# 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 2.5 million liters (660,000 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. 1-6 through 1-7] for a more detailed description.) In 1995, the two high-level waste streams were combined and the subsequent mixture washed a final time. The last ste[
vitrification of the remaining high-leve
residues.

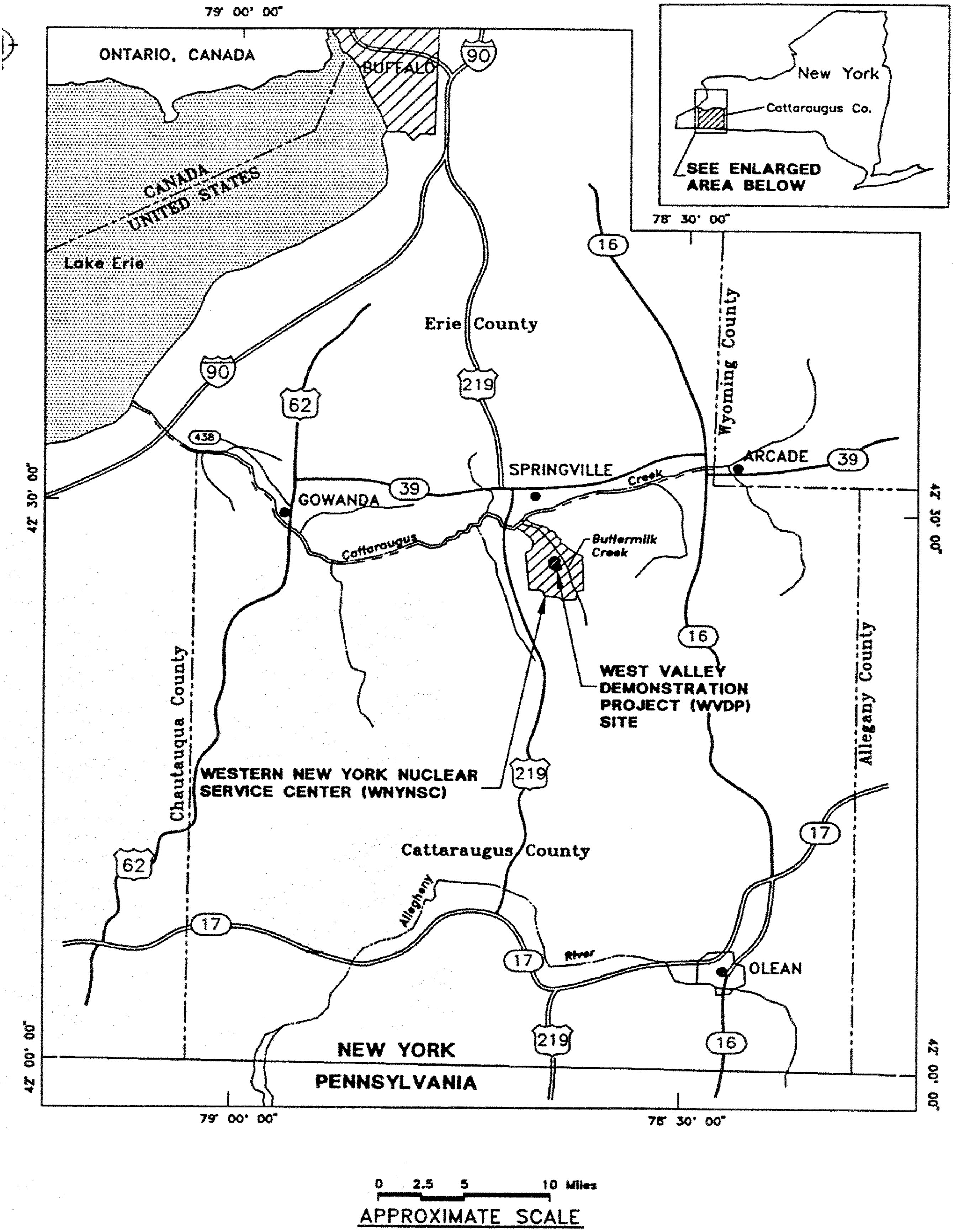
This annual environmental monitoring r
published to inform WVDP stakeholde
environmental monitoring conditions. Th
presents a summary of the environment
toring data gathered during the year in
characterize the performance of the V
environmental management, confirm con
with standards and regulations, and h
significant programs.

The geography, economy, climate, ecolc
geology of the region are principal fa
assessing possible effects of site activitie
surrounding population and environment
an integral consideration in the design an
ture of the environmental monitoring prc

## Location

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

The WVDP is situated on New York
Allegheny plateau at an average elevatio
meters (1,300 ft). The communities c
Valley, Riceville, Ashford Hollow, and
lage of Springville are located within 8 kil
(5 mi) of the plant. Several roads and a
pass through the WNYNSC, but the pub
not have access to the WNYNSC. Ge
hunting, fishing, and human habitation
WNYNSC are prohibited. (For purpose
fining environmental monitoring
collection locations, the land with
WNYNSC is considered to be "on-si
NYSERDA-sponsored pilot program to




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

pilot program to control the deer population was initiated in 1994 and continued in 1995. Limited hunting permits were issued to local residents, and community response was 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 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 1995 totaled 87 centimeters (34 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.

*A Young White-tailed Resident*

## 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.

Within the Lavery till on both the north and south plateaus are other localized permeable units capable of letting groundwater flow through. The uppermost few feet of shale bedrock has also demonstrated the ability to let significant quantities of groundwater flow through 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 1995, 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-55) summarizes the 1995 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-vi through A-ix].) *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 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-7) 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-31) 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-11) 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 site drainage and specifies the sampling and analytical requirements for each outfall.

In addition, the site operates under state-issued air discharge permits for nonradiological plant effluents. Radiological air discharges must also be permitted by the Environmental Protection Agency (EPA) and comply with the National Emissions Standards for Hazardous Air Pollutants (NESHAP).

For more information about air and SPDES permits see the *Environmental Compliance Summary: Calendar Year 1995* (pp. il and li). 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. 2-5] in *Chapter 2, Environmental Monitoring*.) Samples of this effluent and the effluent at three other 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 and conductivity. Additional analyses of composite samples determine metals content, solids, biochemical oxygen demand, nitrates, nitrites, ammonia, sulfate, organic chemicals, and specific isotopic radioactivity.

On-site groundwater and surface water samples are collected regularly and analyzed, at a minimum, for gross alpha and 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 C1-25] 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 [p. 3-15] and Table 3-3 [p. 3-20] in *Chapter 3, Groundwater Monitoring*.)

## Air Pathways

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 nuclides.

Iodine-129 and tritium also are measured in effluent ventilation air. At two locations silica gel-filled columns are used to extract water vapor that is then distilled from the desiccant and analyzed for tritium. Five 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-55] 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. 2-4] 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 C2-24] 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. (See *Appendix C-2* [p. C2-23] for fallout data summaries and *Appendix C-1* [pp. C1-23 through C1-25] 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 for the first three quarters of 1995 were processed on-site to obtain the integrated gamma exposure. A contract with an off-site service to prepare and process TLDs was placed in 1995. (See *Appendix D*, Table D-4 [p. D-7] for a comparison of on-site and subcontract results.)

Forty-three measurement points were used in 1995. (See *Appendix C-4* [pp. C4-1 through C4-5] for a summary of the direct radiation data.)

## Meteorological Monitoring

Meteorological data are continuously gathered and recorded on-site. Wind speed and direction, barometric changes, temperature, and rainfall are all measured. Such data are valuable in evaluating long-term geohydrological trends and in developing airborne dispersion models. In the event of an emergency, immediate access to the most recent 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-7] 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 planned actions for their implementation.