.34	NS	5.88	NS
801	DOWN - D(2)	120	NS	16.0	NS	79.0	NS	1.80	NS	1.00	NS	0.200	NS	0.960	NS
802	DOWN - D(2)	30.1	NS	3.81	NS	8.93	NS	2.24	NS	4.00	NS	0.194	NS	4.93	NS
803	DOWN - D(2)	215	NS	44.8	NS	25.8	NS	1.45	NS	0.392	NS	1.58	NS	0.178	NS
804	DOWN - D(2)	94.6	NS	13.0	NS	46.8	NS	1.65	NS	2.58	NS	0.357	NS	1.14	NS
8603	DOWN - D(2)	170	NS	28.8	NS	89.4	NS	2.64	NS	0.16	NS	0.032	NS	<0.048	NS
8604	DOWN - D(2)	160	NS	25.0	NS	100	NS	2.60	NS	0.11	NS	0.052	NS	0.049	NS
8612	DOWN - D(2)	133	NS	30.4	NS	22.8	NS	1.13	NS	0.761	NS	0.147	NS	<0.048	NS
Unweathered Lavery Till															
110	DOWN - B(2)	65.6	NS	22.2	NS	22.7	NS	1.39	NS	<0.030	NS	<0.010	NS	<0.048	NS
107	DOWN - C(2)	117	NS	26.1	NS	17.7	NS	1.89	NS	0.032	NS	<0.010	NS	<0.048	NS
108	DOWN - C(2)	80.5	NS	22.2	NS	22.2	NS	1.61	NS	0.391	NS	0.033	NS	0.170	NS

** as mg $CaCO_3$/L*
NS - Not sampled
Sample collection period (rep) noted in parenthesis next to hydraulic position.

Table E - 7

Modified Practical Quantitation Limits (PQLs) in µg/L for Appendix IX Parameters

COMPOUND	PQL	COMPOUND	PQL
Appendix IX Volatiles		*Appendix IX Volatiles*	
Acetone	10	Methacrylonitrile	5
Acetonitrile	100	Methyl ethyl ketone	10
Acrolein	5	Methyl iodide	5
Acrylonitrile	5	Methyl methacrylate	5
Allyl chloride	5	4-Methyl-2-pentanone	10
Benzene	5	Methylene bromide	5
Bromodichloromethane	5	Methylene chloride	5
Bromoform	5	Pentachloroethane	5
Bromomethane	10	Propionitrile	50
Carbon disulfide	10	Styrene	5
Carbon tetrachloride	5	1,1,1,2-Tetrachloroethane	5
Chlorobenzene	5	1,1,2,2-Tetrachloroethane	5
Chloroethane	10	Tetrachloroethylene	5
Chloroform	5	Toluene	5
Chloromethane	10	1,1,1-Trichloroethane	5
Chloroprene	5	1,1,2-Trichloroethane	5
1,2-Dibromo-3-chloropropane	5	1,2,3-Trichloropropane	5
Dibromochloromethane	5	Vinyl acetate	10
1,2-Dibromoethane	5	Vinyl chloride	10
Dichlorodifluoromethane	5	Xylene (total)	5
1,1-Dichloroethane	5	cis-1,3-Dichloropropene	5
1,2-Dichloroethane	5	trans-1,2-Dichloroethylene	5
1,1-Dichloroethylene	5	trans-1,3-Dichloropropene	5
1,2-Dichloropropane	5	trans-1,4-Dichloro-2-butene	5
Ethyl benzene	5	Trichloroethylene	5
Ethyl methacrylate	5	Trichlorofluoromethane	5
2-Hexanone	10	1,2-Dichloroethylene (total)	5
Isobutyl alcohol	100		
Metals		*Metals*	
Antimony*	10	Mercury*	0.2
Arsenic*	10	Nickel*	40
Barium*	200	Selenium*	5
Beryllium*	1	Silver*	10
Cadmium*	5	Thallium*	10
Chromium*	10	Tin	3000
Cobalt	50	Vanadium	50
Copper	25	Zinc	20
Lead*	3		

** These parameters comprise the WVDP sampling list for metals from RCRA part 261, Appendix VIII, Hazardous Constituents List.*
Note: Specific quantitation limits are highly matrix-dependent and may not always be achievable.

Table E - 7 (*continued*)

Modified Practical Quantitation Limits (PQLs) in μg/L for Appendix IX Parameters

COMPOUND	PQL	COMPOUND	PQL
Appendix IX Semivolatiles		*Appendix IX Semivolatiles*	
Acenaphthene	10	2,4-Dinitrotoluene	10
Acenaphthylene	10	2,6-Dinitrotoluene	10
Acetophenone	10	Diphenylamine	10
2-Acetylaminofluorene	10	Ethyl methanesulfonate	10
4-Aminobiphenyl	10	Famphur	10
Aniline	10	Fluoranthene	10
Anthracene	10	Fluorene	10
Aramite	10	Hexachlorobenzene	10
Benzo[a]anthracene	10	Hexachlorobutadiene	10
Benzo[a]pyrene	10	Hexachlorocyclopentadiene	10
Benzo[b]fluoranthene	10	Hexachloroethane	10
Benzo[ghi]perylene	10	Hexachlorophene	10
Benzo[k]fluoranthene	10	Hexachloropropene	10
Benzyl alcohol	10	Indeno(1,2,3,-cd)pyrene	10
Bis(2-chlorethyl)ether	10	Isodrin	10
Bis(2-chloroethoxy)methane	10	Isophorone	10
Bis(2-ethylhexyl)phthalate	10	Isosafrole	10
Bis(2-chloro-1- methylethyl) ether	10	Kepone	10
4-Bromophenyl phenyl ether	10	Methapyrilene	10
Butyl benzyl phthalate	10	Methyl methanesulfonate	10
Carbazole	10	3-Methylcholanthrene	10
Chlorobenzilate	10	2-Methylnaphthalene	10
2-Chloronaphthalene	10	1,4-Naphthoquinone	10
2-Chlorophenol	10	1-Naphthylamine	10
4-Chlorophenyl phenyl ether	10	2-Naphthylamine	10
Chrysene	10	Nitrobenzene	10
Di-n-butyl phthalate	10	5-Nitro-o-toluidine	10
Di-n-octyl phthalate	10	4-Nitroquinoline 1-oxide	50
Diallate	10	N-Nitrosodi-n-butylamine	10
Dibenz[a,h]anthracene	10	N-Nitrosodimethylamine	10
Dibenzofuran	10	N-Nitrosodipropylamine	10
3,3-Dichlorobenzidine	10	N-Nitroso-di-N-phenylamine	10
2,4-Dichlorophenol	10	N-Nitrosodimethylamine	10
2,6-Dichlorophenol	10	N-Nitrosodipropylamine	10
Diethyl phthalate	10	N-Nitrosodiphenylamine	10
Dimethoate	10	N-Nitrosomethylethylamine	10
7, 12-Dimethylbenz[a]anthracene	10	N-Nitrosomorpholine	10
3,3-Dimethylbenzidine	20	N-Nitrosopiperidine	10
2,4-Dimethylphenol	10	N-Nitrosopyrrolidine	10
Dimethyl phthalate	10	Naphthalene	10
4,6-Dinitro-o-cresol	25	0,0,0-Triethyl phosphorothioate	10
2,4-Dinitrophenol	25	0,0-Diethyl 0-2-pyrazinyl- phosphorous	10

Note: Specific quantitation limits are highly matrix-dependent and may not always be achievable.

Table E - 7 (concluded)

Modified Practical Quantitation Limits (PQLs) in µg/L for Appendix IX Parameters

COMPOUND	PQL	COMPOUND	PQL
Appendix IX Semivolatiles		*Appendix IX Semivolatiles*	
p-(Dimethylamino)azobenzene	10	2,3,4,6-Tetrachlorophenol	10
p-Chloroaniline	10	Tetraethyl dithiopyrophosphate	10
p-Chloro-m-cresol	10	1,2,4-Trichlorobenzene	10
p-Cresol	10	2,4,5-Trichlorophenol	25
p-Dichlorobenzene	10	2,4,6-Trichlorophenol	10
p-Nitroaniline	25	alpha,alpha-Dimethylphenethylamine	10
p-Nitrophenol	25	m-Cresol	10
p-Phenylenediamine	10	m-Dichlorobenzene	10
Parathion	10	m-Dinitrobenzene	10
Pentachlorobenzene	10	m-Nitroaniline	25
Pentachloronitrobenzene	10	o-Cresol	10
Pentachlorophenol	25	o-Dichlorobenzene	10
Phenacetin	10	o-Nitroaniline	25
Phenanthrene	10	o-Nitrophenol	10
Phenol	10	o-Toluidine	10
Pronamide	10	sym-Trinitrobenzene	10
Pyrene	10	2-Picoline	10
Safrole	10	Pyridine	10
1,2,4,5-Tetrachlorobenzene	10	1,4-Dioxane	10
Pesticides and PCBs		*Pesticides and PCBs*	
Aldrin	0.05	Methoxychlor	0.5
alpha Chlordane	0.05	Methyl parathion	10
gamma Chlordane	0.05	PCB-1242	0.5
Chlordane (total)	0.5	PCB-1254	1
2,4-D	10	PCB-1221	0.5
4,4-DD	0.1	PCB-1232	0.5
4,4-DDE	0.1	PCB-1248	0.5
4,4-DDT	0.1	PCB-1260	1
Dieldrin	0.1	PCB-1016	0.5
Dinoseb	10	Phorate	10
Disulfoton	10	Silvex	2
Endosulfan I	0.1	2,4,5-T	2
Endosulfan II	0.1	Toxaphene	1
Endosulfan sulfate	0.1	alpha-BHC	0.05
Endrin	0.1	beta-BHC	0.05
Endrin aldehyde	0.1	delta-BHC	0.05
Hepatachlor	0.05	gamma-BHC (Lindane)	0.05
Hepatachlor epoxide	0.05		

Note: Specific quantitation limits are highly matrix-dependent and may not always be achievable.

Table E - 8

Detections of Volatile Organic Compounds at Selected Groundwater Monitoring Locations

Location	**Date**	**1,1,1-TCA** *(µg/L)*	**1,1-DCA** *(µg/L)*	**DCDFMeth** *(µg/L)*	**1,2-DCE** *(µg/L)*
SP-12	09/16/96	<5.0	5.75	0.80*	N/A
	11/05/96	<5.0	3.50*	0.65*	N/A
8609	03/06/96	<5.0	<5.0	<5.0	N/A
8612	12/05/95	4.0*	39.5	8.0	10.0
	03/06/96	3.5*	32.5	5.0	9.5
	06/05/96	4.0*	34	3.0*	<5.0
	09/05/96	5.5	36	3.5*	16.0
803	12/05/95	<5.0	<5.0	<5.0	N/A
	03/06/96	<5.0	<5.0	3.0*	N/A
	06/05/96	<5.0	<5.0	2.5*	N/A
	09/18/96	<5.0	1.0*	3.0*	N/A

Note: Samples are collected according to different schedules (annual, semiannual, or quarterly schedules).

** Compound was detected below the practical quantitation limit (PQL).*

Table E - 9

Tributyl Phosphate Sampling Results for 1996 at Selected Groundwater Monitoring Locations

Location	**Date**	**Tributyl Phosphate*** *(µg/L)*
111	12/13/95	1.0
	06/11/96	<10.0
8605	12/13/95	160
	06/11/96	120

Note: Samples are collected according to different schedules (annual, semiannual, or quarterly schedules).
** Practical quantitation limit for TBP is 10 µg/L.*

Table E - 10
RCRA Hazardous Constituent List and Appendix IX Metals (µg/L) Sampling Results

Location Code	Hydraulic Position	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper
Kent Recessional Deposits									
901	UP(1)	<4.00	<5.30	639	<0.20	<0.40	<1.00	NS	NS
901	UP(3)	<10.0	<10.0	623	<1.00	<5.00	<10.0	NS	NS
902	UP(1)	<4.00	<5.30	744	<0.20	<0.40	<1.00	NS	NS
902	UP(3)	<10.0	<10.0	752	<1.00	<5.00	<10.0	NS	NS
1008B	UP(1)	<4.00	<5.30	447	<0.20	<0.40	<1.00	NS	NS
1008B	UP(2)	<3.00	<8.60	427	<0.20	<0.50	<1.30	NS	NS
903	DOWN - B(1)	<4.00	<5.30	51.3	<0.20	<0.40	1.9	NS	NS
903	DOWN - B(3)	<10.0	59.6	481	4.6	<5.00	143	NS	NS
8611	DOWN - B(1)	<4.00	<5.30	35.5	<0.20	0.45	13.7	NS	NS
8611	DOWN - B(3)	<10.0	<10.0	< 200	<1.00	<5.00	32.7	NS	NS
Sand and Gravel									
301	UP(1)	<4.00	<5.30	218	0.42	<0.40	1,750	NS	NS
301	UP(2)	<3.00	<8.60	180	<0.20	<0.50	210	NS	NS
401	UP(1)	<4.00	<5.30	469	<0.20	<0.40	604	NS	NS
401	UP(2)	3.4	<8.60	421	0.32	<0.50	475	NS	NS
403	UP(1)	<4.00	<5.30	240	<0.20	<0.40	404	NS	NS
403	UP(2)	<3.00	<8.60	315	<0.20	<0.50	217	NS	NS
403	UP(3)	<10.0	<10.0	306	<1.00	<5.00	101	NS	NS
403	UP(4)	<10.0	200	1,680	8.4	217	10,000	NS	NS
706	UP(1)	<4.00	12.1	253	0.51	<0.40	65.7	NS	NS
706	UP(2)	19.7	12.3	156	0.53	0.85	17.8	NS	NS
706	UP(3)	<10.0	<10.0	< 200	<1.00	<5.00	15.5	NS	NS
706	UP(4)	<10.0	<10.0	< 200	<1.00	<5.00	13.3	NS	NS
NB1S	UP(1)	<4.00	6.3	107	<0.20	<0.40	2,220	NS	NS
NB1S	UP(2)	<3.00	<8.60	97.9	<0.20	<0.50	1,280	NS	NS
201	DOWN - B(1)	7.0	8.9	254	<0.20	<0.40	174	NS	NS
201	DOWN - B(3)	<10.0	<10.0	306	<1.00	<5.00	<10.0	NS	NS
103	DOWN - C(1)	<4.00	170	93.8	0.73	0.63	164	NS	NS
103	DOWN - C(3)	<10.0	97	33	<1.00	<5.00	6.7	NS	NS

Sample collection period (rep) noted in parenthesis next to hydraulic position.
NS - Not sampled

Table E - 10 *(continued)*
RCRA Hazardous Constituent List and Appendix IX Metals (µg/L) Sampling Results

Location Code	Hydraulic Position	Lead	Mercury	Nickel	Selenium	Silver	Thallium	Tin	Vanadium	Zinc
Kent Recessional Deposits										
901	UP(1)	<1.40	<0.20	2.1	<5.00	<0.20	<7.10	NS	NS	NS
901	UP(3)	<3.00	<0.20	<40.0	<5.00	<10.0	<10.0	NS	NS	NS
902	UP(1)	<1.40	<0.20	<1.40	<5.00	NR	9.2	NS	NS	NS
902	UP(3)	<3.00	<0.20	<40.0	<5.00	<10.0	<10.0	NS	NS	NS
1008B	UP(1)	<1.40	<0.20	1.4	<5.00	<0.20	7.2	NS	NS	NS
1008B	UP(2)	<2.40	<0.20	<1.90	<3.00	<0.20	<9.00	NS	NS	NS
903	DOWN - B(1)	<1.40	<0.20	4.6	<5.00	<0.20	<7.10	NS	NS	NS
903	DOWN - B(3)	105	<0.20	226	<5.00	<10.0	<10.0	NS	NS	NS
8611	DOWN - B(1)	8.0	<0.20	19.4	<5.00	<0.20	<7.10	NS	NS	NS
8611	DOWN - B(3)	14.3	<0.20	<40.0	<5.00	<10.0	<10.0	NS	NS	NS
Sand and Gravel										
301	UP(1)	13.2	<0.20	200	5.5	0.27	<7.10	NS	NS	NS
301	UP(2)	2.5	<0.20	91.1	<3.00	<0.20	<9.00	NS	NS	NS
401	UP(1)	3.1	<0.20	617	<5.00	<0.20	<7.10	NS	NS	NS
401	UP(2)	4.4	<0.20	351	<3.00	<0.20	<9.00	NS	NS	NS
403	UP(1)	9.8	<0.20	18.4	7.7	0.22	<7.10	NS	NS	NS
403	UP(2)	<2.40	<0.20	7.0	<3.00	<0.20	<9.00	NS	NS	NS
403	UP(3)	<3.00	<0.20	<40.0	<5.00	<10.0	<10.0	NS	NS	NS
403	UP(4)	422	0.82	3700	<5.00	<10.0	<10.0	NS	NS	NS
706	UP(1)	26.9	<0.20	38.9	8.6	0.56	<7.10	NS	NS	NS
706	UP(2)	15.8	<0.20	20.3	<4.00	1.2	<9.00	NS	NS	NS
706	UP(3)	9.9	<0.20	<40.0	<5.00	<10.0	<10.0	NS	NS	NS
706	UP(4)	6.2	<0.20	<40.0	<5.00	<10.0	<10.0	NS	NS	NS
NB1S	UP(1)	2.3	<0.20	24.8	<5.00	0.31	<7.10	NS	NS	NS
NB1S	UP(2)	<2.40	<0.20	9.6	<3.00	<0.20	<9.00	NS	NS	NS
201	DOWN - B(1)	3.0	<0.20	13.2	11	0.20	7.3	NS	NS	NS
201	DOWN - B(3)	<3.00	<0.20	57.1	<5.00	<10.0	<10.0	NS	NS	NS
103	DOWN - C(1)	152	0.28	89.4	5.8	1.7	<7.10	NS	NS	NS
103	DOWN - C(3)	12	0.079	22	6.7	<10.0	4.2	NS	NS	NS

Sample collection period (rep) noted in parenthesis next to hydraulic position.
NS - Not sampled
NR - Not reported. These results have not been reported because the data validation process indicated the data were not reliable.

Table E - 10 *(continued)*
RCRA Hazardous Constituent List and Appendix IX Metals (µg/L) Sampling Results

Location Code	Hydraulic Position	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper
Sand and Gravel									
104	DOWN - C(1)	<10.0	<5.00	185	<1.00	3.35	8.7	NS	NS
104	DOWN - C(3)	<10.0	<10.0	140	<1.00	<5.00	10.4	NS	NS
111	DOWN - C(1)	<10.0	<5.00	62	<1.00	1.6	<10.0	NS	NS
111	DOWN - C(2)	<10.0	<10.0	58	<1.00	<5.00	<10.0	NS	NS
111	DOWN - C(3)	<10.0	<10.0	72	<1.00	<5.00	4.1	NS	NS
111	DOWN - C(4)	<10.0	<10.0	94	<1.00	<5.00	<10.0	NS	NS
205	DOWN - C(1)	<4.00	6.7	166	0.26	<0.40	693	NS	NS
205	DOWN - C(3)	<10.0	<10.0	< 200	<1.00	<5.00	791	NS	NS
406	DOWN - C(1)	<4.00	<5.30	144	<0.20	<0.40	4.9	NS	NS
406	DOWN - C(2)	<3.00	<8.60	156	0.24	<0.50	3.4	NS	NS
408	DOWN - C(1)	<10.0	<5.00	290	<1.00	1.6	210	NS	NS
408	DOWN - C(2)	<10.0	<10.0	300	<1.00	<5.00	360	NS	NS
501	DOWN - C(1)	<10.0	<5.00	330	<1.00	1.7	36	NS	NS
501	DOWN - C(3)	<10.0	5.0	380	0.36	<5.00	66	NS	NS
502	DOWN - C(1)	<10.0	<5.00	370	<1.00	2.0	1300	9.7	13
502	DOWN - C(2)	<35.0	<10.0	370	<1.00	<5.00	2100	6.2	16
502	DOWN - C(3)	NS	<5.00	NS	NS	<5.00	590	<50.0	<20.0
502	DOWN - C(4)	NS	<10.0	NS	NS	<5.00	2050	<50.0	11.8
602	DOWN - C(1)	<4.00	<5.30	380	0.64	<0.40	12.8	NS	NS
602	DOWN - C(2)	<3.00	<8.60	398	0.71	<0.50	8.4	NS	NS
602	DOWN - C(3)	<10.0	24.4	374	1.6	<5.00	47	NS	NS
602	DOWN - C(4)	NR	73.4	676	3.6	<5.00	105	NS	NS
604	DOWN - C(1)	<4.00	9.9	140	<0.20	<0.40	4.7	NS	NS
604	DOWN - C(2)	<3.00	<8.60	128	<0.20	<0.50	2.7	NS	NS
604	DOWN - C(3)	<10.0	<10.0	< 200	<1.00	<5.00	<10.0	NS	NS
604	DOWN - C(4)	<10.0	10.5	< 200	<1.00	<5.00	20	NS	NS
8605	DOWN - C(1)	<10.0	6.2	100	<1.00	2.9	5.2	NS	NS
8605	DOWN - C(2)	<10.0	4.25	98.5	<1.00	<5.00	7.1	NS	NS
8605	DOWN - C(3)	<10.0	8.3	120	<1.00	<5.00	5.6	NS	NS
8607	DOWN - C(1)	<4.00	<5.30	50.4	<0.20	<0.40	<1.00	NS	NS
8607	DOWN - C(2)	<3.00	<8.60	65.4	<0.20	<0.50	<1.30	NS	NS
8609	DOWN - C(1)	<4.00	<5.30	198	<0.20	<0.40	<1.00	NS	NS
8609	DOWN - C(2)	3.15	<8.60	187	<0.20	<0.50	<1.30	NS	NS
GSEEP	DOWN - D(3)	<10.0	<10.0	< 200	<1.00	<5.00	<10.0	NS	NS

Sample collection period (rep) noted in parenthesis next to hydraulic position.
NS - Not sampled
NR - Not reported. These results have not been reported because the data validation process indicated the data were not reliable.

Table E - 10 *(continued)*
RCRA Hazardous Constituent List and Appendix IX Metals (µg/L) Sampling Results

Location Code	Hydraulic Position	Lead	Mercury	Nickel	Selenium	Silver	Thallium	Tin	Vanadium	Zinc
Sand and Gravel										
104	DOWN - C(1)	<3.00	<0.10	<40.0	<5.00	<10.0	<10.0	NS	NS	NS
104	DOWN - C(3)	<3.00	<0.10	<40.0	<5.00	<10.0	5.7	NS	NS	NS
111	DOWN - C(1)	<3.00	<0.10	<40.0	<5.00	<10.0	<10.0	NS	NS	NS
111	DOWN - C(2)	<3.00	0.055	<40.0	<5.00	<10.0	<10.0	NS	NS	NS
111	DOWN - C(3)	<3.00	<0.10	<40.0	<5.00	<10.0	5.3	NS	NS	NS
111	DOWN - C(4)	2.6	<0.20	<40.0	<5.00	<10.0	<10.0	NS	NS	NS
205	DOWN - C(1)	10.6	<0.20	194	<5.00	0.25	<7.10	NS	NS	NS
205	DOWN - C(3)	8.5	<0.20	65.7	<5.00	<10.0	<10.0	NS	NS	NS
406	DOWN - C(1)	8.0	<0.20	5.1	<5.00	0.21	<7.10	NS	NS	NS
406	DOWN - C(2)	11.3	<0.20	5.0	<3.00	<0.20	<9.00	NS	NS	NS
408	DOWN - C(1)	<3.00	<0.10	140	<5.00	<10.0	<10.0	NS	NS	NS
408	DOWN - C(2)	<3.00	0.063	230	<5.00	<10.0	<10.0	NS	NS	NS
501	DOWN - C(1)	<3.00	<0.10	130	2.6	<10.0	<10.0	NS	NS	NS
501	DOWN - C(3)	6.5	<0.10	68	<5.00	<10.0	4.4	NS	NS	NS
502	DOWN - C(1)	<3.00	<0.10	61	<5.00	<10.0	<10.0	NS	2.6	<20.0
502	DOWN - C(2)	<3.00	<0.10	81	<5.00	<10.0	<10.0	<3000	6.2	5.8
502	DOWN - C(3)	<3.00	NS	54	<5.00	NS	NS	NS	<50.0	120
502	DOWN - C(4)	5.85	NS	65.5	<5.00	NS	NS	NS	<50.0	<20.0
602	DOWN - C(1)	28.7	<0.20	17.8	<5.00	<0.20	<7.10	NS	NS	NS
602	DOWN - C(2)	28.9	<0.20	12.4	<3.00	<0.20	<9.00	NS	NS	NS
602	DOWN - C(3)	46.9	<0.20	54.6	<5.00	<10.0	<10.0	NS	NS	NS
602	DOWN - C(4)	91.2	<0.20	126	NR	<10.0	<10.0	NS	NS	NS
604	DOWN - C(1)	4.6	<0.20	<1.40	8.2	NR	<7.10	NS	NS	NS
604	DOWN - C(2)	5.0	<0.20	<1.90	<3.00	<0.20	<9.00	NS	NS	NS
604	DOWN - C(3)	3.7	<0.20	<40.0	<5.00	<10.0	<10.0	NS	NS	NS
604	DOWN - C(4)	8.8	<0.20	<40.0	<5.00	<10.0	<10.0	NS	NS	NS
8605	DOWN - C(1)	<3.00	<0.10	<40.0	5.1	<10.0	<10.0	NS	NS	NS
8605	DOWN - C(2)	<3.00	0.08	<40.0	<5.00	<10.0	<10.0	NS	NS	NS
8605	DOWN - C(3)	<3.00	<0.10	<40.0	<5.00	<10.0	<10.0	NS	NS	NS
8607	DOWN - C(1)	<1.40	<0.20	2.0	<5.00	<0.20	<7.10	NS	NS	NS
8607	DOWN - C(2)	<2.40	<0.20	2.0	<3.00	<0.20	<9.00	NS	NS	NS
8609	DOWN - C(1)	<1.40	<0.20	<1.40	<5.00	<0.20	<7.10	NS	NS	NS
8609	DOWN - C(2)	<2.40	<0.20	<1.90	<3.00	<0.20	<9.00	NS	NS	NS
GSEEP	DOWN - D(3)	<3.00	<0.20	<40.0	<5.00	<10.0	<10.0	NS	NS	NS

Sample collection period (rep) noted in parenthesis next to hydraulic position.
NS - Not sampled

Table E - 10 (continued)
RCRA Hazardous Constituent List and Appendix IX Metals (µg/L) Sampling Results

Location Code	Hydraulic Position	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper
Sand and Gravel									
105	DOWN - D(1)	<4.00	14.8	208	<0.20	<0.40	16	NS	NS
105	DOWN - D(3)	<10.0	27.7	227	<1.00	<5.00	39.7	NS	NS
106	DOWN - D(1)	<4.00	10.6	339	1.0	<0.40	204	NS	NS
106	DOWN - D(3)	<10.0	<10.0	264	1.1	<5.00	335	NS	NS
116	DOWN - D(1)	<4.00	16.7	555	1.5	<0.40	327	NS	NS
116	DOWN - D(3)	<10.0	26.5	446	1.6	<5.00	797	NS	NS
605	DOWN - D(1)	<4.00	6.8	90.6	<0.20	<0.40	3550	NS	NS
605	DOWN - D(2)	<3.00	<8.60	53.4	<0.20	<0.50	275	NS	NS
605	DOWN - D(3)	<10.0	10.6	211	<1.00	<5.00	4330	NS	NS
605	DOWN - D(4)	<10.0	<10.0	203	<1.00	<5.00	1360	NS	NS
801	DOWN - D(1)	<10.0	<5.00	150	<1.00	2.1	10	NS	NS
801	DOWN - D(3)	<10.0	<10.0	140	<1.00	<5.00	6.5	NS	NS
802	DOWN - D(1)	<4.00	<5.30	500	<0.20	<0.40	11.4	NS	NS
802	DOWN - D(3)	<10.0	<10.0	544	<1.00	<5.00	<10.0	NS	NS
803	DOWN - D(1)	<4.00	<5.30	246	<0.20	<0.40	9.95	NS	NS
803	DOWN - D(3)	<10.0	<10.0	< 200	<1.00	<5.00	<10.0	NS	NS
804	DOWN - D(1)	<4.00	19.2	310	1.1	<0.40	325	NS	NS
804	DOWN - D(3)	<10.0	<10.0	< 200	<1.00	<5.00	124	NS	NS
8603	DOWN - D(1)	<4.00	<5.30	338	<0.20	<0.40	<1.00	NS	NS
8603	DOWN - D(3)	<10.0	<10.0	300	<1.00	<5.00	<10.0	NS	NS
8604	DOWN - D(1)	<10.0	<5.00	320	<1.00	1.7	<10.0	NS	NS
8604	DOWN - D(3)	<10.0	<10.0	280	<1.00	<5.00	2.1	NS	NS
8612	DOWN - D(1)	<4.00	<5.30	250	<0.20	<0.40	<1.00	NS	NS
8612	DOWN - D(3)	<10.0	<10.0	243	<1.00	<5.00	<10.0	NS	NS
Till-Sand									
302	UP(1)	<4.00	9.7	648	0.46	<0.40	34.2	NS	NS
302	UP(2)	<3.00	<8.60	546	<0.20	<0.50	3.6	NS	NS
302	UP(3)	<10.0	<10.0	582	<1.00	<5.00	11.7	NS	NS
302	UP(4)	<10.0	<10.0	519	<1.00	<5.00	<10.0	NS	NS

Sample collection period (rep) noted in parenthesis next to hydraulic position.
NS - Not sampled

Table E - 10 *(continued)*
RCRA Hazardous Constituent List and Appendix IX Metals (μg/L) Sampling Results

Location Code	Hydraulic Position	Lead	Mercury	Nickel	Selenium	Silver	Thallium	Tin	Vanadium	Zinc
Sand and Gravel										
105	DOWN - D(1)	<1.40	<0.20	8.6	5.4	0.22	<7.10	NS	NS	NS
105	DOWN - D(3)	<3.00	<0.20	<40.0	<5.00	<10.0	<10.0	NS	NS	NS
106	DOWN - D(1)	24	<0.20	362	10	0.21	<7.10	NS	NS	NS
106	DOWN - D(3)	31.9	<0.20	247	<5.00	<10.0	<10.0	NS	NS	NS
116	DOWN - D(1)	54.6	<0.20	456	7.6	0.29	<7.10	NS	NS	NS
116	DOWN - D(3)	50.5	<0.20	222	<5.00	<10.0	<10.0	NS	NS	NS
605	DOWN - D(1)	3.6	<0.20	1020	5.0	<0.20	<7.10	NS	NS	NS
605	DOWN - D(2)	<2.40	<0.20	642	<3.00	<0.20	<9.00	NS	NS	NS
605	DOWN - D(3)	34.1	<0.20	1750	<5.00	<10.0	<10.0	NS	NS	NS
605	DOWN - D(4)	7.5	<0.20	679	<5.00	<10.0	<10.0	NS	NS	NS
801	DOWN - D(1)	<3.00	<0.10	<40.0	3.3	<10.0	<10.0	NS	NS	NS
801	DOWN - D(3)	<3.00	<0.10	<40.0	<5.00	<10.0	4.2	NS	NS	NS
802	DOWN - D(1)	<1.40	<0.20	40.8	<5.00	NR	<7.10	NS	NS	NS
802	DOWN - D(3)	<3.00	<0.20	<40.0	<5.00	<10.0	<10.0	NS	NS	NS
803	DOWN - D(1)	<1.40	<0.20	10.4	<5.00	<0.20	<7.10	NS	NS	NS
803	DOWN - D(3)	4.55	<0.20	<40.0	<5.00	<10.0	<10.0	NS	NS	NS
804	DOWN - D(1)	37	<0.20	252	<5.00	<0.20	<7.10	NS	NS	NS
804	DOWN - D(3)	9.8	<0.20	57.9	<5.00	<10.0	<10.0	NS	NS	NS
8603	DOWN - D(1)	<1.40	<0.20	1.5	<5.00	0.26	<7.10	NS	NS	NS
8603	DOWN - D(3)	<3.00	<0.10	<40.0	<5.00	<10.0	5.7	NS	NS	NS
8604	DOWN - D(1)	<3.00	<0.10	<40.0	<5.00	<10.0	<10.0	NS	NS	NS
8604	DOWN - D(3)	<3.00	<0.10	<40.0	<5.00	<10.0	5.0	NS	NS	NS
8612	DOWN - D(1)	<1.40	<0.20	14	<5.00	0.22	<7.10	NS	NS	NS
8612	DOWN - D(3)	<3.00	<0.20	<40.0	<5.00	<10.0	<10.0	NS	NS	NS
Till-Sand										
302	UP(1)	17.3	<0.20	30.9	5.7	NR	<7.10	NS	NS	NS
302	UP(2)	2.5	<0.20	4.9	<3.00	<0.20	<9.00	NS	NS	NS
302	UP(3)	<3.00	<0.20	<40.0	<5.00	<10.0	<10.0	NS	NS	NS
302	UP(4)	<3.00	<0.20	<40.0	<5.00	<10.0	<10.0	NS	NS	NS

Sample collection period (rep) noted in parenthesis next to hydraulic position.
NR - Not reported. These results have not been reported because the data validation process indicated the data were not reliable.
NS - Not sampled

Table E - 10 (continued)
RCRA Hazardous Constituent List and Appendix IX Metals (μg/L) Sampling Results

Location Code	Hydraulic Position	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper
Unweathered Lavery Till									
110	DOWN - B(1)	<4.00	<5.30	162	<0.20	<0.40	5.3	NS	NS
110	DOWN - B(3)	<10.0	<10.0	< 200	<1.00	<5.00	<10.0	NS	NS
704	DOWN - B(1)	<4.00	<5.30	36.6	<0.20	<0.40	6.9	NS	NS
704	DOWN - B(3)	<10.0	<10.0	< 200	<1.00	<5.00	<10.0	NS	NS
707	DOWN - B(1)	<4.00	16.3	236	0.91	<0.40	122	NS	NS
707	DOWN - B(2)	<3.00	<8.60	72.5	<0.20	<0.50	21.2	NS	NS
707	DOWN - B(3)	<10.0	13.1	264	<1.00	<5.00	626	NS	NS
707	DOWN - B(4)	<10.0	43.4	453	2.7	<5.00	516	NS	NS
107	DOWN - C(1)	<4.00	<5.30	45.9	<0.20	<0.40	10.2	NS	NS
107	DOWN - C(3)	<10.0	<10.0	< 200	<1.00	<5.00	<10.0	NS	NS
108	DOWN - C(1)	<4.00	<5.30	53	<0.20	<0.40	4.9	NS	NS
108	DOWN - C(3)	<10.0	<10.0	< 200	<1.00	<5.00	<10.0	NS	NS
910	DOWN - C(1)	<4.00	<5.30	16.7	<0.20	2.7	<1.00	NS	NS
910	DOWN - C(3)	<10.0	<10.0	< 200	<1.00	<5.00	<10.0	NS	NS
Weathered Lavery Till									
908	UP(1)	<4.00	7.3	39.6	<0.20	<0.40	18.6	NS	NS
908	UP(3)	<10.0	<10.0	< 200	<1.00	<5.00	12.2	NS	NS
1005	UP(1)	<4.00	<5.30	100	<0.20	<0.40	3.3	NS	NS
1005	UP(3)	<10.0	<10.0	< 200	<1.00	<5.00	<10.0	NS	NS
1008C	UP(1)	<4.00	<5.30	210	<0.20	<0.40	7.2	NS	NS
1008C	UP(3)	<10.0	<10.0	247	<1.00	<5.00	21.2	NS	NS
906	DOWN - B(1)	<4.00	<5.30	84.8	<0.20	<0.40	13.2	NS	NS
906	DOWN - B(3)	<10.0	<10.0	< 200	<1.00	<5.00	21	NS	NS
1006	DOWN - B(1)	<4.00	<5.30	13.9	<0.20	<0.40	<1.00	NS	NS
1006	DOWN - B(3)	<10.0	<10.0	< 200	<1.00	<5.00	<10.0	NS	NS
NDATR	DOWN - C(1)	<4.00	7.7	80.2	<0.20	<0.40	<1.00	<1.60	3.3
NDATR	DOWN - C(2)	<3.00	<8.60	87.4	<0.20	<0.50	<1.30	<1.30	4.1
NDATR	DOWN - C(3)	<10.0	<10.0	< 200	<1.00	<5.00	<10.0	<50.0	<25.0
NDATR	DOWN - C(4)	<10.0	<10.0	< 200	<1.00	<5.00	<10.0	<50.0	<25.0
909	DOWN - C(1)	<4.00	6.2	118	<0.20	0.98	4.2	NS	NS
909	DOWN - C(3)	<10.0	<10.0	< 200	<1.00	<5.00	<10.0	<50.0	<25.0

Sample collection period (rep) noted in parenthesis next to hydraulic position.
NS - Not sampled

Table E - 10 (concluded)

RCRA Hazardous Constituent List and Appendix IX Metals (µg/L) Sampling Results

Location Code	Hydraulic Position	Lead	Mercury	Nickel	Selenium	Silver	Thallium	Tin	Vanadium	Zinc
Unweathered Lavery Till										
110	DOWN - B(1)	<1.40	<0.20	2.6	5.3	<0.20	<7.10	NS	NS	NS
110	DOWN - B(3)	<3.00	<0.20	<40.0	<5.00	<10.0	<10.0	NS	NS	NS
704	DOWN - B(1)	<1.40	<0.20	3.7	<5.00	<0.20	<7.10	NS	NS	NS
704	DOWN - B(3)	<3.00	<0.20	<40.0	<5.00	<10.0	<10.0	NS	NS	NS
707	DOWN - B(1)	25	<0.20	176	<5.00	0.28	<7.10	NS	NS	NS
707	DOWN - B(2)	<2.40	<0.20	65.1	<3.00	<0.20	<9.00	NS	NS	NS
707	DOWN - B(3)	28.5	<0.20	302	<5.00	<10.0	<10.0	NS	NS	NS
707	DOWN - B(4)	54.9	<0.20	794	12.2	<10.0	<10.0	NS	NS	NS
107	DOWN - C(1)	<2.00	<0.20	5.3	<5.00	0.23	<7.10	NS	NS	NS
107	DOWN - C(3)	<3.00	<0.20	<40.0	<5.00	<10.0	<10.0	NS	NS	NS
108	DOWN - C(1)	<2.00	<0.20	2.5	<5.00	NR	<7.10	NS	NS	NS
108	DOWN - C(3)	<3.00	<0.20	<40.0	<5.00	<10.0	<10.0	NS	NS	NS
910	DOWN - C(1)	3.4	<0.20	3.4	<5.00	<0.20	<7.10	NS	NS	NS
910	DOWN - C(3)	8.8	<0.20	<40.0	<5.00	<10.0	<10.0	NS	NS	NS
Weathered Lavery Till										
908	UP(1)	14.3	<0.20	20.1	<5.00	<0.20	<7.10	NS	NS	NS
908	UP(3)	9.3	<0.20	<40.0	<5.00	<10.0	<10.0	NS	NS	NS
1005	UP(1)	1.8	<0.20	5.3	<5.00	<0.20	<7.10	NS	NS	NS
1005	UP(3)	4.1	<0.20	<40.0	<5.00	<10.0	<10.0	NS	NS	NS
1008C	UP(1)	<1.40	<0.20	24	<5.00	<0.20	<7.10	NS	NS	NS
1008C	UP(3)	<3.00	<0.20	<40.0	<5.00	<10.0	<10.0	NS	NS	NS
906	DOWN - B(1)	2.5	<0.20	9.4	<5.00	<0.20	<7.10	NS	NS	NS
906	DOWN - B(3)	5.6	<0.20	<40.0	<5.00	<10.0	<10.0	NS	NS	NS
1006	DOWN - B(1)	<1.40	<0.20	9.5	<5.00	NR	<7.10	NS	NS	NS
1006	DOWN - B(3)	<3.00	<0.20	<40.0	<5.00	<10.0	<10.0	NS	NS	NS
NDATR	DOWN - C(1)	<2.00	<0.20	1.7	7.2	<0.20	<3.00	<3.9	<1.60	107
NDATR	DOWN - C(2)	<2.40	<0.20	<1.90	<3.00	<0.20	<9.00	<9.7	<1.40	4.4
NDATR	DOWN - C(3)	<3.00	<0.20	<40.0	<5.00	<10.0	<10.0	<3000	<50.0	143
NDATR	DOWN - C(4)	<3.00	<0.20	<40.0	<5.00	<10.0	<10.0	<3000	<50.0	<20.0
909	DOWN - C(1)	2.8	<0.20	12.4	<5.00	<0.20	<7.10	NS	NS	NS
909	DOWN - C(3)	8.2	<0.20	<40.0	<5.00	<10.0	<10.0	<3000	<50.0	80.1

Sample collection period (rep) noted in parenthesis next to hydraulic position.
NR - Not reported. These results have not been reported because the data validation process indicated the data were not reliable.
NS - Not sampled

Table E - 11

Sampling Parameters at Early Warning Monitoring Wells (µg/L)

Location	Aluminum *Dissolved*	Antimony *Dissolved*	Arsenic *Dissolved*	Barium *Dissolved*	Beryllium *Dissolved*	Boron *Total*	Cadmium *Dissolved*
502 (Sand and Gravel Unit)	43	<35.0	<10.0	280.0	<1.0	36.0	<5.0

Location	Chromium *Dissolved*	Cobalt *Dissolved*	Copper *Dissolved*	Iron *Dissolved*	Lead *Dissolved*	Magnesium *Dissolved*	Manganese *Dissolved*
502 (Sand and Gravel Unit)	9.500	<50.0	3.0	110	<3.0	17,000	4.1

Location	Mercury *Dissolved*	Nickel *Dissolved*	Selenium *Dissolved*	Silver *Dissolved*	Thallium *Dissolved*	Tin *Dissolved*	Vanadium *Dissolved*
502 (Sand and Gravel Unit)	<0.10	13.0	<5.0	<10.0	<10.0	<3,000.0	<50.0

Location	**Hexachromium**		**Molybdenum**		**Titanium**		**Zinc**
	Total	*Dissolved*	*Total*	*Dissolved*	*Total*	*Dissolved*	*Dissolved*
502 (Sand and Gravel Unit)	8.800	<10.0	<15.0	18.0	<50.0	<50.0	<20.0

Location	Lead *Dissolved*
602 (Sand and Gravel Unit)	2.0

Note: These parameters were sampled in addition to routine monitoring parameters during the second quarter of 1996.

Table E - 12
Alpha- Beta- and Gamma-emitting Radioisotopic Results (µCi/mL)

Location Code	Hydraulic Position	C-14	I-129	Cs-137	Co-60	K-40
Sand and Gravel						
401	UP - A(3)	-1.19±1.08E-08	1.68±8.53E-10	0.00±1.75E-08	0.00±1.34E-08	0.00±2.29E-07
104	DOWN - C(3)	-0.31±1.06E-08	0.24±1.17E-09	0.00±1.70E-08	0.00±1.56E-08	0.00±1.98E-07
111	DOWN - C(3)	0.17±1.06E-08	5.38±1.97E-09	0.00±1.66E-08	0.00±1.65E-08	0.00±2.15E-07
406	DOWN - C(3)	0.09±1.12E-08	9.01±8.94E-10	0.00±1.40E-08	0.00±9.60E-09	0.00±2.19E-07
408	DOWN - C(3)	1.10±1.07E-08	0.00±1.27E-09	-0.65±3.45E-09	-0.38±1.90E-09	3.52±3.21E-08
502	DOWN - C(2)	NS	NS	0.00±2.19E-08	0.00±2.05E-08	0.87±1.03E-07
8605	DOWN - C(3)	1.50±1.10E-08	7.70±2.38E-09	0.00±1.39E-08	0.00±1.87E-08	0.00±1.94E-07
801	DOWN - D(3)	0.41±1.08E-08	0.08±9.82E-10	0.00±1.26E-08	0.00±1.34E-08	0.00±1.74E-07
8603	DOWN - D(2)	1.77±4.03E-09	1.66±1.69E-09	NS	NS	NS
Weathered Lavery Till						
NDATR	DOWN - C(1)	1.07±0.60E-08	4.28±2.87E-10	0.00±1.19E-08	0.00±1.32E-08	0.00±2.15E-07
NDATR	DOWN - C(3)	3.35±1.18E-08	8.22±8.60E-10	0.00±1.52E-08	0.00±1.52E-08	0.00±1.85E-07
909	DOWN - C(1)	1.04±0.60E-08	4.62±0.87E-09	0.00±1.34E-08	0.00±1.21E-08	0.00±2.10E-07

Location Code	Hydraulic Position	Ra-226	Ra-228	Sr-90	Tc-99	U-232
Sand and Gravel						
401	UP - A(3)	1.17±0.62E-09	-1.68±0.56E-09	3.98±2.04E-09	0.03±1.56E-09	2.53±5.23E-11
104	DOWN - C(3)	1.32±0.52E-09	2.54±0.14E-08	6.99±0.07E-06	7.82±1.82E-09	1.09±0.77E-10
111	DOWN - C(3)	9.32±3.61E-10	4.28±0.88E-09	2.49±0.04E-06	0.40±1.23E-09	1.80±0.22E-09
406	DOWN - C(3)	1.01±0.54E-09	-2.42±0.56E-09	8.81±2.70E-09	4.91±1.66E-09	1.64±1.26E-10
408	DOWN - C(3)	2.28±0.33E-08	4.22±9.00E-09	3.05±0.00E-04	1.46±0.11E-08	5.30±2.98E-11
501	DOWN - C(3)	NS	NS	6.66±0.02E-05	NS	NS
502	DOWN - C(2)	2.28±2.09E-10	NS	NS	NS	NS
502	DOWN - C(3)	NS	NS	7.17±0.03E-05	NS	NS
602	DOWN - C(1)	NS	NS	2.33±0.38E-08	NS	NS
602	DOWN - C(3)	NS	NS	2.22±0.38E-08	NS	NS
8605	DOWN - C(3)	6.58±3.13E-10	3.24±0.10E-08	1.05±0.01E-05	0.74±1.19E-09	6.24±0.53E-09
8609	DOWN - C(1)	NS	NS	1.88±0.10E-07	NS	NS
8609	DOWN - C(3)	NS	NS	1.72±0.09E-07	NS	NS
116	DOWN - D(1)	NS	NS	5.42±0.55E-08	NS	NS
116	DOWN - D(3)	NS	NS	7.25±0.69E-08	NS	NS
605	DOWN - D(1)	NS	NS	6.21±0.58E-08	NS	NS
605	DOWN - D(3)	NS	NS	1.80±0.36E-08	NS	NS
801	DOWN - D(1)	NS	NS	3.70±0.04E-06	NS	NS
801	DOWN - D(2)	NS	NS	3.04±0.04E-06	NS	NS
801	DOWN - D(3)	5.40±3.70E-10	8.54±0.80E-09	3.47±0.06E-06	1.52±0.20E-08	6.74±5.94E-11
801	DOWN - D(4)	NS	NS	3.69±0.04E-06	NS	NS
8603	DOWN - D(1)	NS	NS	3.85±0.14E-07	NS	NS
8603	DOWN - D(2)	1.24±2.68E-10	8.41±4.91E-10	6.27±0.18E-07	1.35±0.25E-08	4.28±4.17E-11
8603	DOWN - D(3)	NS	NS	7.80±0.27E-07	NS	NS
Weathered Lavery Till						
NDATR	DOWN - C(1)	4.97±1.78E-10	1.30±0.50E-09	3.31±0.42E-08	-0.62±1.38E-09	5.07±0.41E-11
NDATR	DOWN - C(3)	9.02±5.06E-10	-1.66±1.00E-09	3.97±0.46E-08	0.40±1.52E-09	5.15±9.08E-11
909	DOWN - C(1)	4.55±1.73E-10	2.20±0.50E-09	1.65±0.09E-07	0.02±1.39E-09	1.79±0.15E-11

NS - Not sampled

Table E - 12 *(concluded)*
Alpha- Beta- and Gamma-emitting Radioisotopic Results (µCi/mL)

Location Code	Hydraulic Position	U-233/234	U-235/236	U-238	Total U (µg/mL)
Sand and Gravel					
401	UP - A(3)	2.02±1.10E-10	3.37±4.88E-11	9.43±7.16E-11	2.62±0.07E-04
104	DOWN - C(3)	4.30±1.19E-10	4.68±4.79E-11	1.71±0.84E-10	4.14±0.10E-04
111	DOWN - C(3)	1.22±0.20E-09	1.02±0.68E-10	6.58±1.44E-10	2.78±0.18E-03
406	DOWN - C(3)	1.41±1.09E-10	2.47±6.47E-11	2.99±1.42E-10	6.32±0.80E-06
408	DOWN - C(3)	2.56±0.72E-10	5.14±3.20E-11	2.57±0.68E-10	5.88±0.08E-04
8605	DOWN - C(3)	3.52±0.31E-09	1.59±0.63E-10	2.26±0.23E-09	6.06±0.34E-03
801	DOWN - D(3)	2.94±0.93E-10	1.89±4.29E-11	2.40±0.85E-10	5.20±0.12E-04
8603	DOWN - D(2)	1.54±0.52E-10	1.42±1.68E-11	1.32±0.48E-10	0.00±2.28E-03
Weathered Lavery Till					
NDATR	DOWN - C(1)	1.05±0.16E-09	4.12±2.92E-11	8.11±1.39E-10	2.52±0.04E-03
NDATR	DOWN - C(3)	1.93±0.29E-09	1.19±0.79E-10	1.52±0.25E-09	4.58±0.07E-03
909	DOWN - C(1)	1.15±0.18E-09	6.16±3.77E-11	9.46±1.55E-10	3.30±0.11E-04

Table E - 13

1996 Radiological Concentrations (uCi/mL) at Well Points

Location Code	Gross Alpha	Gross Beta	H-3	Cs-137	Co-60	K-40
WP-A	-4.30±2.81E-09	9.75±0.98E-08	1.57±0.05E-05	0.00±1.45E-08	0.00±1.53E-08	0.00±1.92E-07
WP-C	-3.49±4.10E-09	5.34±1.10E-08	9.10±0.27E-05	0.00±1.50E-08	0.00±1.29E-08	0.00±1.78E-07
WP-D	-5.42±5.01E-09	3.27±0.07E-06	1.47±0.11E-06	0.00±1.33E-08	0.00±1.11E-08	0.00±2.21E-07
WP-E	-0.70±1.09E-08	3.98±0.03E-05	1.34±0.11E-06	0.00±1.79E-08	0.00±1.38E-08	0.00±2.10E-07
WP-F	7.86±3.60E-09	0.00±6.60E-07	2.54±1.30E-07	3.53±6.21E-09	2.25±5.12E-09	3.39±5.08E-08
WP-G	-6.06±4.48E-09	8.11±1.29E-08	2.58±0.14E-06	0.00±1.01E-08	0.00±7.83E-09	0.00±1.38E-07
WP-H	-2.43±8.25E-09	1.94±0.06E-06	1.19±0.04E-05	0.00±1.54E-08	0.00±1.87E-08	0.00±1.72E-07

NS - Not sampled

Table E - 14

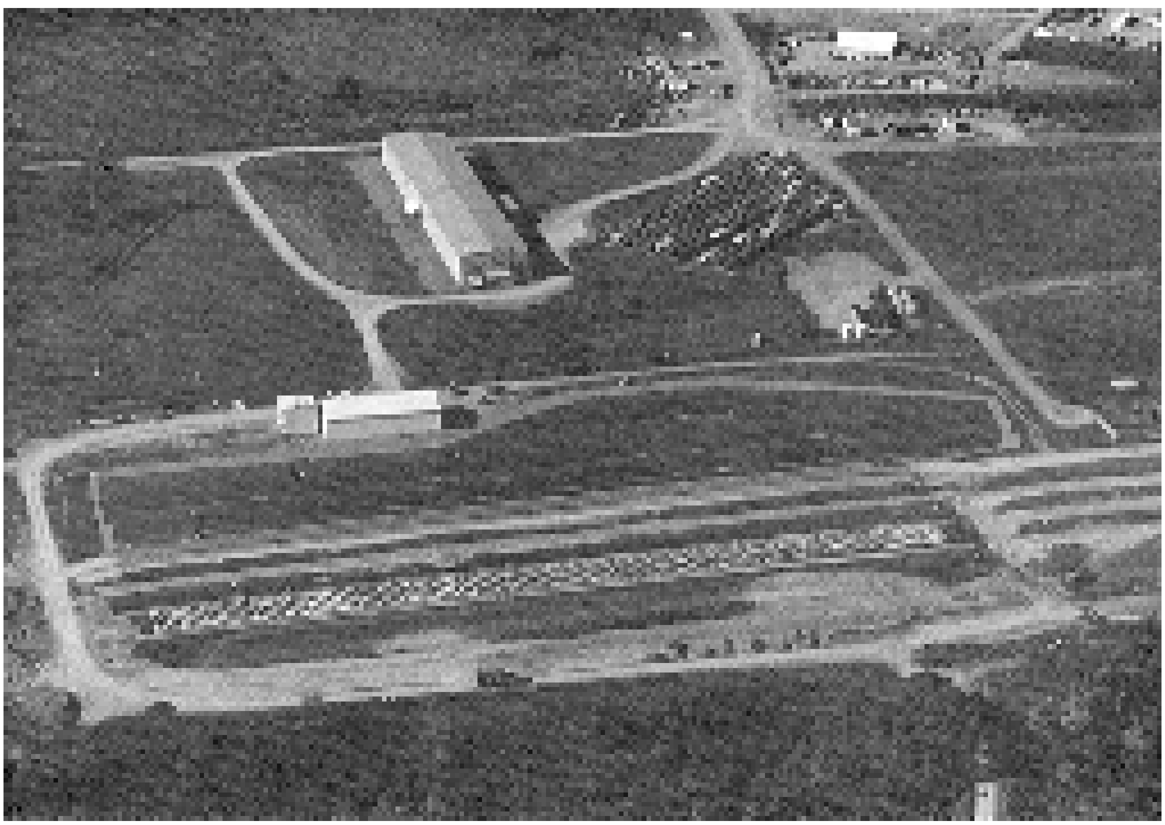
1996 Contamination Indicator and Radiological Indicator Results at North Plateau Seeps

Location Code	Date Collected	pH	Conductivity *µmhos/cm@25°C*	Gross Alpha *µCi/mL*	Gross Beta *µCi/mL*	H-3 *µCi/mL*
SP02	12/05/95	NS	NS	5.54±0.77E-08	5.25±0.61E-08	9.43±0.95E-07
SP02	01/19/96	NS	NS	1.98±1.33E-09	NS	NS
SP02	03/18/96	NS	NS	2.24±1.51E-09	8.64±3.61E-09	7.77±0.90E-07
SP02	06/14/96	NS	NS	0.28±2.27E-09	7.74±2.96E-09	8.57±0.91E-07
SP02	09/16/96	NS	NS	-0.09±1.87E-09	8.13±2.78E-09	1.02±0.10E-06
SP04	12/05/95	NS	NS	2.20±1.32E-09	8.17±2.57E-09	5.03±0.75E-07
SP04	03/18/96	NS	NS	2.18±1.75E-09	5.56±4.02E-09	3.08±0.85E-07
SP04	06/14/96	NS	NS	0.12±1.79E-09	3.62±2.65E-09	3.14±0.85E-07
SP04	09/16/96	NS	NS	0.68±1.84E-09	1.18±0.35E-08	5.06±0.89E-07
SP05	12/05/95	NS	NS	2.17±0.67E-08	3.76±0.86E-08	2.29±0.85E-07
SP05	03/18/96	NS	NS	1.30±1.38E-09	7.99±4.09E-09	1.44±0.83E-07
SP05	06/14/96	NS	NS	0.58±1.53E-09	3.60±2.12E-09	2.14±0.84E-07
SP05	09/16/96	NS	NS	0.70±1.79E-09	9.53±2.84E-09	4.53±0.76E-07
SP06	12/05/95	NS	NS	1.56±0.50E-08	2.66±0.78E-08	7.94±8.36E-08
SP06	03/19/96	NS	NS	0.78±1.07E-09	7.21±4.00E-09	-0.36±8.10E-08
SP06	06/14/96	NS	NS	-0.76±1.09E-09	-0.17±1.46E-09	8.18±8.26E-08
SP06	09/16/96	NS	NS	-0.78±1.16E-09	5.73±1.74E-09	3.09±0.86E-07
SP11	06/14/96	NS	NS	-1.16±2.25E-09	2.52±4.37E-09	6.50±8.24E-08
SP11	09/16/96	NS	NS	0.15±1.79E-09	1.01±0.29E-08	2.26±0.84E-07
SP12	12/05/95	NS	NS	1.74±0.54E-08	2.56±0.78E-08	9.68±0.94E-07
SP12	03/19/96	NS	NS	9.27±3.79E-09	6.23±4.24E-09	9.05±0.82E-07
SP12	06/14/96	NS	NS	2.35±4.18E-09	8.99±4.84E-09	1.04±0.10E-06
SP12	09/16/96	7.24	1143	-0.22±1.94E-09	1.18±0.36E-08	1.00±0.10E-06
SP12	11/05/96	7.13	1128	2.88±2.32E-09	-0.75±3.89E-09	1.19±0.11E-06
SP18	12/05/95	NS	NS	8.85±5.51E-10	4.17±1.93E-09	0.00±1.00E-07
SP18	03/19/96	NS	NS	1.15±0.72E-09	1.70±3.15E-09	-1.31±0.81E-07
SP18	06/14/96	NS	NS	1.02±0.56E-09	6.51±1.64E-09	-6.57±0.96E-07

NS - Not sampled

Appendix F

Summary of NYSERDA Groundwater Monitoring Data



An Arial View of the New York State-licensed Disposal Area

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Table F - 1

1996 Contamination Indicator Results at SDA Monitoring Wells

Sample Location	**Date**	**Conductivity** (µmhos/cm@25°C)	**pH** (standard units)	**Temperature** (°C)	**Turbidity** (NTU)
1101A	06/05/96	573	6.03	9.9	4.57
1101A	12/06/96	536	7.47	10.0	3.21
1101B	06/05/96	723	6.61	10.3	2.08
1101B	12/06/96	607	7.51	9.0	3.92
1101C	06/05/96	419	6.77	11.8	1000.00
1101C	12/06/96	345	7.74	9.0	252.00
1102A	06/06/96	798	6.80	10.8	2.89
1102A	12/06/96	649	6.78	9.0	8.19
1102B	06/06/96	655	5.85	12.2	98.80
1102B	12/06/96	506	7.32	8.9	20.30
1103A	06/05/96	912	6.04	8.9	5.33
1103A	12/05/96	837	7.30	8.5	51.80
1103B	06/04/96	618	6.13	10.2	31.60
1103B	12/05/96	637	7.50	7.6	7.14
1103C	12/04/96	623	7.47	5.4	520.00
1104A	06/05/96	645	6.94	13.9	1.17
1104A	12/04/96	566	7.45	10.7	3.01
1104B	06/05/96	602	6.53	10.8	2.10
1104B	12/04/96	572	7.08	10.1	2.72
1104C	12/03/96	1405	6.90	10.8	69.00
1105A	06/07/96	869	6.61	10.1	1000.00
1105A	12/05/96	687	7.34	9.2	35.40
1105B	06/07/96	968	6.59	10.0	135.00
1105B	12/05/96	771	7.31	8.4	88.40
1106A	12/03/96	677	7.06	11.2	80.10
1106B	12/03/96	736	6.95	10.2	448.00
1107A	06/06/96	1861	5.96	12.5	3.95
1107A	12/03/96	1575	6.47	10.9	3.06

Table F - 1 *(concluded)*

1996 Contamination Indicator Results at SDA Monitoring Wells

Sample Location	Date	Conductivity (µmhos/cm@25°C)	pH (standard units)	Temperature (°C)	Turbidity (NTU)
1108A	06/04/96	997	7.20	11.9	237.00
1108A	12/04/96	931	7.24	9.7	48.90
1109A	12/03/96	607	7.17	11.1	4.70
1109B	12/03/96	315	7.37	10.9	15.60
1110A	12/04/96	996	7.92	10.2	75.40
1111A	06/06/96	576	5.55	10.3	36.80
1111A	12/05/96	861	7.07	10.1	11.90

Table F - 2

1996 Radiological Indicator Results at SDA Monitoring Wells (µCi/mL)

Sample Location	Date	Gross Alpha	Gross Beta	H-3	C-14
1101A	06/05/96	2.60±1.80E-09	3.10±1.50E-09	1.85±0.97E-07	0.90±5.80E-08
1101A	12/06/96	3.70±2.90E-09	0.40±2.10E-09	2.00±0.69E-07	NA
1101B	06/05/96	5.40±2.50E-09	3.80±1.70E-09	6.40±9.20E-08	3.20±5.90E-08
1101B	12/06/96	6.00±3.30E-09	3.00±2.20E-09	9.10±6.20E-08	NA
1101C	06/05/96	0.30±1.60E-09	2.40±1.40E-09	-0.20±8.90E-08	2.90±5.90E-08
1101C	12/06/96	1.80±1.90E-09	2.70±1.60E-09	1.05±0.63E-07	NA
1102A	06/06/96	4.10±2.70E-09	2.30±1.60E-09	4.50±1.10E-07	NA
1102A	12/06/96	5.80±3.40E-09	1.80±2.30E-09	3.47±0.81E-07	-3.60±3.70E-09
1102B	06/06/96	1.30±1.50E-09	2.50±1.40E-09	5.40±9.20E-08	-7.12±0.36E-09
1102B	12/06/96	1.10±2.10E-09	0.80±1.70E-09	4.50±6.20E-08	-1.20±3.90E-09
1103A	06/05/96	7.50±3.50E-09	3.10±2.20E-09	5.30±1.10E-07	4.00±5.90E-08
1103A	12/05/96	7.80±4.70E-09	7.50±3.70E-09	6.42±0.98E-07	NA
1103B	06/04/96	3.00±1.90E-09	1.60±1.50E-09	6.80±9.30E-08	0.60±5.90E-08
1103B	12/05/96	2.20±3.00E-09	3.30±2.30E-09	1.55±0.70E-07	NA
1103C	06/03/96	NA	NA	1.32±0.94E-07	2.80±5.90E-08
1103C	12/04/96	1.60±3.20E-09	1.51±0.41E-08	-0.40±5.50E-08	NA
1104A	06/05/96	2.50±1.70E-09	2.20±1.40E-09	2.71±1.00E-07	1.90±5.90E-08
1104A	12/04/96	3.50±3.00E-09	7.60±1.70E-09	2.90±0.74E-07	NA
1104B	06/05/96	1.00±2.00E-09	1.30±1.40E-09	6.40±9.20E-08	1.30±5.80E-08
1104B	12/04/96	2.60±2.80E-09	2.60±2.40E-09	4.00±6.10E-08	NA
1104C	06/04/96	0.90±1.20E-08	2.11±1.00E-08	1.03±0.94E-07	5.20±6.00E-08
1104C	12/04/96	1.10±1.40E-08	0.90±1.10E-08	2.40±5.7E-08	0.60±4.10E-09
1105A	06/07/96	6.00±2.80E-09	3.30±2.00E-09	1.55±0.96E-07	2.40±5.90E-08
1105A	12/05/96	7.40±3.60E-09	4.10±2.30E-09	9.90±6.60E-08	NA
1105B	06/07/96	3.80±3.00E-09	3.20±2.20E-09	9.00±5.60E-08	2.40±5.90E-08
1105B	12/05/96	6.90±4.20E-09	4.20±3.10E-09	1.50±5.80E-08	NA
1106A	06/06/96	2.70±2.70E-09	3.80±2.40E-09	9.80±1.30E-07	NA
1106A	12/03/96	5.40±3.70E-09	5.90±2.90E-09	1.05±0.12E-06	-0.30±4.00E-09
1106B	06/06/96	1.80±3.10E-09	2.30±2.50E-09	1.20±0.95E-07	NA
1106B	12/03/96	-1.20±2.30E-09	4.00±2.70E-09	3.80±5.90E-08	-0.10±4.20E-09
1107A	06/06/96	2.70±5.60E-09	1.80±0.54E-08	1.87±0.08E-05	2.30±5.90E-08
1107A	12/03/96	4.10±7.70E-09	2.01±0.76E-08	1.83±0.12E-05	NA

NA - Not available.

Table F - 2 (concluded)

1996 Radiological Indicator Results at SDA Monitoring Wells (µCi/mL)

Sample Location	Date	Gross Alpha	Gross Beta	H-3	Carbon-14
1108A	06/04/96	8.20±4.50E-09	5.90±2.80E-09	2.32±0.99E-07	1.70±5.90E-08
1108A	12/04/96	6.20±4.70E-09	7.20±3.60E-09	1.97±0.70E-07	NA
1109A	09/04/96	4.70±3.50E-09	3.20±2.30E-09	6.01±0.91E-07	-2.30±5.40E-09
1109A	12/03/96	5.30±3.30E-09	5.40±2.60E-09	4.76±0.88E-07	NA
1109B	06/07/96	0.10±1.20E-09	1.00±1.30E-09	8.15±1.00E-07	3.10±5.90E-08
1109B	12/03/96	-0.70±1.10E-09	1.80±2.00E-09	6.92±0.99E-07	NA
1110A	06/04/96	1.41±0.65E-08	5.20±3.80E-09	1.60±0.95E-07	3.30±5.90E-08
1110A	12/04/96	1.40±0.68E-08	7.40±4.20E-09	1.31±0.66E-07	NA
1111A	06/06/96	7.70±3.40E-09	3.30±2.30E-09	3.12±1.00E-07	-5.80±0.29E-09
1111A	12/05/96	4.90±4.30E-09	4.20±3.40E-09	2.05±0.72E-07	-2.30±4.30E-09

NA - Not available.

Table F - 3

1996 Radioisotopic Results at SDA Monitoring Wells (µCi/mL)

Sample Location	Date	Actinium-228	Bismuth-214	Cs-134	Cs-137
1101A	06/05/96	-0.30±1.80E-08	4.20±1.90E-08	4.70±8.50E-09	2.80±8.50E-09
1101B	06/05/96	1.20±2.10E-08	1.40±1.40E-08	1.20±3.50E-09	-1.30±5.00E-09
1101C	06/05/96	0.600±2.50E-08	0.20±1.50E-08	-2.60±3.10E-09	-2.00±3.10E-09
1102A	06/06/96	-0.20±1.30E-08	2.10±1.70E-08	1.80±4.00E-09	-5.60±5.80E-09
1102B	06/06/96	1.80±2.50E-08	1.20±1.50E-08	-4.10±2.70E-09	1.60±5.60E-09
1103A	06/05/96	-0.40±5.40E-08	-2.20±4.60E-08	-0.90±1.20E-08	1.30±1.90E-08
1103B	06/04/96	2.30±2.50E-08	2.30±1.70E-08	3.50±3.80E-09	1.00±5.50E-09
1104A	06/05/96	-1.50±1.70E-08	0.50±1.40E-08	-1.50±3.70E-09	2.10±5.40E-09
1104B	06/05/96	-1.60±3.90E-08	-0.70±2.70E-08	-2.00±4.80E-09	2.80±9.00E-09
1104C	06/04/96	3.00±7.00E-08	4.90±4.80E-08	-2.90±8.10E-09	-1.00±1.50E-08
1105A	06/07/96	-0.90±1.20E-08	1.50±1.60E-08	-1.70±2.60E-09	1.60±8.00E-09
1105B	06/07/96	1.40±2.60E-08	2.90±1.80E-08	-0.30±4.10E-09	0.50±5.80E-09
1106A	06/06/96	0.41±1.00E-08	1.80±6.60E-09	-0.70±1.20E-09	0.20±.2.20E-09
1106B	06/06/96	-1.90±1.70E-08	1.30±1.60E-08	-1.90±3.60E-09	2.80±8.20E-09
1107A	06/06/96	1.20±9.20E-09	1.94±0.82E-08	-1.44±0.96E-09	1.70±2.10E-09
1108A	06/04/96	-1.00±1.70E-08	-0.10±1.50E-08	1.60±3.90E-09	-5.50±3.30E-09
1109A	09/04/96	-2.90±1.80E-08	1.40±1.50E-08	-3.20±3.00E-09	1.60±5.90E-09
1109B	06/07/96	4.80±9.10E-09	1.49±0.760E-08	-1.70±1.40E-09	-1.20±2.50E-09
1110A	06/04/96	-2.90±9.70E-09	5.60±7.30E-09	-4.10±6.80E-10	0.40±1.90E-09
1111A	06/06/96	2.70±8.70E-09	5.70±7.00E-09	-6.80±6.70E-10	1.40±2.10E-09

Table F - 3 (continued)

1996 Radioisotopic Results at SDA Monitoring Wells (µCi/mL)

Sample Location	Date	Co-57	Co-60	Pb-212	Pb-214
1101A	06/05/96	-0.80±1.50E-09	-1.10±3.10E-09	0.10±1.10E-08	2.70±1.40E-08
1101B	06/05/96	-0.70±2.50E-09	-2.80±2.90E-09	5.80±9.90E-09	1.50±1.20E-08
1101C	06/05/96	0.50±3.60E-09	-2.40±4.90E-09	-0.08±1.00E-08	0.20±1.30E-08
1102A	06/06/96	0.50±2.50E-09	1.40±5.20E-09	0.70±1.10E-08	0.30±1.30E-08
1102B	06/06/96	0.40±2.50E-09	3.00±5.70E-09	0.80±1.10E-08	0.40±1.20E-08
1103A	06/05/96	6.70±8.00E-09	-1.54±0.81E-08	-0.60±3.70E-08	2.80±4.00E-08
1103B	06/04/96	-2.20±2.50E-09	0.50±5.60E-09	0.20±1.10E-08	1.90±1.40E-08
1104A	06/05/96	-0.40±2.60E-09	-3.80±1.80E-09	0. 90±1.10E-08	0.50±1.30E-08
1104B	06/05/96	1.50±6.80E-09	-5.10±3.00E-09	1.50±2.70E-08	-1.50±2.60E-08
1104C	06/04/96	0.40±1.10E-08	0.30±1.50E-08	-0.20±3.80E-08	2.70±4.00E-08
1105A	06/07/96	-1.50±1.60E-09	1.80±4.20E-09	0.60±1.10E-08	0.90±1.30E-08
1105B	06/07/96	0.30±2.60E-09	-2.30±2.90E-09	1.30±1.10E-08	2.80±1.40E-08
1106A	06/06/96	0.30±1.90E-09	0.90±1.80E-09	4.40±6.10E-09	4.50±6.10E-09
1106B	06/06/96	-0.30±1.40E-09	-2.40±2.70E-09	0.10±1.10E-08	-0.10±1.20E-08
1107A	06/06/96	0. 90±1.90E-09	0.30±1.90E-09	5.80±6.20E-09	1.31±0.68E-08
1108A	06/04/96	1.50±3.70E-09	-3.50±2.70E-09	0.20±1.10E-08	0.10±1.20E-08
1109A	09/04/96	-1.90±1.60E-09	0.00±2.70E-09	0.30±1.10E-08	-0.10±1.30E-08
1109B	06/07/96	-1.20±1.90E-09	-1.10±1.40E-09	2.80±6.10E-09	1.50±0.670E-08
1110A	06/04/96	1.50±1.90E-09	-2.10±1.30E-09	7.60±6.50E-09	-0.90±6.00E-09
1111A	06/06/96	1.90±1.90E-09	-0.20±2.30E-09	2.40±6.00E-09	2.70±6.10E-09

NA - Not available.

Table F - 3 *(concluded)*

1996 Radioisotopic Results at SDA Monitoring Wells (µCi/mL)

Sample Location	Date	I-129	Th-234	U-235
1101A	06/05/96	0.50±1.40E-09	-0.30±1.30E-07	-0.70±3.10E-08
1101B	06/05/96	0.30±1.10E-09	-0.30±1.20E-07	1.20±2.70E-08
1101C	06/05/96	0.80±2.30E-09	-2.60±7.90E-08	-1.30±2.20E-08
1102A	06/06/96	0.80±1.70E-09	-1.30±8.30E-08	2.20±3.00E-08
1102B	06/06/96	0.50±1.20E-09	1.00±8.00E-08	-0.10±3.00E-08
1103A	06/05/96	0.70±1.50E-09	0.50±4.10E-07	-3.20±9.40E-08
1103B	06/04/96	0.40±1.30E-09	-0.60±8.10E-08	0.90±2.90E-08
1104A	06/05/96	0.00±1.10E-09	0.20±1.40E-07	1.10±2.80E-08
1104B	06/05/96	1.50±3.30E-09	1.0±2.20E-07	-3.90±5.10E-08
1104C	06/04/96	NA	-0.20±3.10E-07	0.80±1.10E-07
1105A	06/07/96	0.20±1.30E-09	0.60±8.00E-08	0.70±3.00E-08
1105B	06/07/96	0.60±1.30E-09	3.00±8.20E-08	-2.20±2.30E-08
1106A	06/06/96	3.20±9.20E-10	0.00±6.10E-08	-0.40±1.80E-08
1106B	06/06/96	1.50±1.40E-09	-0.40±1.30E-07	-0.20±3.00E-08
1107A	06/06/96	0.60±1.60E-09	0.90±6.20E-08	-1.10±1.50E-08
1108A	06/04/96	0.30±1.20E-09	-4.20±7.90E-08	-1.20±2.20E-08
1109A	09/04/96	0.90±7.30E-09	4.00±8.20E-08	-0.20±2.90E-08
1109B	06/07/96	0.40±1.20E-09	0.80±6.30E-08	0.50±1.90E-08
1110A	06/04/96	0.40±1.50E-09	5.70±6.00E-08	1.10±1.80E-08
1111A	06/06/96	1.90±4.60E-09	1.50±6.10E-08	0.10±1.80E-08

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Glossary

ACCURACY. The degree of agreement between a measurement and its true value. The accuracy of a data set is assessed by evaluating results from standards or spikes containing known quantities of an analyte.

ACTION PLAN. An action plan addresses assessment findings and root causes that have been identified in an audit or an assessment report. It is intended to set forth specific actions that the site will undertake to remedy deficiencies. The plan includes a timetable and funding requirements for implementation of the planned activities.

ALLUVIAL FAN. A cone-shaped deposit of alluvium made by a stream where it runs out onto a level plain.

ALLUVIUM. Sedimentary material deposited by flowing water such as a river.

ANION. A negatively charged ion that migrates to an anode during electrolysis.

AQUIFER. A water-bearing unit of permeable rock or soil that will yield water in usable quantities to wells. *Confined aquifers* are bounded above and below by less permeable layers. Groundwater in a confined aquifer is under a pressure greater than the atmospheric pressure. *Unconfined aquifers* are bounded below by less permeable material but are not bounded above. The pressure on the groundwater in an unconfined aquifer at the top of the aquifer is equal to that of the atmosphere.

AS LOW AS REASONABLY ACHIEVABLE (ALARA). Describes an approach to radiation protection in order to control or manage exposures (both individual and collective) to the work force and the general public and releases of radioactive material to the environment as low as social, technical, economic, practical, and public policy considerations permit. As used in DOE Order 5400.5, ALARA is not a dose limit but, rather, a process that has as its objective the attainment of dose levels as far below the applicable limits of the Order as practicable.

BACKGROUND RADIATION. Includes both natural and manmade radiation such as cosmic radiation and radiation from naturally radioactive elements and from commercial sources and medical procedures.

BECQUEREL (Bq). A unit of radioactivity equal to one nuclear transformation per second.

CATEGORICAL EXCLUSION. A proposed action that normally does not require an ENVIRONMENTAL ASSESSMENT or an ENVIRONMENTAL IMPACT STATEMENT and that the Department of Energy has determined does not individually or cumulatively have a significant effect on the human environment. See 10 CFR 1021.410.

CATION. A positively charged ion that moves toward a negative electrode during electrolysis.

CLASS A, B, AND C LOW-LEVEL WASTE. Waste classifications from the Nuclear Regulatory Commission's 10 CFR Part 61 rule. Maximum concentration limits are set for specific isotopes. Class A waste disposal is minimally restricted with respect to the form of the waste. Class B waste must meet more rigorous requirements to ensure physical stability after disposal. Greater concentration limits are set for the same isotopes in Class C waste, which also must meet physical stability requirements. Moreover, special measures must be taken at the disposal facility to protect against inadvertent intrusion.

COMPLIANCE FINDINGS. Conditions that may not satisfy applicable environmental or safety and health regulations, DOE Orders and memoranda, enforcement actions, agreements with regulatory agencies, or permit conditions.

CONFIDENCE COEFFICIENT OR FACTOR. The chance or probability, usually expressed as a percentage, that a confidence interval includes some defined parameter of a population. The confidence coefficients usually associated with confidence intervals are 90%, 95%, and 99%.

CONSISTENCY. The condition of showing steady conformity to practices. In the environmental monitoring program, approved procedures are in place in order to ensure that data collection activities are carried out in a consistent manner so that variability is minimized.

COSMIC RADIATION. High-energy subatomic particles from outer space that bombard the earth's atmosphere. Cosmic radiation is part of natural background radiation.

COUNTING ERROR. The variability caused by the inherent random nature of radioactive disintegration and the detection process.

CURIE (Ci). A unit of radioactivity equal to 37 billion (3.7×10^{10}) nuclear transformations per second.

DECAY (RADIOACTIVE). Disintegration of the nucleus of an unstable nuclide by spontaneous emission of charged particles and/or photons or by spontaneous fission.

DERIVED CONCENTRATION GUIDE (DCG). Concentrations of radionuclides in air and water by which a person continuously exposed and inhaling 8,400 cubic meters of air or ingesting 730 liters of water per year would receive an annual effective dose equivalent of 100 mrem per year from either mode of exposure. The committed dose equivalent is included in the DCGs for radionuclides with long half-lives. (See Appendix B.)

DETECTION LIMIT OR LEVEL. The smallest amount of a substance that can be distinguished in a sample by a given measurement procedure at a given confidence level.

DISPERSION (GROUNDWATER). The process whereby solutes are spread or mixed as they are transported by groundwater as it moves through sediments.

DOSIMETER. A portable device for measuring the total accumulated exposure to ionizing radiation.

DOWNGRADIENT. The direction of water flow from a reference point to a selected point of interest. (See **GRADIENT.**)

EFFECTIVE DOSE. See EFFECTIVE DOSE EQUIVALENT under RADIATION DOSE.

EFFLUENT. Any treated or untreated air emission or liquid discharge, including storm water runoff, at a DOE site or facility.

EFFLUENT MONITORING. Sampling or measuring specific liquid or gaseous effluent streams for the presence of pollutants.

ENVIRONMENTAL ASSESSMENT. An evaluation that provides sufficient evidence and analysis for determining whether to prepare an environmental impact statement or a finding of no significant impact. See 40 CFR 1508.9.

ENVIRONMENTAL IMPACT STATEMENT. A detailed statement that includes the environmental impact of the proposed action, any adverse environmental effects that cannot be avoided should the proposal be implemented, and alternatives to the proposed action. See Section 102 (2) (C) of the National Environmental Policy Act.

ENVIRONMENTAL MONITORING. The collection and analysis of samples or the direct measurements of environmental media. Environmental monitoring consists of two major activities: effluent monitoring and environmental surveillance.

ENVIRONMENTAL SURVEILLANCE. The collection and analysis of samples or the direct measurement of air, water, soil, foodstuff, and biota in order to determine compliance with applicable standards and permit requirements.

ERG. One-billionth (1E-09) of the energy released by a 100-watt bulb in 1 second.

EXPOSURE. The subjection of a target (usually living tissue) to radiation.

FALLOUT. Radioactive materials mixed into the earth's atmosphere. Fallout constantly precipitates onto the earth.

FINDING. A Department of Energy compliance term. A finding is a statement of fact concerning a condition in the Environmental, Safety, and Health program that was investigated during an appraisal. Findings include best management practice findings, compliance findings, and noteworthy practices. A finding may be a simple statement of proficiency or a description of deficiency (i.e., a variance from procedures or criteria). See also SELF-ASSESSMENT.

GAMMA ISOTOPIC (also **GAMMA SCAN**). An analytical method by which the quantity of several gamma ray-emitting radioactive isotopes may be determined simultaneously. Typical nuclear fuel cycle isotopes determined by this method include but are not limited to Co-60, Zr-95, Ru-106, Ag-110m, Sb-125, Cs-134, Cs-137, and Eu-154. Naturally occurring isotopes that are often requested include Be-7, K-40, Ra-224, and Ra-226.

GRADIENT. Change in value of one variable with respect to another variable, especially vertical or horizontal distance.

GRAY. A unit of absorbed dose.

GROUNDWATER. Subsurface water in the pore spaces of soil and geologic units.

HALF-LIFE. The time in which half the atoms of a radionuclide disintegrate into another nuclear form. The half-life may vary from a fraction of a second to thousands of years.

HIGH-LEVEL WASTE (HLW). The highly radioactive waste material that results from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing and any solid waste derived from the liquid, that contains a combination of transuranic waste and fission products in concentrations sufficient to require permanent isolation. (See also TRANSURANIC WASTE.)

HYDRAULIC CONDUCTIVITY. The ratio of flow velocity to driving force for viscous flow under saturated conditions of a specified liquid in a porous medium; the ratio describing the rate at which water can move through a permeable medium.

INTERIM STATUS. Any facility in existence on the effective date of statutory or regulatory amendments under RCRA that render the facility subject to the requirement to have a RCRA permit shall have interim status and shall be treated as having been issued a permit (Title 6 New York Code of Rules and Regulations [**NYCRR**] Part 373.

INTERSTITIAL LEAK DETECTION SYSTEM. The (annular) space between the inner and outer tank walls in a double-walled storage tank.

ION. An atom or group of atoms with an electric charge.

ION EXCHANGE. The reversible exchange of ions contained in solution with other ions that are part of the ion-exchange material.

ISOTOPE. Different forms of the same chemical element that are distinguished by having the same number of protons but a different number of neutrons in the nucleus. An element can have many isotopes. For example, the three isotopes of hydrogen are protium, deuterium, and tritium, with one, two, and three neutrons in the nucleus, respectively.

KAME DELTA. A conical hill or short irregular ridge of gravel or sand deposited in contact with glacier ice.

LACUSTRINE SEDIMENTS. A sedimentary deposit consisting of material pertaining to, produced by, or formed in a lake or lakes.

LAND DISPOSAL RESTRICTIONS (LDR). Regulations promulgated by the U.S. EPA (and by NYSDEC in New York State) governing the land disposal of hazardous wastes. The wastes must be treated using the best demonstrated available technology or must meet certain treatment standards before being disposed.

LEACHED HULLS. Stainless steel cladding that remains after acid dissolution of spent fuel.

LOWER LIMIT OF DETECTION (LLD). The lowest limit an instrument is capable of detecting. A measurement of analytical sensitivity.

LOW-LEVEL WASTE (LLW). Radioactive waste not classified as high-level waste, transuranic waste, spent fuel, or uranium mill tailings. (See CLASS A, B, AND C LOW-LEVEL WASTE.)

MAXIMALLY EXPOSED INDIVIDUAL. A hypothetical person who remains in an uncontrolled area who would, when all potential routes of exposure from a facility's operations are considered, receive the greatest possible dose equivalent.

MEAN. The average value of a series of measurements.

MILLIREM (MREM). A unit of radiation dose equivalent that is equal to one one-thousandth of a rem. An individual member of the public can receive up to 500 millirems per year according to DOE standards. This limit does not include radiation received for medical treatment or the 100 to 360 mrem that people receive annually from background radiation.

MINIMUM DETECTABLE CONCENTRATION (MDC). Depending on the sample medium, the smallest amount or concentration of a radioactive or nonradioactive analyte that can be reliably detected using a specific analytical method. Calculations of the minimum detectable concentrations are based on the lower limit of detection.

MIXED WASTE. A waste that is both radioactive and hazardous. Also referred to as RADIOACTIVE MIXED WASTE (RMW).

N-DODECANE/TRIBUTYL PHOSPHATE. An organic solution composed of 30% tributyl phosphate (TBP) dissolved in n-dodecane used to separate the uranium and plutonium from the fission products in the dissolved fuel and to separate the uranium from the plutonium.

NEUTRON. An electrically neutral subatomic particle in the baryon family with a mass 1,839 times that of an electron, stable when bound in an atomic nucleus, and having a mean lifetime of approximately 16.6 minutes as a free particle.

NOTICE OF VIOLATION. A letter of notice from a regional water engineer in response to an instance of significant noncompliance with a SPDES permit. Generally, an official notification from a regulatory agency of noncompliance with permit requirements.

NUCLEUS. The positively charged central region of an atom, made up of protons and neutrons and containing almost all of the mass of the atom.

OUTFALL. The end of a drain or pipe that carries wastewater or other effluents into a ditch, pond, or river.

PARAMETER. Any of a set of physical properties whose values determine the characteristics or behavior of something (e.g., temperature, pressure, density of air). In relation to environmental monitoring, a monitoring parameter is a constituent of interest. Statistically, the term "parameter" is a calculated quantity, such as a mean or variance, that describes a statistical population.

PARTICULATES. Solid particles and liquid droplets small enough to become airborne.

PERSON-REM. The sum of the individual radiation dose equivalents received by members of a certain group or population. It may be calculated by multiplying the average dose per person by the number of persons exposed. For example, a thousand people each exposed to one millirem would have a collective dose of one person-rem.

PLUME. The distribution of a pollutant in air or water after being released from a source.

PRECISION. The degree of reproducibility of a measurement under a given set of conditions. Precision in a data set is assessed by evaluating results from duplicate field or analytical samples.

PROGLACIAL LAKE. A lake occupying a basin in front of a glacier; generally in direct contact with the ice.

PROTON. A stable, positively charged subatomic particle in the bayron family with a mass of 1,836 times that of an electron.

QUALITY FACTOR. The extent of tissue damage caused by different types of radiation of the same energy. The greater the damage, the higher the quality factor. More specifically, the factor by which absorbed doses are multiplied to obtain a quantity that indicates the degree of biological damage produced by ionizing radiation. (See RADIATION DOSE.) The factor is dependent upon radiation type (alpha, beta, gamma, or x-ray) and exposure (internal or external).

RAD. Radiation absorbed dose. One hundred ergs of energy absorbed per gram.

RADIATION. The process of emitting energy in the form of rays or particles that are thrown off by disintegrating atoms. The rays or particles emitted may consist of alpha, beta, or gamma radiation.

ALPHA RADIATION. The least penetrating type of radiation. Alpha radiation can be stopped by a sheet of paper or outer dead layer of skin.

BETA RADIATION. Electrons emitted from a nucleus during fission and nuclear decay. Beta radiation can be stopped by an inch of wood or a thin sheet of aluminum.

GAMMA RADIATION. A form of electromagnetic, high-energy radiation emitted from a nucleus. Gamma rays are essentially the same as x-rays and require heavy shielding such as lead, concrete, or steel to be stopped.

INTERNAL RADIATION. Radiation originating from a source within the body as a result of the inhalation, ingestion, or implantation of natural or manmade radionuclides in body tissues.

RADIATION DOSE:

ABSORBED DOSE. The amount of energy absorbed per unit mass in any kind of matter from any kind of ionizing radiation. Absorbed dose is measured in rads or grays.

COLLECTIVE DOSE EQUIVALENT. The sum of the dose equivalents for all the individuals comprising a defined population. The per capita dose equivalent is the quotient of the collective dose equivalent divided by the population. The unit of collective dose equivalent is person-rem or person-sievert.

COLLECTIVE EFFECTIVE DOSE EQUIVALENT. The sum of the effective dose equivalents for the individuals comprising a defined population. Units of measurement are person-rems or person-sieverts. The per capita effective dose equivalent is obtained by dividing the collective dose equivalent by the population. Units of measurement are rems or sieverts.

COMMITTED DOSE EQUIVALENT. A measure of internal radiation. The predicted total dose equivalent to a tissue or organ over a fifty-year period after a known intake of a radionuclide into the body. It does not include contributions from sources of external penetrating radiation. Committed dose equivalent is measured in rems or sieverts.

COMMITTED EFFECTIVE DOSE EQUIVALENT. The sum of the committed dose equivalents to various tissues in the body, each multiplied by the appropriate weighting factor. Committed effective dose equivalent is measured in rems or sieverts.

RADIOACTIVITY. A property possessed by some elements such as uranium whereby alpha, beta, or gamma rays are spontaneously emitted.

RADIOISOTOPE. A radioactive isotope of a specified element. Carbon-14 is a radioisotope of carbon. Tritium is a radioisotope of hydrogen. (See ISOTOPE.)

RADIONUCLIDE. A radioactive nuclide. Radionuclides are variations (isotopes) of elements. They have the same number of protons and electrons but different numbers of neutrons, resulting in different atomic masses. There are several hundred known nuclides, both manmade and naturally occurring.

REM. An acronym for Roentgen Equivalent Man. A unit of radiation exposure that indicates the potential effect of radiation on human cells.

SELF-ASSESSMENT. Self-assessments are appraisals conducted by the WVDP to identify and correct any existing deficiencies in the environmental monitoring program. Under the WVDP environmental monitoring procedure *Self-Assessments for Environmental Programs*, information obtained from an appraisal is categorized as follows:

> **KEY FINDING**. A direct and significant violation of a Department of Energy regulatory or other applicable guidance or procedural requirement, or a recurring pattern of observed deficiencies that could result in such a violation. A finding is a deficiency that requires corrective action.
>
> **OBSERVATION**. A weakness that, if not corrected, could result in a deficiency. An observation may result if an explicit procedural nonconformance is noted but the nonconformance is an isolated incident or of minor significance. An observation requires corrective action.
>
> **COMMENT OR CONCERN**. A comment is a subjective opinion of the assessment team that may be used to improve any of the specific environmental monitoring program activities, noted in *Self-Assessments for Environmental Programs,* such as sample collection, preparation, logging, storage, and shipping; instrument and equipment calibration; data receipt and data entry; training requirements and records; and compliance with discharge permit requirements. Corrective action in response to a comment or concern is at the discretion of the cognizant staff.
>
> **COMMENDABLE PRACTICE**. A significant strength noted during the course of a self-assessment.
>
> **DEFICIENCY**. A condition that does not meet or cannot be documented to meet applicable requirements.

SIEVERT. A unit of dose equivalent from the International System of Units (Systeme Internationale). Equal to one joule per kilogram.

SOLID WASTE MANAGEMENT UNIT (SWMU). Any discernible unit at which solid wastes have been placed at any time, irrespective of whether the unit was intended for the management of solid or hazardous waste. Such units include any area at a facility at which solid wastes have been routinely and systematically released.

SPENT FUEL. Nuclear fuel that has been used in a nuclear reactor; this fuel contains uranium, activation products, fission products, and plutonium.

STANDARD DEVIATION. An indication of the dispersion of a set of results around their average.

SUPER SOLID WASTE MANAGEMENT UNIT (SSWMU). Individual solid waste management units that have been grouped and ranked into larger units — super solid waste management units — because some individual units are contiguous or so close together as to make monitoring of separate units impractical.

SURFACE WATER. Water that is exposed to the atmospheric conditions of temperature, pressure, and chemical composition at the surface of the earth.

SURVEILLANCE. The act of monitoring or observing a process or activity to verify conformance with specified requirements.

THERMOLUMINESCENT DOSIMETER (TLD). A device that luminesces upon heating after being exposed to radiation. The amount of light emitted is proportional to the amount of radiation to which the luminescent material has been exposed.

TRANSURANIC WASTE. Transuranic elements having an atomic number greater than 92, including neptunium, plutonium, americium, and curium.

UPGRADIENT. Referring to the flow of water or air, "upgradient" is analogous to upstream. Upgradient is a point that is "before" an area of study that is used as a baseline for comparison with downstream data. See GRADIENT and DOWNGRADIENT.

WATERSHED. The area contained within a drainage divide above a specified point on a stream.

WATER TABLE. The upper surface in a body of groundwater; the surface in an unconfined aquifer or confining bed at which the pore water pressure is equal to atmospheric pressure.

X-RAY. Penetrating electromagnetic radiations having wave lengths shorter than those of visible light. They are usually produced by bombarding a metallic target with fast electrons in a high vacuum. In nuclear reactions it is customary to refer to photons originating in the nucleus as gamma rays and those originating in the extranuclear part of the atom as x-rays. These rays are sometimes called roentgen rays after their discoverer, W.C. Roentgen.

Acronyms

AEA. Atomic Energy Act

ALARA. As Low As Reasonably Achievable

ANOVA. Analysis of Variance

BEIR. Committee on Biological Effects of Ionizing Radiation

BOD-5. Biochemical Oxygen Demand (5-day)

CAA. Clean Air Act

CDDL. Construction and Demolition Debris Landfill

CEDE. Committed Effective Dose Equivalent

CEQ. (President's) Council on Environmental Quality

CERCLA. Comprehensive Environmental Response, Compensation, and Liability Act

CFR. Code of Federal Regulations

CO. Certificate-to-Operate

CSPF. Container Sorting and Packaging Facility

CPC. Chemical Process Cell

CSRF. Contact Size-reduction Facility

CSS. Cement Solidification System

CWA. Clean Water Act

CX. Categorical Exclusion

CY. Calendar Year

DCG. Derived Concentration Guide

DE. Dose Equivalent

DMR. Discharge Monitoring Report

DOE. (U.S.) Department of Energy

DOE-EM. (U.S.) Department of Energy, Office of Environmental Restoration and Waste Management

DOE-HQ. Department of Energy, Headquarters Office

DOE-OH. Department of Energy, Ohio Field Office

DOE-WV. Department of Energy, West Valley Area Office

EA. Environmental Assessment

EDE. Effective Dose Equivalent

EE. Environmental Evaluation

Acronyms

EHS. Extremely Hazardous Substance
EID. Environmental Information Document
EIS. Environmental Impact Statement
ELAP. Environmental Laboratory Approval Program
EML. Environmental Measurements Laboratory
EMSL. Environmental Monitoring Systems Laboratory (Las Vegas)
EPA. (U.S.) Environmental Protection Agency
EPI. Environmental Physics, Inc.
EPCRA. Emergency Planning and Community Right-to-Know Act
ES&H. Environmental Safety and Health
ESR. (WVDP) Effluent Summary Report
FFC Act. Federal Facility Compliance Act
FONSI. Finding of No Significant Impact
FSFCA. Federal and State Facility Compliance Agreement
FY. Fiscal Year
GC/MS. Gas Chromatograph/Mass Spectrometer
HEPA. High-efficiency Particulate Air (filter)
HLW. High-level (radioactive) Waste
HPIC. High-pressure Ion Chamber
HVAC. Heating, Ventilation, and Air Conditioning
ICRP. International Commission on Radiological Protection
INEL. Idaho National Engineering Laboratory
IRTS. Integrated Radwaste Treatment System
LAS. Linear Alkylate Sulfonate
LDR. Land Disposal Restriction
LIMS. Laboratory Information Management System
LLD. Lower Limit of Detection
LLW. Low-level (radioactive) Waste
LLWTF. Low-level Liquid Waste Treatment Facility
LPS. Liquid Pretreatment System
LWTS. Liquid Waste Treatment System
MDC. Minimum Detectable Concentration
MDL. Method Detection Limit
MSDS. Material Safety Data Sheet

MTAR. Monthly Trend Analysis Report

NCRP. National Council on Radiation Protection and Measurements

NDA. Nuclear Regulatory Commission-licensed Disposal Area

NEPA. National Environmental Policy Act

NERL CRD. National Exposure Research Laboratory, Characterization Research Division (formerly EMSL)

NESHAP. National Emissions Standards for Hazardous Air Pollutants

NFS. Nuclear Fuel Services, Inc.

NIST. National Institute of Standards and Technology

NOI. Notice of Intent

NPOC. Nonpurgeable Organic Carbon

NPDES. National Pollutant Discharge Elimination System

NRC. (U.S.) Nuclear Regulatory Commission

NTU. Nephlometric Turbidity Unit

NYCRR. New York Official Compilation of Codes, Rules, and Regulations

NYSDEC. New York State Department of Environmental Conservation

NYSDOH. New York State Department of Health

NYSERDA. New York State Energy Research and Development Authority

NYSGS. New York State Geological Survey

ODIS. On-site Discharge Information System Report

ORR. Operational Readiness Review

OSHA. Occupational Safety and Health Act

OSR. Operational Safety Requirement

OVE. Outdoor Ventilated Enclosure

PC. Permit-to-Construct

PCB. Polychlorinated biphenyl

PQL. Practical Quantitation Limit

PVU. Portable Ventilation Unit

QA. Quality Assurance

QAP. Quality Assessment Program

QC. Quality Control

QEMDR. Quarterly Environmental Monitoring Data Report

RCRA. Resource Conservation and Recovery Act

RFI. RCRA Facility Investigation

RMW. Radioactive Mixed Waste

RTS. Radwaste Treatment System

Acronyms

SAR. Safety Analysis Report

SARA. Superfund Amendments and Reauthorization Act

SD. Standard Deviation

SDA. (New York) State-licensed Disposal Area

SDWA. Safe Drinking Water Act

SER. Site Environmental Report

SI. Systeme Internationale (International System of Units)

SPDES. State Pollutant Discharge Elimination System

STS. Supernatant Treatment System

SWMU. Solid Waste Management Unit

SSWMU. Super Solid Waste Management Unit

TCL. Target Compound List

TIC. Tentatively Identified Compound

TLD. Thermoluminescent Dosimetry

TOC. Total Organic Carbon

TOX. Total Organic Halogens

TPQ. Threshold Planning Quantity

TRI. Toxic Release Inventory

TSCA. Toxic Substances and Control Act

TSDF. Treatment, Storage, and Disposal Facility

USGS. U.S. Geological Survey

VOC. Volatile Organic Compound

WNYNSC. Western New York Nuclear Service Center

WVDP. West Valley Demonstration Project

WVNS. West Valley Nuclear Services Company, Inc.

WWTF. Wastewater Treatment Facility

Units of Measure

Radioactivity

Symbol	*Name*
Ci	curie
mCi	millicurie (1E-03 Ci)
μCi	microcurie (1E-06 Ci)
nCi	nanocurie (1E-09 Ci)
pCi	picocurie (1E-12 Ci)
Bq	becquerel (27 pCi)

Volume

Symbol	*Name*
cm^3	cubic centimeter
L	liter
mL	milliliter
m^3	cubic meter
gal	gallon
ft^3	cubic feet
ppm	parts per million
ppb	parts per billion

Dose

Symbol	*Name*
Sv	sievert (100 rems)
mSv	millisievert (1E-03 Sv)
Gy	gray (100 rads)

Area

Symbol	*Name*
ha	hectare (10,000 m^2)

Concentration

Symbol	*Name*
μCi/mL	microcuries per milliliter
mL/L	milliliter per liter
μCi/g	microcuries per gram
mg/L	milligrams per liter
μg/mL	micrograms per milliliter

Length

Symbol	*Name*
m	meter
km	kilometer (1E+03 m)
cm	centimeter (1E-02 m)
mm	millimeter (1E-03 m)
μm	micrometer (1E-06 m)

Mass

Symbol	*Name*
g	gram
kg	kilogram (1E+03 g)
mg	milligram (1E-03 g)
μg	microgram (1E-06 g)
ng	nanogram (1E-09 g)
t	metric ton (1E+06 g)

Flow Rate

Symbol	*Name*
mgd	million gallons per day
cfm	cubic feet per minute
Lpm	liters per minute

Unit Prefixes

centi	$1/100 = 1 \times 10^{-2} = 0.01$
milli	$1/1,000 = 1 \times 10^{-3} = 0.001$
micro	$1/1,000,000 = 1 \times 10^{-6} = 0.000001$
nano	$1/1,000,000,000 = 1 \times 10^{-9} = 0.000000001$
pico	$1/1,000,000,000,000 = 1 \times 10^{-12} = 0.000000000001$

Scientific Notation

Scientific notation is used to express very large or very small numbers. A very small number is expressed with a negative exponent, e.g., 1.3×10^{-6}. To convert this number to decimal form, the decimal point is moved left by the number of places equal to the exponent. Thus, 1.3×10^{-6} becomes 0.0000013.

A very large number is expressed with a positive exponent, e.g., 1.3×10^{6}. To convert this number to decimal form, the decimal point is moved right by the number of places equal to the exponent. Thus, 1.3×10^{6} becomes 1,300,000.

The power of 10 also is expressed as E. For example, 1.3×10^{-6} also can be written as 1.3E-06. The chart below shows the values of exponents.

1E+01	=	10	
1E+00	=	1	
1E-01	=	0.1	
1E-02	=	0.01	
1E-03	=	0.001	
1E-04	=	0.0001	
1E-05	=	0.00001	
1E-06	=	0.000001	One Millionth
1E-07	=	0.0000001	
1E-08	=	0.00000001	

Conversion Chart

Both traditional radiological units (curie, roentgen, rad, rem) and the Systeme Internationale (S.I.) units (becquerel, gray, sievert) are used in this report. Nonradiological measurements are presented in metric units with the English equivalent noted in parentheses.

1 centimeter (cm)	=	0.3937 inches (in)
1 meter (m)	=	39.37 inches (in) = 3.28 feet (ft)
1 kilometer (km)	=	0.62 miles (mi)
1 milliliter (mL)	=	0.0338 ounces (oz)
	=	0.061 cubic inches (in^3)
	=	1 cubic centimeter (cm^3)
1 liter (L)	=	1.057 quarts (qt)
	=	61.02 cubic inches (in^3)
1 gram (g)	=	0.0353 ounces (oz)
	=	0.0022 pounds (lbs)
1 kilogram (kg)	=	2.2 pounds (lbs)
1 curie (Ci)	=	3.7×10^{10} disintegrations per second (d/s)
1 becquerel (Bq)	=	1 disintegration per second (d/s)
	=	27 picocuries (pCi)
1 roentgen (R)	=	2.58×10^{-4} coulombs per kilogram of air (C/kg)
1 rad	=	0.01 gray (Gy)
1 rem	=	0.01 sievert (Sv)
1 millirem (mrem)	=	0.001 rem

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Acknowledgments

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