INTRODUCTION

Purpose of this Report

This annual environmental monitoring report is published to inform Project stakeholders (see *stakeholder* in the Glossary) about environmental conditions at the WVDP. The report summarizes 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.

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 2000, 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 illustrate important trends and concepts. The bulk of the supporting data is found in the appendices following the text. Page numbers refer the reader to the appendices, figures, and graphs cited in the text.

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

Appendix B summarizes the calendar year 2000 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, monitoring and reporting requirements, and a brief rationale for the monitoring activities conducted at each location.

Appendices C through I summarize radiometric, chemical analytical, and physical data from air, surface water, groundwater, fallout in precipitation, sediment, soils, biological samples (meat, milk, food crops, and fish), and 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 and chemical water quality parameters in crosscheck samples of air, water, soil, and vegetation are reported here.

Appendix K provides a list of radiation protection standards set by the Department of Energy (DOE) that are most relevant to the operation of the WVDP. It also lists federal and state laws and regulations that affect the WVDP.

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

Acronyms, often used in technical documents to speed up the reading process, are listed in a separate section at the back of this report. Although using acronyms can be a practical way of referring to agencies or systems with 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, acronyms that the reader is apt to recognize (e.g., DOE, EPA, NRC, NYSERDA) or that are used often in this report (e.g.,WVDP, WNYNSC) are spelled out only at the beginning of sections. Other information that may be helpful is found in the Glossary, References, Scientific Notation, Conversion Chart, and Units sections at the back of this report.

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 (3,345 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 NYSERDA, constructed and began operating a nuclear fuel reprocessing plant under a co-license issued by the Atomic Energy Commission (later the Nuclear Regulatory Commission [NRC]).

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 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.

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 DOE to dem-

onstrate 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.

Under the original agreement between NFS and New York State, the state was ultimately responsible for both the radioactive wastes and the facility. The WVDP Act specifically provides 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 to complete the Project. The facility's NRC license was amended in 1981 to allow the DOE cleanup to proceed at the Project under a Memorandum of Understanding. Although the lead agency for the WVDP is the DOE, under the Memorandum of Understanding the DOE and the NRC each have specific responsibilities related to the WVDP.

West Valley Nuclear Services Co. (WVNS), a subsidiary of Westinghouse Government Services Group, was chosen by the DOE to be the management and operating contractor for the West Valley Demonstration Project. Site operations began at the WVDP in March 1982.

The high-level waste, contained in underground storage tanks, 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 Vitrification Overview [p.1-6] in Chapter 1 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 residuals (heels) remaining in the tanks, and is planning for future decommissioning of vitrification and support facilities.

Description of the West Valley Demonstration 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.

At this stage in the Project, the high-level waste has been solidified in glass in 254 stainless steel canisters and stored in a shielded cell. In order to continue the Project mission, seven major projects are under way that will lead to completion of the cleanup work:

Spent fuel shipping. The original operator at the site, Nuclear Fuel Services, Inc. (NFS), had accepted 750 spent fuel assemblies for reprocessing before discontinuing operations in 1975. These spent fuel assemblies were stored in the

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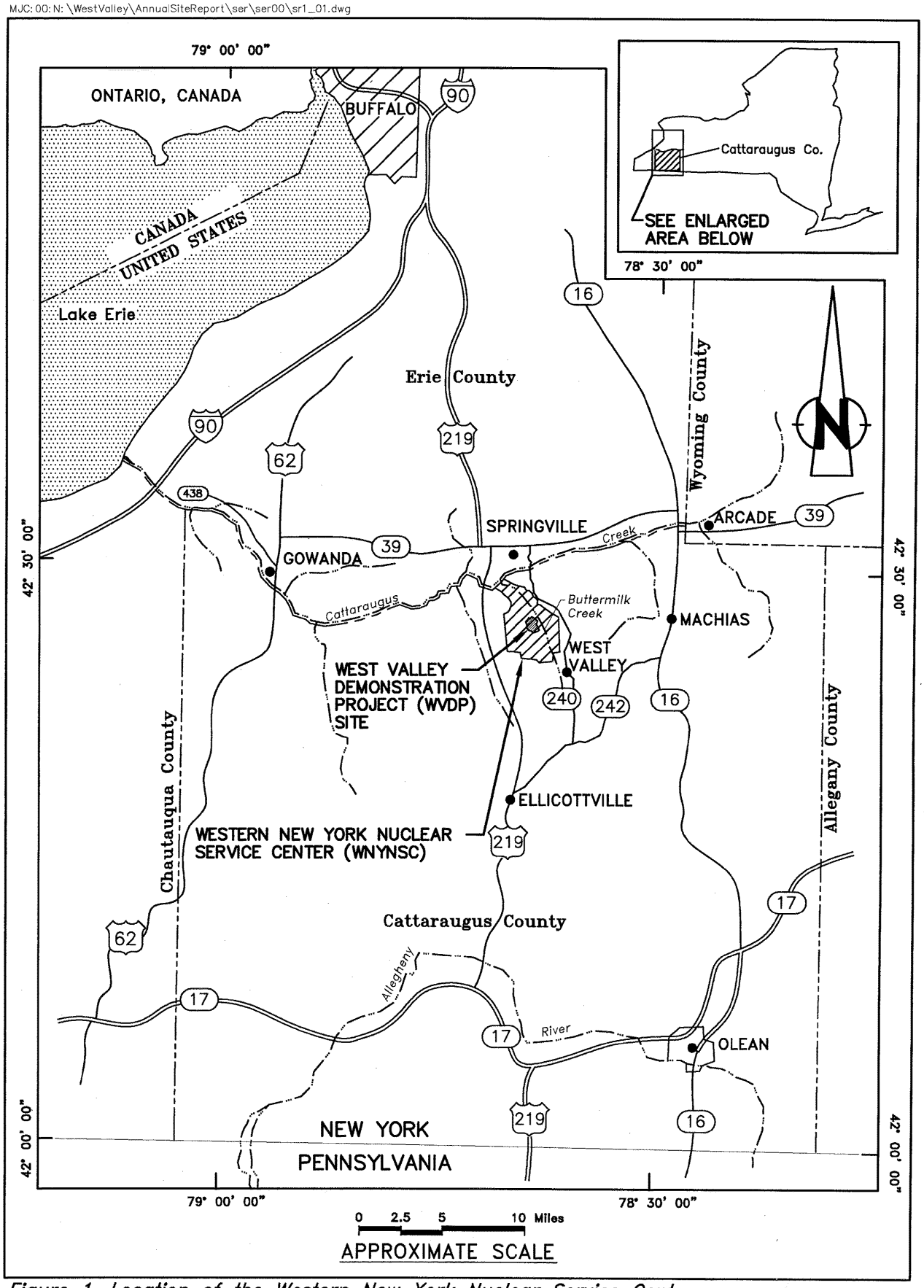

Figure 1. Location of the Western New York Nuclear Service Center.

on-site fuel pool. During an early 1980 shipping campaign, 625 of the spent fuel assemblies were returned to the utilities that owned them. The remaining 125 assemblies, which continued to be stored at the WVDP, will be transported to the Idaho National Engineering and Environmental Laboratory (INEEL) for interim storage in 2001. Removal of the spent fuel will enable the WVDP's fuel pool to be drained and decontaminated.

Waste management. Part of the DOE's cleanup mission at the West Valley site is the disposal of low-level radioactive waste that is generated through WVDP operations. Stored wastes resulting from cleanup activities are being shipped off-site for disposal. The WVDP has refurbished the 1.8-mile railroad spur that enters the Project premises and is now shipping low-level waste directly from the site.

Vitrification expended materials processing. As materials used in vitrification are expended they are inventoried, identified, sorted, classified, cleaned, size-reduced (as needed), packaged, and removed from the facility. The vitrification facility itself will be decontaminated and decommissioned when high-level waste processing is complete.

High-level waste tank closure. Liquid high-level waste processing is expected to be completed in 2003. The underground waste tanks will be closed following decisions on long-term site management.

Remote-handled waste. A remote-handled waste facility is under construction on-site. It will be used to prepare higher activity wastes for shipment and disposal.

Environmental monitoring. Site-wide environmental monitoring and management will continue to ensure the safety of the public and the environment.

Facility closure projects. To complete the West Valley Demonstration Project Act, the facilities used to solidify the high-level waste will be decontaminated and decommissioned in preparation for implementing long-term management decisions.

General Environmental Setting

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.

Location of the West Valley Demonstration Project. The WVDP is located in northern Cattaraugus County 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 approximately 8 kilometers (5 mi) of the Project. Several roads and a railway pass through the WNYNSC, but the public does not have access to the WNYNSC. Hunting, fishing, and human habitation on the WNYNSC generally are prohibited. A NYSERDA-sponsored program to control the deer population, initiated in 1994,

continued in 2000. Limited access to the WNYNSC was given to local hunters, 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 south of Buffalo, New York. Water from Lake Erie is used as a public drinking-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 2000 was slightly below average, totaling about 97 centimeters (38 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 at the WVDP

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 the ground surface, where weathering has fractured the near-surface sediments. Groundwater flow in the weathered till has both a vertically downward component and a hori-

zontal 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 toward the northeast with discharge to Buttermilk Creek.

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 or pre-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 [pp.3 and 4] 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 Project or pre-Project activities. 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 specific 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 or chemical concentrations 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 Emission 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. The WVDP received final approval of a State Facility Air Permit from NYSDEC on June 1, 2000.

For more information about air and SPDES permits see the Environmental Compliance Summary: Calendar Year 2000 (pp.ECS-7 and ECS-9). Environmental permits are listed at the back of the Environmental Compliance Summary (pp.ECS-22 through ECS-23).

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 radioactivity that might reach the public from site releases. Extensive groundwater monitoring addresses the subsurface pathway.

Water and Sediment Pathways. Process waters are treated through filtration and ion-exchange in a liquid-treatment facility, the LLW2. The treated water is sent to a series of on-site holding lagoons for testing 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, 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-25] for water and sediment data summaries.)

Groundwater Pathways. Groundwater discharge at the WVDP site occurs as springs or seeps along stream channels, direct discharge to streams, evapotranspiration, vertical groundwater migration to underlying strata, 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 (pH and conductivity, and gross alpha, gross beta, and tritium) and for specific analytes of interest such as volatile organic compounds, semivolatile organic compounds, metals, and radionuclides at selected monitoring locations. (See Table E-1 [pp. E-3 through E-6] 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 of the effluent 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 at effluent locations 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.) Samples from these

locations 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-23 and C-24] for soil data summaries.)

Food Pathways. A potentially significant pathway for radioactivity to reach humans is through consuming produce, meat, and milk from domesticated farm animals raised near the WVDP and game animals and fish that live in the vicinity of the WVDP. 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 along Cattaraugus Creek at several locations downstream of the WVDP. Venison is sampled from deer 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 locations are around the site perimeter and access road and at background locations remote from the WVDP. Forty-three measurement points were used in 2000. The TLDs are retrieved quarterly and are processed by an off-site service to obtain the integrated gamma exposure. (See Appendix H [pp. H-3 through H-6] for a summary of the direct radiation data.)

Meteorological Monitoring

Meteorological data are continuously gathered and recorded at meteorological towers on-site and a nearby regional location south of the WNYNSC. Wind speed and direction, barometric pressure, temperature, dewpoint, and rainfall are measured on-site. Wind speed and direction are measured at the regional tower. These data are valuable for modeling both airborne dispersion and long-term hydrologic trends. 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-8] 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-7] 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 the 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.

Safety Management System

During 1998 WVNS developed a safety management system for the WVDP, which was subsequently 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. As a continuation of this effort, the WVDP applied for the DOE Voluntary Protection Program STAR designation, reserved for companies that have demonstrated sustained excellence in their safety and health program. STAR status for the WVDP was announced in early 2000.

The WVDP also was recognized as a top environmental leader in 2000 and was accepted into the EPA's National Environmental Performance Track. The WVDP was awarded Charter Member status as part of the first group of applicants.

To qualify for the award the WVDP had to demonstrate that it voluntarily has adopted and implemented an environmental management system, has attained previous specific environmental achievements, has made a commitment to achieve four future goals, and has a sustained record of environmental compliance.

The WVDP is one of only two DOE sites to hold both the EPA's highest award for environmental achievement and the DOE's STAR award for excellence in safety and health.