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 State 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), constructed and began operating 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 WNYNSC 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, new and more rigorous federal and state safety regulations 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 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. (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 as long as 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 separated into two layers, a liquid supernatant and a settled sludge layer. Various subsystems were constructed that permitted the successful startup in May 1988 of the integrated radwaste treatment system (IRTS). The system removed most of the 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.1-6], 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. Vitrification of the high-level waste residues began in July 1996. In June 1998 the WVDP successfully completed the first phase of the vitrification campaign. Currently the WVDP is conducting the second phase of vitrification, which involves removing and solidifying the high-level wastes remaining in the tanks.

Purpose of this Report

This annual environmental monitoring report is published to inform WVDP stakeholders about environmental conditions at the WVDP. 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, socioeconomics, 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.

Description of the West Valley Demonstration Project

The WVDP is located about 50 kilometers (30 mi) south of Buffalo, New York (Fig. 1 [*facing page*]). The WVDP facilities occupy a security-fenced area of about 80 hectares (200 acres) within the WNYNSC. This fenced area is referred to as either 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. A NYSERDA-sponsored pilot program to control the deer population, initiated in 1994, continued in 1998.

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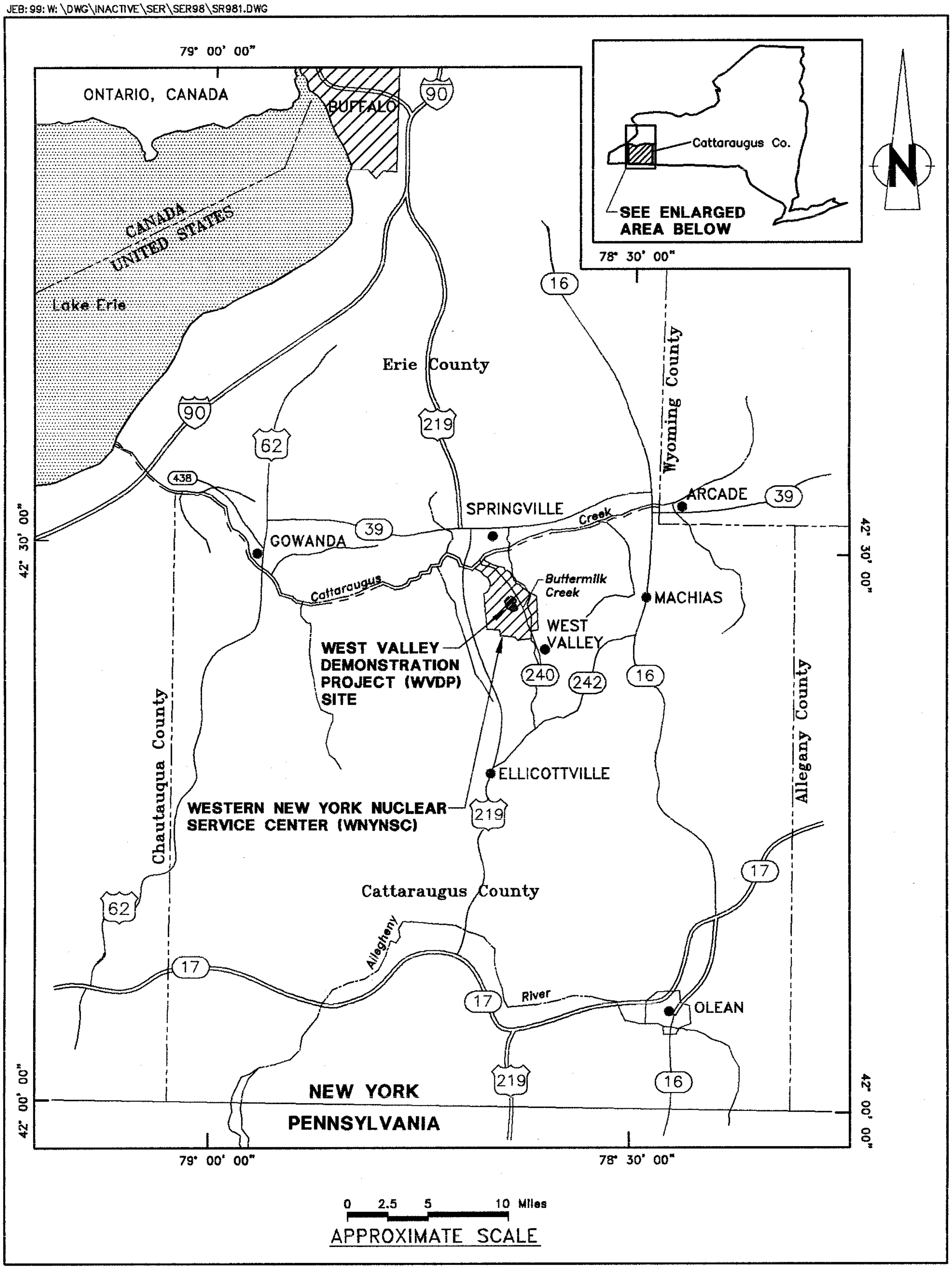

Figure 1. Location of the Western New York Nuclear Service Center.

Limited hunting permits were issued to local residents, and community response continued to be favorable.

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 principally 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. Water from Lake Erie is 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 1998 totaled 109 centimeters (43 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.

Indigenous Small Mammal (Marmota monax)

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 sequence of glacial sediments. (See Figs.3-1 and 3-2 [p.3-3] 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 Figs.A-6 through A-8 [pp.A-8 through A-10] in Appendix A.)

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 downward.

On the north plateau a permeable alluvial sand and gravel layer overlies the less permeable 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 extent, the Lavery till-sand. Gradients indicate that groundwater flows east-southeast. Surface discharge points have not been observed.

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.

Information in this Report

Individual chapters in this report provide information on compliance with regulations, general information about the monitoring program and significant activities in 1998, summaries of the results of radiological and nonradiological monitoring, calculations of radiation doses to the population within 80 kilometers (50 mi) of the site, and information about practices that ensure the quality of environmental monitoring data. Graphs and tables are included to illustrate important trends and concepts. The bulk of the supporting data is found in the appendices following the text. Page numbers are provided in the text wherever such information is noted.

Appendix A contains maps showing on-site and off-site sampling locations.

Appendix B summarizes the 1998 environmental monitoring program at the on-site (i.e., on the WNYNSC) 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 B [pp.B-v through B-vii].) Appendix B lists the kinds of samples taken, the frequency of collection, the parameters analyzed, the location of the sampling points, and a brief rationale for the monitoring activities conducted at each location.

Appendices C through I summarize radiochemical and chemical analytical data from air, surface water, groundwater, fallout in precipitation, sediment, soils, and biological samples (meat, milk, food crops, and fish), and from direct radiation measurements and meteorological monitoring.

Appendix J provides data from the comparison of results of analyses of identically prepared samples (crosscheck samples) by both the WVDP and independent laboratories. Radiological concentrations in crosscheck samples of air, water, soil, and vegetation are reported here, as are chemical water quality parameters.

Appendix K provides a list of radiation protection standards set by the DOE that are most relevant to the operation of the WVDP. It also lists federal and state laws and regulations that affect the WVDP and the environmental permits held by the site in 1998.

Appendix L contains groundwater monitoring data for the New York State-licensed disposal area (SDA), provided by NYSERDA.

The Glossary and the References sections are intended to help the reader with the scientific and technical terminology used in this report.

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 recognize (e.g., DOE, EPA, NRC, NYSDEC, NYSERDA) 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 provided at the end of this report.

Environmental Monitoring Program

The WVDP's environmental monitoring program 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 is provided. As processes are completed, unnecessary monitoring may be eliminated from the program.

Monitoring and Sampling. The environmental monitoring program consists of on-site effluent monitoring and on- and off-site environmental surveillance in which samples are measured for both radiological and nonradiological constituents. (See the Glossary [p.3] 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 changes in the levels of constituents that could affect the environment. Sampling is the collection of media at scheduled times; sampling is slower than direct monitoring in indicating changes in constituent levels because the samples must be analyzed in a laboratory to obtain data. However, sample analysis allows much smaller quantities of radioactivity to be detected.

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 (General Environmental Protection Program), 5400.5 (Radiation Protection of the Public and Environment), and 231.1 (Environment, Safety, and Health Reporting), and DOE Regulatory Guide DOE/EH-0173T (Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance).

The WVDP 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. It also specifies that concentrations of radionuclides at these outfalls must meet the requirements of DOE Orders 5400.1 and 5400.5.

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). In addition, the site operates under state-issued air discharge permits for nonradiological plant emissions.

For more information about air and SPDES permits see the Environmental Compliance Summary: Calendar Year 1998 (pp.ECS-8 and ECS-10). Environmental permits are listed in Appendix K (pp.K-5 and K-6).

Exposure Pathways Monitored at the West Valley Demonstration Project. The major near-term pathways for potential movement of 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, various water effluent points, and surface water drainage locations. Analyses of samples of air, water, soils, and biota from the environment surrounding the site would detect any radioactivity that might reach the public from site releases. Extensive groundwater monitoring addresses the subsurface pathway.

Water and Sediment Pathways. Process waters are treated in a series of on-site lagoons before being discharged through a single outfall. (The locations of the lagoons are noted on Fig.A-2 [p.A-4] in Appendix A.) Samples of this process water and the effluent at two other discharge points are collected in accordance with permit requirements. The samples are analyzed for radiological parameters, including gross alpha and gross beta, tritium, strontium-90, and gamma-emitting 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 radionuclides.

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-emitting radionuclides, pH, and conductivity.

Off-site surface waters, primarily from Cattaraugus Creek and Buttermilk Creek, are sampled 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 [pp.C-3 through C-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 parameters and specific analytes of interest such as volatiles, semivolatiles, metals, and radionuclides at particular monitoring locations. (See Table E-1 [p.E-3] in Appendix E.)

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 collect water vapor that is then distilled from the desiccant and analyzed for tritium. The distillates are analyzed weekly. Six permanent samplers contain activated charcoal adsorbent that is analyzed for iodine-129; 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-12 [p. A-14] in Appendix A for these four off-site air sampling locations.) Six samplers are located on the perimeter of the WNYNSC. (See Fig.A-5 [p. A-7] in Appendix A.) These samples are analyzed for parameters similar to the effluent air samples. (See Appendix D [pp.D-3 through D-26] 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 that which occurred at Chernobyl in the Ukraine.

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 assessed 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 D [pp.D-24 through D-26] for fallout data summaries and Appendix C [pp.C-22 and C-23] for soil data summaries.)

Food Pathways. A potentially significant pathway for radioactivity to reach humans is through consuming produce and meat and milk from domesticated farm animals raised near the WVDP and 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 at various distances downstream from the WVDP. Venison is sampled from the deer herd ranging within the WNYNSC. Control samples of both fish and venison are collected from background areas outside WVDP influence. Beef, milk, hay, and produce samples also are collected at nearby farms and at selected locations well away from WVDP influence. (See Appendix F [pp.F-3 through F-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 around the site perimeter and access road and at background locations remote from the WVDP. Forty-three measurement points were used in 1998.

The TLDs are retrieved quarterly and are processed by an off-site service to obtain the integrated gamma exposure. (Appendix H [p.H-3 is a summary of the direct radiation data.)

Meteorological Monitoring

Meteorological data are continuously gathered and recorded on-site and at a nearby regional location. Wind speed and direction, barometric pressure, temperature, dewpoint, and rainfall are all measured. Such data are valuable for evaluating long-term geohydrologic trends and for modeling airborne dispersion. 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 I [pp.I-3 through I-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. Assessments 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 J [pp. J-3 through J-9] for a summary of crosscheck performance.) The performance of outside laboratories contracted to analyze WVDP samples also is regularly assessed.

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 as they are completed.

During 1998 WVNS developed a safety management system for the WVDP, which was validated by the DOE Ohio Field Office. The safety management system integrates all safety programs, including environmental protection, to ensure that Project work can be safely and efficiently performed.

A special assessment was conducted in 1998 to determine if environmental monitoring program hardware and software were capable of handling data correctly when the year 2000 arrives. Several systems were examined, including the meteorological system, water samplers, air samplers, radiological counting instruments, and data management and reporting systems. A schedule for completing corrective actions such as purchasing updated equipment and software was developed, and corrective actions were started so that all systems will be year-2000 compliant in 1999.