CHAPTER 3
AFFECTED ENVIRONMENT

3.0 AFFECTED ENVIRONMENT

This chapter describes the existing conditions at the Western New York Nuclear Service Center (WNYNSC) and surrounding area. This information provides the context for understanding the environmental consequences and also serves as a baseline to evaluate the alternatives in this environmental impact statement (EIS) as of completion of the Interim End State. The affected environment at the WNYNSC is described for the following resource areas: land use and visual resources; site infrastructure; geology, geomorphology, seismology, and soils; water resources; meteorology, air quality, and noise; ecological resources; cultural resources; socioeconomics; human health and safety; environmental justice; and waste management and pollution prevention.

In accordance with the Council on Environmental Quality National Environmental Policy Act (NEPA) regulations (40 *Code of Federal Regulations* [CFR] Parts 1500 through 1508), the affected environment is "interpreted comprehensively to include the natural and physical environment and the relationship of people with that environment." In addition, the State Environmental Quality Review Act (SEQR) (6 NYCRR 617.9) states that the affected environment is to be a "concise description of the environmental setting of the areas to be affected, sufficient to understand the impacts of the proposed action and alternatives." The affected environment descriptions provide the context for understanding the environmental consequences described in Chapter 4 of this EIS. For the purposes of this analysis, this chapter serves as a baseline from which any environmental changes brought about by implementing the alternatives can be evaluated.

For this *Revised Draft Environmental Impact Statement for Decommissioning and/or Long-Term Stewardship at the West Valley Demonstration Project and Western New York Nuclear Service Center (Decommissioning and/or Long-Term Stewardship EIS)*, each resource area is described that may be particularly affected by the Proposed Action and alternatives. The level of detail varies depending on the potential for impacts resulting from each alternative. A number of site-specific and recent project-specific documents are important sources of information in describing the existing environment at WNYNSC and from which information is summarized and/or incorporated by reference. Numerous other sources of site- and resource-related data were also used in the preparation of this chapter and are cited as appropriate.

The U.S. Department of Energy (DOE) evaluated the environmental impacts of the alternatives within defined regions of influence (ROIs) and along potential transportation routes. The ROIs are specific to the type of effect evaluated, and encompass geographic areas within which impacts may occur. For example, human health risks to the general public from exposure to hazardous and radionuclide airborne contaminant emissions were assessed for an area within an 80-kilometer (50-mile) radius of the WNYNSC. The human health risks from shipping materials were evaluated for populations living along certain transportation routes. Economic effects such as job and income changes were evaluated within a socioeconomic ROI that includes the county in which the WNYNSC is located and nearby counties in which substantial portions of the site's workforce reside. **Table 3–1** summarizes the affected environment resource areas and associated ROIs.

Site Facilities

Chapter 1 contains a general description of the Project Premises. The Project Premises and State-licensed Disposal Area (SDA) are shown in **Figure 3–1**. The Project Premises within the greater WNYNSC are shown in **Figure 3–2**.

Table 3–1 General Regions of Influence by Resource Area

–	***Affected Environment***	***Region of Influence***
Land use and visual resources	Land ownership information, land-use practices, policies, and controls, and viewsheds of the site and surrounding region	WNYNSC and nearby offsite areas within Cattaraugus and Erie Counties
Site infrastructure	The utilities that service the site including electricity, fuel, water, sewage treatment, and roadways	WNYNSC and nearby offsite areas in Cattaraugus and Erie Counties
Geology, geomorphology, seismology, and soils	Geologic and soil characteristics, mineral and energy resources, soil contamination, site erosion processes, and geologic hazards including seismic activity and history	WNYNSC and nearby offsite areas to include regional seismic sources
Water resources	Surface water features and watersheds, groundwater hydrology, water supply sources, and surface and groundwater quality including contaminant sources	WNYNSC and downstream surface water bodies and groundwater
Meteorology, air quality, and noise	Meteorological conditions (i.e., temperature, precipitation, severe weather), air pollutant concentrations and emissions, site and surrounding noise sources	Meteorology: WNYNSC and the Western New York region. Air Quality: WNYNSC and nearby offsite areas within local air quality control regions (nonradiological emissions) Noise: Nearby offsite areas, access routes to the site
Ecological resources	Plants and animals, habitat types and assemblages including terrestrial resources, wetlands, aquatic resources, and threatened and endangered species or special status species	WNYNSC and nearby offsite areas
Cultural resources	Historical and archaeological resources and American Indian concerns	WNYNSC and nearby offsite areas within a 146-hectare (360-acre) area, Seneca Nation of Indians
Socioeconomics	The regional population, housing, public services (i.e., safety, health, education), and local transportation facilities and services	Cattaraugus and Erie Counties – income, housing/public services 80-kilometer (50-mile) and 480-kilometer (300-mile) radius – population distribution
Human health and safety	The health of site workers and the public	WNYNSC, offsite areas within 80 kilometers (50 miles) of the site (radiological air emissions); and the transportation corridors where worker and general population radiation, radionuclide, and hazardous chemical exposures could occur
Environmental justice	The presence of minority and low-income populations	The minority and low-income populations within 80 kilometers (50 miles) of the WNYNSC
Waste management and pollution prevention	Hazardous and nonhazardous solid waste and wastewater generation and management infrastructure practices	WNYNSC

Affected Environment = describes the baseline conditions of the environment, *Region of Influence* = the geographic region evaluated by the Proposed Action or alternatives.

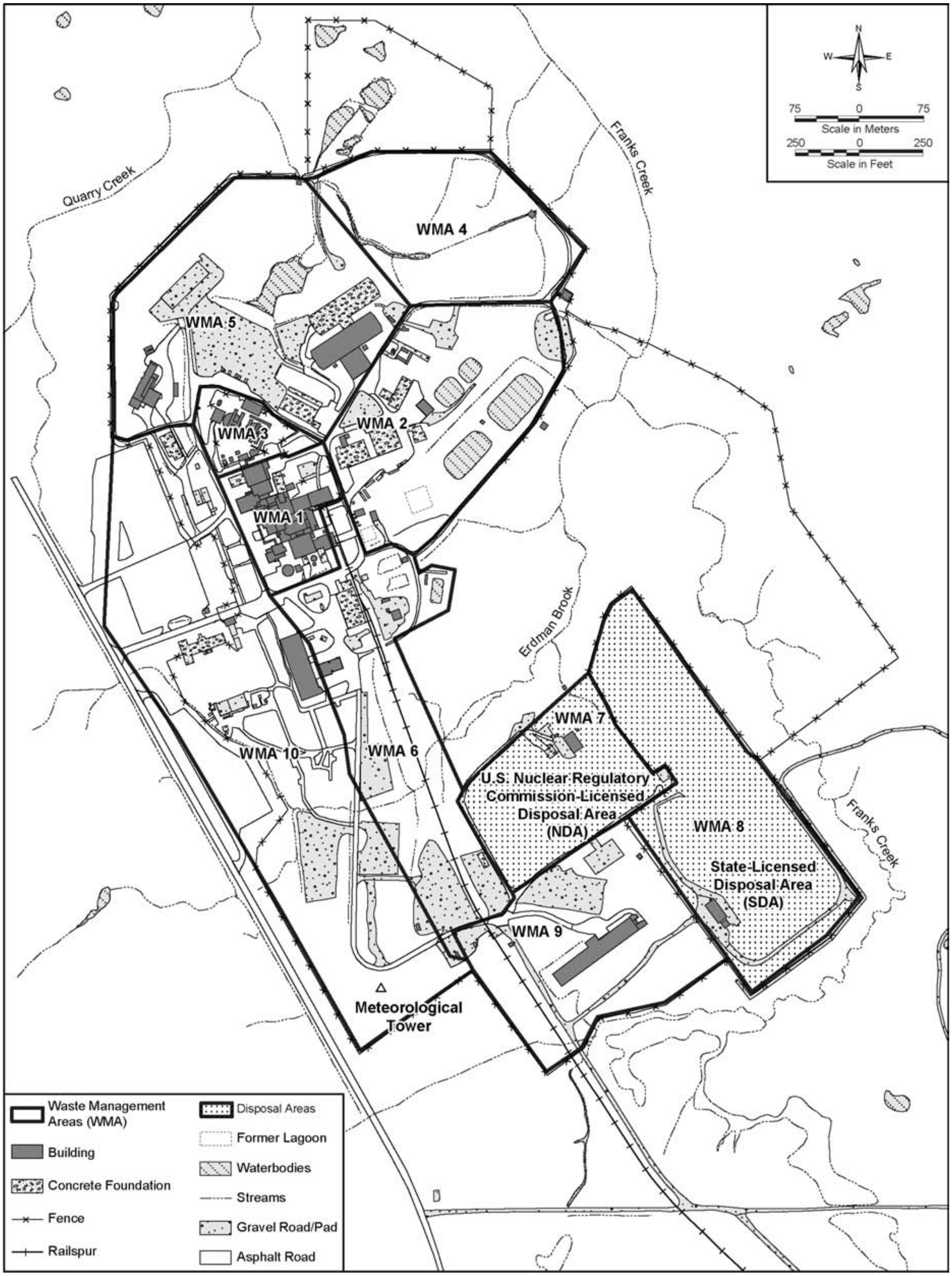


Figure 3–1 The West Valley Demonstration Project Premises (including the NRC-licensed Disposal Area) and the State-licensed Disposal Area

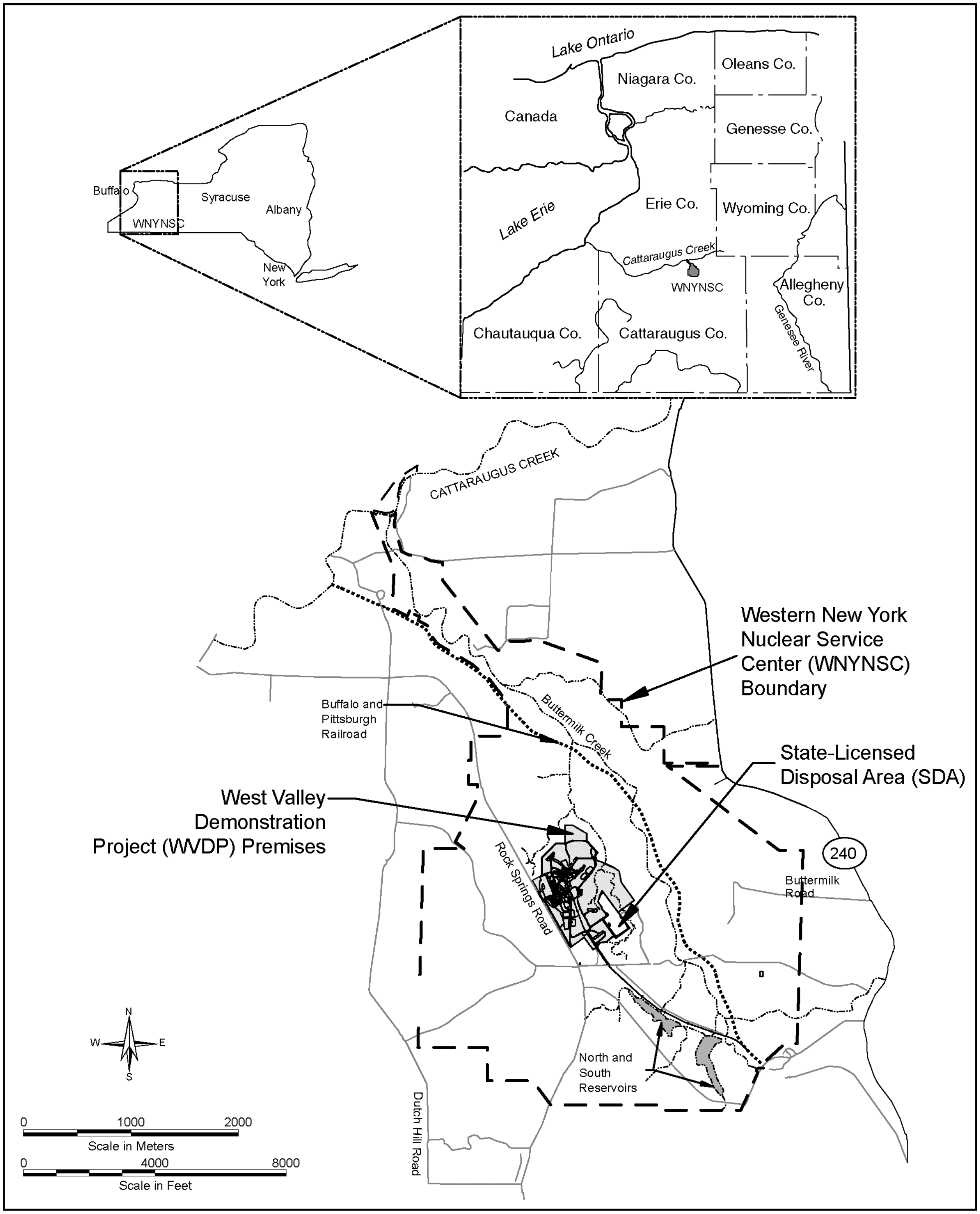


Figure 3–2 The Western New York Nuclear Service Center

Baseline conditions for each environmental resource area were determined for ongoing operations from information provided in previous environmental studies, relevant laws and regulations, and other Government reports and databases. More detailed information on the affected environment at the WNYNSC can be found in annual site environmental reports.

3.1 Land Use and Visual Resources

3.1.1 Land Use

The WNYNSC is on a 1,352-hectare (3,340-acre) site located near the hamlet of West Valley in the town of Ashford, New York, and was acquired by the State of New York in 1961. The property was leased to Nuclear Fuel Services, Inc. (NFS), who developed 67.6 hectares (167 acres) of the land and operated a nuclear fuel reprocessing center there from 1966 to 1972. NFS processed 640 metric tons (705 tons) of spent fuel at its West Valley reprocessing facility from 1966 to 1972 under an Atomic Energy Commission license. Fuel reprocessing ended in 1972 when the plant was shut down for modifications to increase its capacity, and reduce occupational radiation exposure and radioactive effluents. By 1976, NFS judged that over $600 million would be required to modify the facility. Later that year, NFS withdrew from the reprocessing business and requested to return control of the facilities to the site owner, New York State Energy Research and Development Authority (NYSERDA) (DOE 1978). In 1982, DOE assumed control, but not ownership, of the 67.6-hectare (167-acre) Project Premises portion of the site, as required by the 1980 WVDP Act. DOE provides general surveillance and security services for the entire WNYNSC (DOE 1996a, 2003e).

Major land uses in Cattaraugus County include: residential (29.3 percent); wild, forested, conservation lands, and public parks (22.8 percent); vacant land (22.4 percent); and agriculture (19.2 percent). The remaining 6.3 percent of the land within the county is classified as community services, recreation and entertainment, public services, industrial, commercial, or unknown (Crawford 2008). Land use within 8 kilometers (5 miles) of the WNYNSC is predominantly agricultural and the setting includes cropland, pasture, woodlands, natural areas, ponds, and house lots. The major exception is the Village of Springville, which comprises residential/commercial, and industrial land use (DOE 2003e). The Hamlet of West Valley is primarily characterized by residential and commercial land uses. The residential land uses are generally rural in nature (WVNS 2006).

Agricultural land uses are concentrated in the northern region of Cattaraugus County because the landscape is more favorable for agricultural practices (Paoletta 2003). Urban land use increases north of the WNYNSC toward Buffalo and west along the Lake Erie shoreline. Recreational land use increases to the south toward Allegany State Park and west toward Lake Erie. The section of Cattaraugus Creek that is downstream of the WNYNSC is primarily used for recreational purposes; however, some water is used for irrigation purposes (WVNS and URS 2006).

Light industrial and commercial (either retail or service-oriented) land use occurs near the WNYNSC. A field review of an 8-kilometer (5-mile) radius did not indicate the presence of any industrial facilities that would present a hazard in terms of safe operation of the site (DOE 2003e, WVNS 2006). A small military research installation is located approximately 5 kilometers (3 miles) northeast of the Project Premises. The facility, operated by Calspan Corporation, is used to conduct research operations for the U.S. Department of Defense. Although the facility uses small amounts of hazardous materials, it does not produce any products of a hazardous nature (DOE 2003e).

A similar land-use field review of the Village of Springville and the Town of Concord did not indicate the presence of any significant industrial facilities. Industrial facilities near the WNYNSC include Winsmith-Peerless Winsmith, Inc., a gear reducer manufacturing facility; Wayne Concrete Co., Inc., a readi-mix concrete supplier and concrete equipment manufacturing facility; and Springville Manufacturing, a fabricating facility for air cylinders. The industries within the Village of Springville and the Town of Concord, Erie County, are located in a valley approximately 6.4 kilometers (4 miles) to the north and 11.3 kilometers (7 miles) to the northwest, respectively, of the WNYNSC (DOE 2003e).

The Southern Tier West Regional Planning and Development Board, a regional planning board that includes Cattaraugus County, has issued its *2004 Regional Development Strategy* (Southern Tier West 2004). The objectives of the document include identifying an economic development strategy for the region, recommending implementation strategies, ensuring coordinated development, identifying the need to improve public facilities and utilities, facilitating economic development, and supporting Cattaraugus County corridor economic development and land use planning along U.S. Route 219 and NY Route 16 in the vicinity of the WNYNSC.

Most of the land use data for the region dates back to the late 1960s and 1970s, when many of the region's land use plans were developed. There have been no significant changes in these land use patterns since the development of this information. Minor changes include a decrease in active agricultural land acreage, an increase in maturing forest acreage, and an increase in the number of acreage lots (Southern Tier West 2004). In Cattaraugus County, use of agricultural land is expected to remain relatively unchanged. Residential growth near the WNYNSC is expected to continue in the towns of Yorkshire, Machias, and Ashford. Other towns near the WNYNSC are expected to remain rural for the foreseeable future. Commercial land use is expected to remain in the commercial centers of the county's villages, towns, and cities. Industrial land use is expected to increase in Yorkshire Township (northeast Cattaraugus County). Recreation on the Allegheny River, approximately 32 kilometers (20 miles) south of the WNYNSC, is also expected to increase.

Construction improvements to U.S. Route 219 will promote development and expansion by increasing the area's accessibility to major markets and transportation networks (Cattaraugus 2006a, 2007). Increased development is expected to occur in Ellicottville and Erie County (Cattaraugus 2007). A proposed Business Park will be located on an estimated 30 to 40 hectares (75 to 100 acres) of land within the Village of Ellicottville (Cattaraugus 2006b). The proposed Ashford Education and Business Park is located next to the Ashford Office Complex and would require approximately 8 hectares (20 acres) of land (Cattaraugus 2006a). A Railyard Industrial Park is planned at a site that previously served as a railyard in the Town of Great Valley. This park will support warehouse, industrial, distribution, intermodal, office, and research uses and facilities (Cattaraugus 2006c).

Growth in areas surrounding Ellicottville is partially due to the increased demand for tourism and recreation-related infrastructure (Southern Tier West 2006). Ski areas, including Holiday Valley and HoliMont, contribute to Ellicottville's development as a tourist destination (Cattaraugus 2006b). Proposed projects to develop tourism in Ellicottville include a tourist information center, an interpretive center, a performing arts center, and studio and shopping space that are estimated to total 32 to 40 hectares (80 to 100 acres). Tourism development will be concentrated in the central business district to limit sprawl in outlying areas (Cattaraugus 2006d). In the surrounding area, the Seneca Allegany Casino and Hotel in Salamanca was completed in March 2007 and includes a casino and a 212-room hotel (Seneca Gaming Corporation 2008).

The Zoar Valley Multiple Use Area located in the Towns of Collins, Persia, and Otto includes three areas that total 1,183 hectares (2,923 acres). The *2006 Draft Unit Management Plan* contains a proposal to designate a "protection area" that would encompass the Cattaraugus Creek gorge and nearby trails along the gorge and the banks of the Cattaraugus Creek's South Branch (NYSDEC 2006d).

3.1.2 Visual Environment

The WNYNSC is located in the northwest-southeast trending valley of Buttermilk Creek and consists mainly of fields, forests, and the ravines of several tributaries to Buttermilk Creek. The WNYNSC is in a rural setting surrounded by farms, vacant land, and single homes. From distant northern hilltops, the site appears primarily as hardwood forest and would be indistinguishable from the surrounding countryside if the Main Plant Process Building and main stack were not visible. From that distance, the Main Plant Process Building resembles a factory building or power plant. Several public roads pass through the WNYNSC, including Rock Springs Road, Buttermilk Road, and Thomas Corners Road. The site boundary is marked along the roadsides by a barbed wire fence with regularly spaced “POSTED” signs. Passers-by mainly see hardwood and hemlock forests, overgrown former farm fields, the southern end of the south reservoir bordered by pine trees, and wet low areas.

The WNYNSC facilities are predominantly located on plateaus occurring between Dutch Hill and Buttermilk Creek. The surrounding topography and forested areas obstruct views of the site areas from roadways; however, most of the facilities can be seen from hilltops along Route 240 (east of the WNYNSC). The WNYNSC is generally shielded from Rock Springs Road by pine trees, but can be seen from Rock Springs Road and Thornwood Drive when approaching from the south. Facilities including the Main Plant Process Building and stack, a warehouse, a large white tent-like lag storage area, the Remote-Handled Waste Facility, and other smaller structures, resemble an industrial complex. Two large paved parking lots are located outside the barbed wire-topped chain link security fence. Disposal areas include the SDA and NRC-licensed Disposal Area (NDA). The SDA has a geomembrane cover and is sloped to provide drainage, and the NDA is a maintained, grassed area. DOE installed a geomembrane cover over the NDA in 2008. Security lights illuminate the entire Project Premises at night. The developed portion of the site is consistent with the Bureau of Land Management’s Visual Resource Management Class IV rating, where major modifications to the natural landscape have occurred. The balance of the site’s viewshed generally ranges from Visual Resource Management Class II to Class III, where visible changes to the natural landscape are low to moderate but may attract the attention of the casual observer (DOI 1986).

3.2 Site Infrastructure

Site infrastructure includes those utilities required to support the operations of the WNYNSC and local transportation infrastructure, as summarized in **Table 3–2**.

Table 3–2 Western New York Nuclear Service Center Sitewide Infrastructure Characteristics

Resource	***Site Usage***	***Site Capacity***
Electricity		
Energy consumption (megawatt-hours per year)	15,860	105,120
Peak load (megawatts)	2.2 [a]	12
Fuel		
Natural gas (cubic meters per year)	2,170,000	27,300,000 [b]
Fuel oil (liters per year)	26,500	38,000 [c]
Water (liters per year)	153,000,000	795,000,000
Sanitary Sewage Treatment (liters per day)	–	151,000
U.S. Route 219 near WVDP	–	Level of Service D

[a] Peak load estimated from average sitewide electrical energy usage, assuming peak load is 120 percent of average demand.
[b] Calculated from installed capacity and may not reflect sustainable supply.
[c] Reflects onsite bulk storage only. Capacity is only limited by the ability to ship resources to the site.
Note: To convert liters to gallons, multiply by 0.264; and cubic meters to cubic feet, by 35.315.
Sources: Steiner 2006, WVNS 2004a.

3.2.1 Electricity

Electrical power is transmitted to the WNYNSC via the Niagara Mohawk (now owned by National Grid USA) distribution system (WVNS 2006). For the Project Premises, electricity is purchased through the Defense Energy Support Center (Steiner 2006). Power for the Project Premises is supplied via a 34.5-kilovolt-loop system. A feeder line from a 34.5-kilovolt switching station transmits power to the site substations where it is stepped down to 480 volts. Electricity from the 34.5-kilovolt-line is routed to two 2,500-kilowatt-ampere transformers at the Main Plant Process Building and Utility Room Expansion in Waste Management Area (WMA) 1. The substation switchgears are interconnected through cables to provide backfeed capabilities in the event that any 34.5-kilovolt to 480-volt substation transformer fails (WVNS 2006).

The reservoir pumps that supply water to the Radwaste Treatment System Drum Cell (WMA 9), the Remote-Handled Waste Facility in WMA 5, the NDA facilities, and the site perimeter monitoring stations obtain power from a separate 4,800-volt to 480-volt rural distribution system (WVNS 2006).

Backup electrical power is supplied by three standby (backup) diesel-fired generators with diesel fuel provided from onsite storage tanks. The generators include a 625-kilovolt-ampere unit located in the Utility Room (WMA 1), a 1,560-kilovolt-ampere unit located in the Utility Room Expansion (WMA 1), and a 750-kilovolt-ampere generator located in the Permanent Ventilation System Building mechanical room (WMA 3). In the event of failure of the main power supply, all of the diesel generators will initiate automatically and then the associated switchgears will disconnect the utility line and noncritical loads and supply power to essential systems. Day-tank storage capacity is sufficient for each generator to operate continuously for 8 hours (WVNS 2006).

Between April 2005 to March 2006, electrical energy consumption was 15,860 megawatt-hours (Steiner 2006). This consumption reflects an average load demand of about 1.8 megawatts. The WNYNSC substations have a combined, installed capacity of 12 megawatts, which is equivalent to a site electrical energy availability of about 105,120 megawatt-hours annually. Electricity consumption is expected to decrease as buildings continue to be decommissioned (Steiner 2008).

3.2.2 Fuel

The National Fuel Company provides natural gas, the primary fuel used by WNYNSC facilities, to the WNYNSC, through a 15-centimeter- (6-inch-) supply line. The supply is pressure regulated and metered at the Utility Room. Natural gas is distributed from the Utility Room to onsite areas for heating purposes and is regulated at the points of use. Natural gas is not routed through areas that contain or historically contained radioactive materials. A major use of natural gas is by two natural gas steam boilers housed in the Utility Room Expansion. The boilers can also use number 2 diesel fuel oil. However, cessation of nuclear fuel reprocessing operations resulted in a major reduction in steam usage and associated natural gas demand (WVNS 2006).

Natural gas consumption totaled approximately 2.17 million cubic meters (76.8 million cubic feet) in 2005. Natural gas consumption has historically averaged about 2.8 million cubic meters (100 million cubic feet) annually (Steiner 2006). The natural gas distribution system serving site facilities has an installed capacity of about 3,110 cubic meters (110,000 cubic feet) per hour or approximately 27.3 million cubic meters (964 million cubic feet) annually (WVNS 2006).

Number 2 diesel fuel oil (fuel oil) is also used to operate the backup generators and to run forklifts (Steiner 2006). In addition to day tanks at each generator, the bulk of the fuel is stored in a 38,000-liter (10,000-gallon) aboveground storage tank (Steiner 2008, WVNS 2006). In 2005, approximately 26,500 liters (7,000 gallons) of fuel oil was consumed at the site (Steiner 2006). Fuel use is expected to be smaller in the future (Steiner 2008).

3.2.3 Water

The WNYNSC has its own reservoir and water treatment system to service the site. The system provides potable and facility service water for operating systems and fire protection. The reservoir system was created by constructing dams on Buttermilk Creek tributaries south of the Project Site. The reservoirs provide the raw water source for the non-community, nontransient water supply operated on site (DOE 2003e). Specifically, the two interconnected reservoirs (North and South Reservoirs) cover about 10 hectares (25 acres) of land and contain approximately 2.1 billion liters (560 million gallons) of water (see Figure 3–2). A pump house located adjacent to the North Reservoir with dual 1,500-liters-per-minute (400-gallons-per-minute) rated pumps supplies water to the Project Premises through a 20-centimeter (8-inch) pipeline. A clarifier/filter system in WMA 1 provides treatment for incoming raw water, prior to transfer into a 1.8-million-liter (475,000-gallon) storage tank. An electric pump with a diesel backup is used to pump water from the storage tank through underground mains to the plant or utility system. Water pressure is furnished by two 950-liter-per-minute (250-gallon-per-minute) pumps that supply water at a minimum pressure of 520 kilopascals (75 pounds per square inch). The utility provides makeup water for the cooling operations and other subsystems and directly feeds the fire protection system (WVNS 2006).

Water for the domestic (potable) system is drawn on demand from the utility water and is further chlorinated using sodium hypochlorite, with the treated water stored in a 3,800-liter (1,000-gallon) accumulator tank for distribution. Demineralized water can be produced in the Utility Room (WMA 1) via a cation-anion demineralizer. The demineralized water system will normally produce 60-liters per minute (16 gallons per minute) of demineralized water that is stored in a 68,000-liter (18,000-gallon) storage tank. Three pumps are available to distribute demineralized water to chemical process areas within the WVDP (WVNS 2006).

The raw water supply system has an installed capacity of approximately 1,510 liters per minute (400 gallons per minute) or approximately 795 million liters (210 million gallons) annually (WVNS 2004a). Water use across the WNYNSC has averaged roughly 153 million liters (40.3 million gallons) annually (Steiner 2006). This estimate is based on the average demands for the site's workforce and industrial demands for systems still in operation. Annual water use may be reduced in the future due to ongoing decommissioning activities (Steiner 2008).

3.2.4 Sanitary Sewer

The Sewage Treatment Plant (WMA 6) treats sanitary sewage and nonradioactive industrial wastewater from the Utility Room. The treatment system consists of a 151,000-liter-per-day (40,000-gallon-per-day) extended aeration system with sludge handling (WVNS 2004a).

There are no entry points into the sewage system other than the toilet facilities, washroom, kitchen sinks, and shower facilities. No process area or office building floor drains are connected to the sanitary sewer system other than the floor drains in the facility shower rooms and lavatory facilities (WVNS 2004a).

Industrial wastewater from the Utility Room enters the system through dedicated pipes, tanks, and pumps. The wastewater is collected and pumped into the Sewage Treatment Plant, where it is mixed with sanitary sewage and treated. Entries to the system are through dedicated lines from the Utility Room water treatment equipment, boilers, and floor drains in the Utility Room Expansion. Liquid discharge is to one of four outfalls where liquid effluents are released to Erdman Brook. These four outfalls are identified in the State Pollutant Discharge Elimination System permit, which specifies the sampling and analytical requirements for each outfall (WVNS 2004a).

3.2.5 Local Transportation

Transportation facilities near the WNYNSC include highways, rural roads, a rail line, and aviation facilities. The primary method of transportation in the site vicinity is by motor vehicle on the local roads (see **Figure 3–3**).

The majority of the roads in Cattaraugus County, with the exception of those within the cities of Olean and Salamanca, are considered rural roads. Rural principal arterial highways are connectors of population and industrial centers. This category includes U.S. Route 219, located about 4.2 kilometers (2.6 miles) west of the site; Interstate 86, the Southern Tier Expressway located about 35 kilometers (22 miles) south of the site; and the New York State Thruway (I-90), about 56 kilometers (35 miles) north of the site. U.S. Route 219 exists as a freeway from its intersection with Interstate 90 near Buffalo, New York, to its intersection with Route 39 at Springville, New York; but exists as a 2-lane road from Springville to Salamanca, New York. Traffic volume along U.S. Route 219 between Springville and the intersection with Cattaraugus County Route 12 (East Otto Road) ranges from an average annual daily traffic volume of approximately 8,900 vehicles near Ashford Hollow to approximately 9,700 vehicles at Route 39 near Springville (NYSDOT 2006). This route, as it passes the site, operates at a level of service D, which reflects high density and unstable flow, an operating speed of 80 kilometers (50 miles) per hour, and maneuverability being limited for short periods during temporary backups (USDOT and NYSDOT 2003b).

Rock Springs Road, adjacent to the site on the west, serves as the principal site access road. The portion of this road between Edies Road and U.S. 219 is known as Schwartz Road. Along this road, between the site and the intersection of U.S. 219, are fewer than 21 residences. State Route 240, also identified as County Route 32, is 2 kilometers (1.2 miles) northeast of the site. Average annual daily traffic on the portion of NY Route 240 that is near the site (between County Route 16, Roszyk Hill Road, and NY Route 39) ranges from 880 vehicles to 1,550 vehicles (NYSDOT 2006).

One major road improvement project could impact access to the WNYNSC. In January of 2007, the New York State Department of Transportation started construction to extend the U.S. Route 219 freeway at NY Route 39 in Springville to Interstate 86 in Salamanca. Near West Valley, the new freeway will be located only 0.2 to 0.4 kilometers (0.1 to 0.25 miles) from the existing U.S. Route 219, which will be retained. Completion of a 6.8-kilometer (4.2-mile) extension from Route 39 to Peters Road in Ashford, New York (southwest of WNYNSC), is expected in Summer 2009 (NYSDOT 2008a). An interchange at Peters Road in Ashford will accommodate employees living north of the site (NYSDOT 2003). Continued expansion to I-86 in Salamanca will not proceed until an agreement is reached with the Seneca Nation or additional environmental studies have been completed (NYSDOT 2005).

The Buffalo and Pittsburgh Railroad line is located within 800 meters (2,600 feet) of the site. Owned and operated by Genesee and Wyoming Inc., the Buffalo and Pittsburgh Railroad is part of an integrated regional rail operation which includes Rochester and Southern Railroad and the South Buffalo Railway. Together they have direct connections to both major U.S. railroads that service the east (CSX Transportation and Norfolk Southern) as well as both of Canada's transcontinental railroads (Canadian National and Canadian Pacific). Major types of freight include coal, petroleum, metals and forest products (G&W 2008). In 1999, the Buffalo and Pittsburgh Railroad completed connection of track between Ashford Junction and Machias, New York. Service by the Buffalo and Pittsburgh Railroad on the rail line from the WVDP Premises to Ashford Junction and then to Machias now provides the WNYNSC with rail access (DOE 2003e).

There are no commercial airports in the site vicinity. The only major aviation facility in Cattaraugus County is the Olean Municipal Airport, located in the Town of Ischua, 34 kilometers (21 miles) southeast of the WNYNSC. Regularly scheduled commercial air service was terminated at this airport in early 1972. The nearest major airport is Buffalo Niagara International Airport, 55 kilometers (34 miles) north of the site (DOE 2003e).

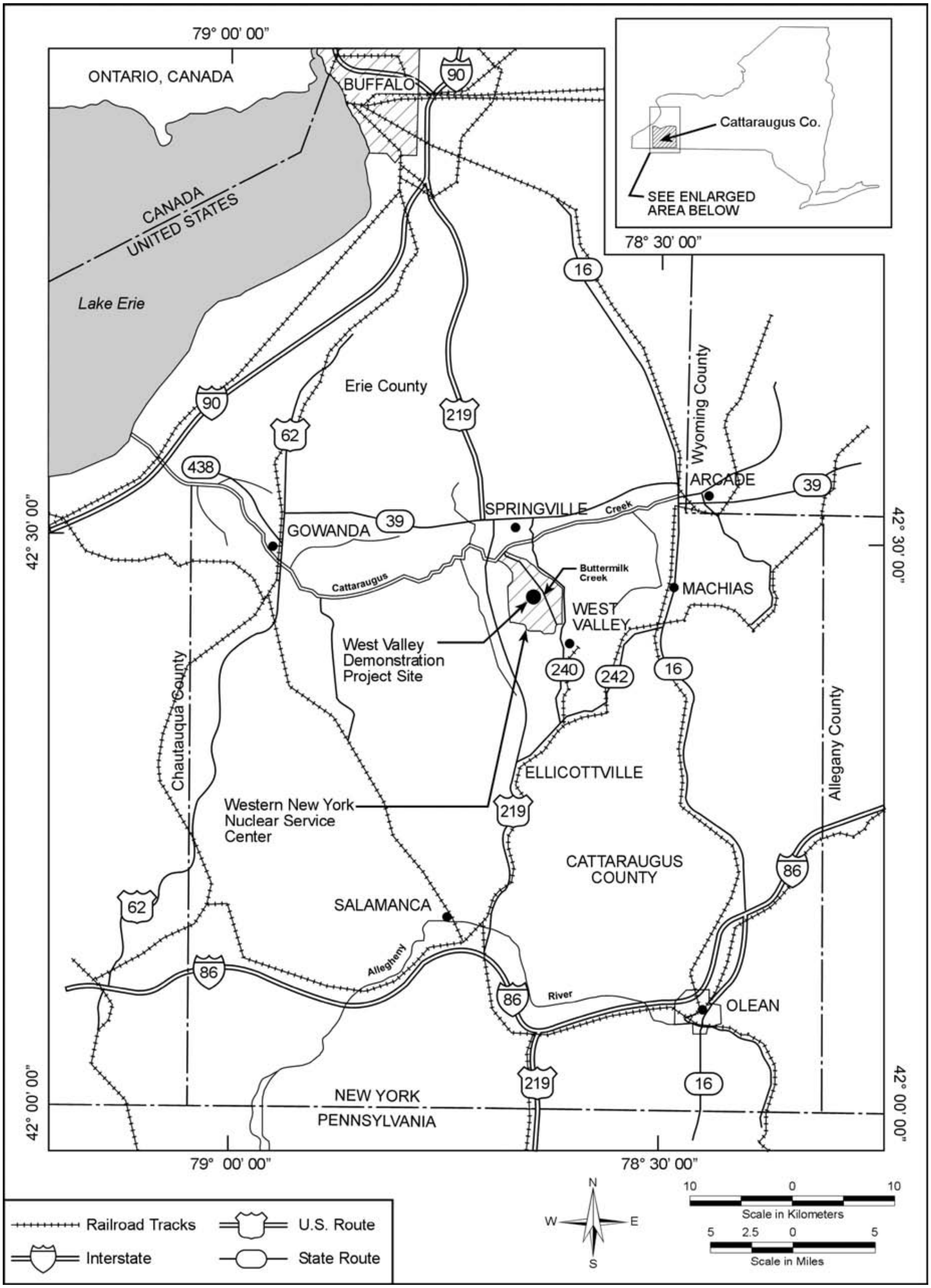


Figure 3–3 Transportation Routes Near the Western New York Nuclear Service Center

3.3 Geology and Soils

The geologic conditions including physiographic location, surface topography, glacial lithology and stratigraphy, and bedrock conditions underlying and surrounding the WNYNSC and the WVDP Premises are described in the following sections.

3.3.1 Geology

Geologic unit descriptions and origins were obtained from Prudic (1986) as modified by WVNS (1993f, 1993d). The thickness of stratigraphic units was obtained from lithologic logs of borings drilled in 1989, 1990, and 1993 (WVNS 1993h, 1994a); Well 905 (WVNS 1993d); and Well 834E (WVNS 1993f).

3.3.1.1 Glacial Geology and Stratigraphy

The WNYNSC is located within the glaciated northern portion of the Appalachian Plateau physiographic province (**Figure 3–4**). The surface topography is dominated by Buttermilk Creek and its tributaries which are incised into bedrock and the surrounding glaciated upland topography. The maximum elevation on the WNYNSC occurs at the southwest corner of the facility at an elevation of 568 meters (1,862 feet) above mean sea level. The minimum elevation of 338 meters (1,109 feet) above mean sea level occurs near the confluence of Buttermilk Creek and Cattaraugus Creek on the floodplain at the northern extent of the facility. The average elevation across the WNYNSC is 435 meters (1,426 feet) with a modal elevation of 423 meters (1,387 feet) above mean sea level (URS 2008a). The facility is approximately midway between the boundary line delineating the southernmost extension of Wisconsin Glaciation and a stream-dissected escarpment to the north that marks the boundary between the Appalachian Plateau and the Interior Low Plateau Province. The Appalachian Plateau is characterized by hills and valleys of low to moderate relief between the Erie-Ontario Lowlands to the north and the Appalachian Mountains to the south (WVNS 1993f).

The Project Premises are located on a stream-disected till plain that occurs west of Buttermilk Creek and east of the glaciated upland. Surface topography on the Project Premises declines from a maximum elevation of 441 meters (1,447 feet) in the main parking lot to 398 meters (1,305 feet) near the confluence of Franks Creek and Erdman Brook with an average elevation of 423 meters (1,389 feet) above mean sea level. Erdman Brook separates the Project Premises into North and South Plateau areas (WVNS 1993f). The confluence of Franks Creek and Erdman Brook delineates an eastern plateau area that is contiguous with the South Plateau. The surface topography east of the Project Premises declines to approximately 366 meters (1,200 feet) within the Buttermilk Creek Valley (**Figure 3–5**).

The WNYNSC is located on the west flank of the Buttermilk Creek Valley which is part of a longer steep-sided, northwest-trending U-shaped valley that has been incised into the underlying Devonian bedrock. A 150 meters (500 feet) thick sequence of Pleistocene age deposits and overlying Holocene (recent age) sediments occupies the valley. Repeated glaciation of the ancestral bedrock valley occurred between 14,500 and 38,000 years ago resulting in the deposition of three glacial tills (Lavery, Kent, and Olean tills) that comprise the majority of the valley fill deposits (WVNS 1993f, WVNS and URS 2005). The uppermost Lavery till and younger surficial deposits form a till plain with elevation ranging from 490 meters to 400 meters (1,600 to 1,300 feet) from south to north covering 25 percent of the Buttermilk Creek basin. The WVDP Premises and the SDA are located on the stream-dissected till plain west of Buttermilk Creek. The Holocene sediments were primarily deposited as alluvial fans and aprons that were derived from the glacial sediments that covered the uplands surrounding the WNYNSC and from floodplain deposits derived from the Pleistocene tills (WVNS 1993f, 2006).

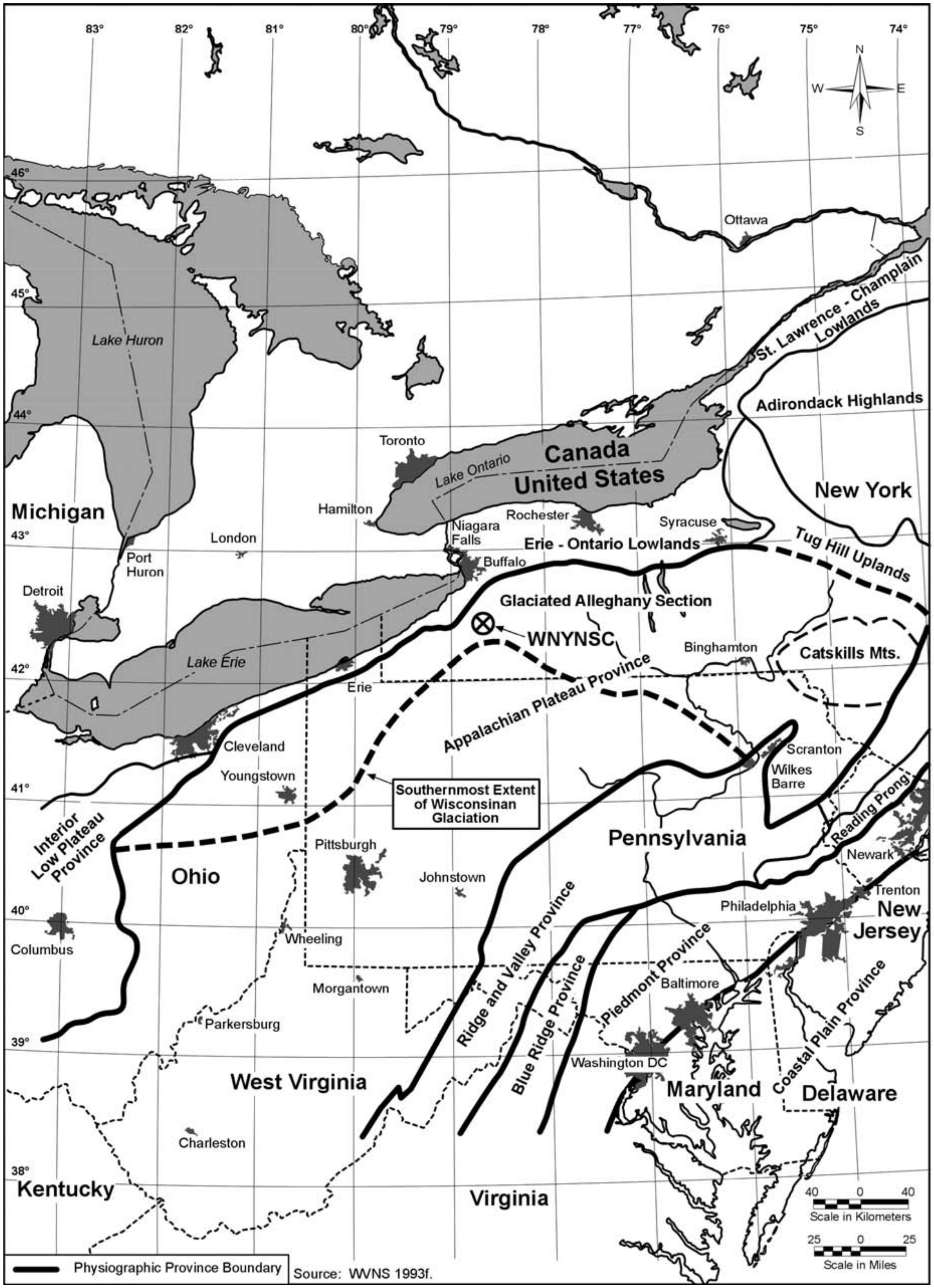


Figure 3–4 Regional Physiographic Map

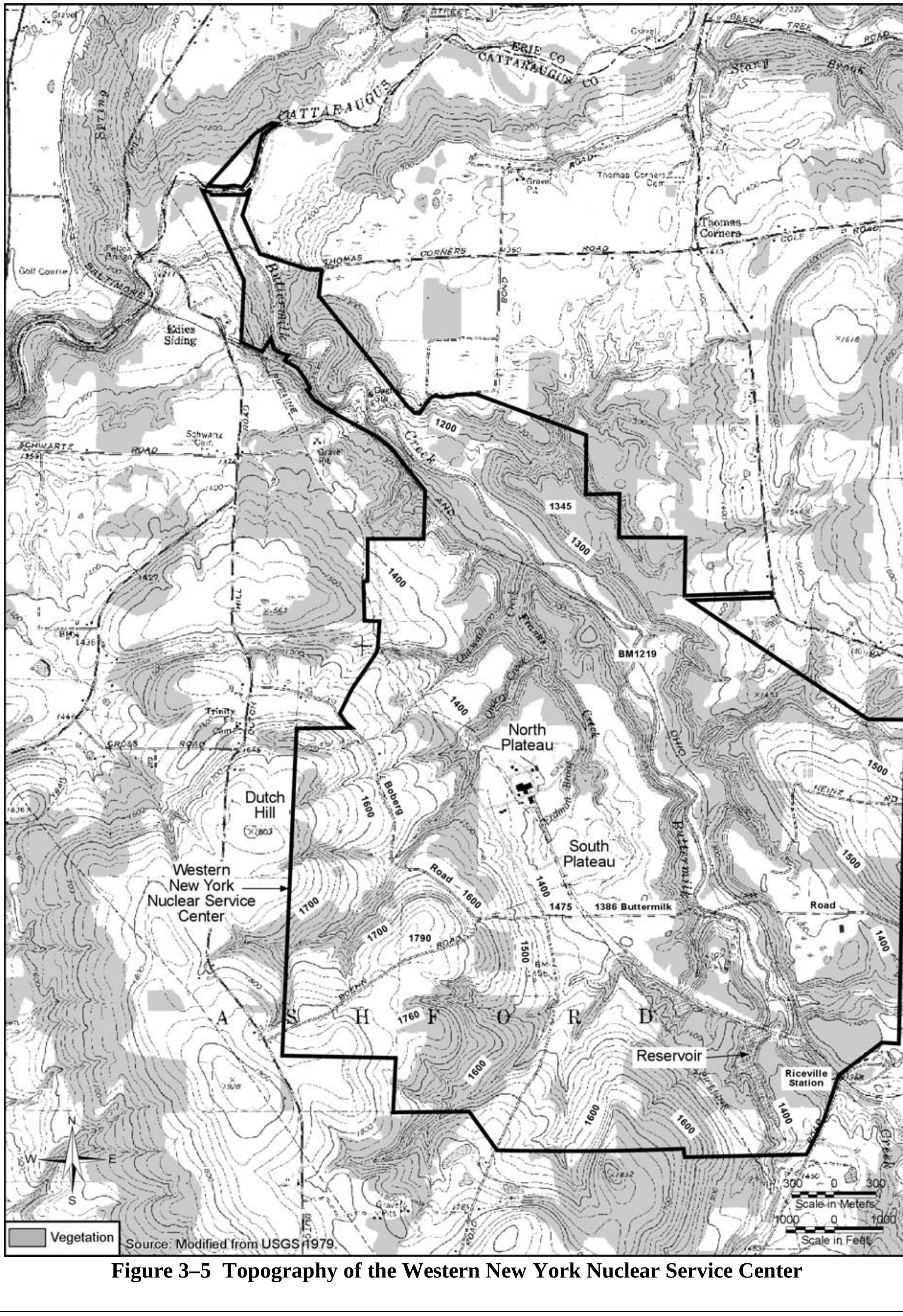


Figure 3–5 Topography of the Western New York Nuclear Service Center

The stratigraphy underlying the North and South Plateaus exhibits key differences as summarized in **Table 3–3** and shown in the generalized cross-sections in **Figures 3–6** and **3–7**, respectively. The surficial geology on the Project Premises and the SDA is shown in **Figure 3–8**. Additional information on the hydrogeologic characteristics of the site stratigraphy is provided in Section 3.6.2 and Appendix E.

Table 3–3 Stratigraphy of the West Valley Demonstration Project Premises and the State-licensed Disposal Area [a]

Geologic Unit	*Description*	*Origin*	*Thickness [b]* North Plateau (meters)	*Thickness [b]* South Plateau (meters)
Colluvium	Soft plastic pebbly silt only on slopes, includes slump blocks several meters thick	Reworked Lavery or Kent till	0.3 to 0.9	0.3 to 0.9
Thick-bedded unit	Sand and gravel, moderately silty	Alluvial fan and terrace deposits	0 to 12.5	0 to 1.5 at Well 905[c]; not found at other locations
Slack-water sequence	Thin-bedded sequence of clays; silts, sands, and fine-grained gravel at base of sand and gravel layer	Lake deposits	0 to 4.6	Not present
Weathered Lavery till	Fractured and moderately porous till, primarily comprised of clay and silt	Weathered glacial ice deposits	0 to 2.7 (commonly absent)	0.9 to 4.9, average = 3
Unweathered Lavery till	Dense, compact, and slightly porous clayey and silty till with some discontinuous sand lenses	Glacial ice deposits	1 to 31.1 Lavery till thins west of the Project Premises	4.3 to 27.4 Lavery till thins west of the Project Premises
Till-sand member of Lavery till	Thick and laterally extensive fine to coarse sand within Lavery till	Possible meltwater or lake deposits	0.1 to 4.9	May be present in one well near northeast corner of the NDA
Kent Recessional Sequence	Gravel comprised of pebbles, small cobbles, and sand, and clay and clay-silt rhythmic layers overlying the Kent till	Proglacial lake, deltaic, and alluvial stream deposits	0 to 21.3	0 to 13.4
Kent till, Olean Recessional Sequence, Olean till	Kent and Olean tills are Clayey and silty till similar to Lavery till. Olean Recessional Sequence predominantly clay, clayey silt, and silt in rhythmic layers similar to the Kent recessional sequence overlying the Olean till	Mostly glacial ice deposits	0 to 91.4	0 to 101
Upper Devonian bedrock	Shale and siltstone, weathered at top	Marine sediments	> 402	> 402

[a] Source: Geologic unit descriptions and origins from Prudic (1986) as modified by WVNS (1993f, 1993d). Thickness from lithologic logs of borings drilled in 1989, 1990, and 1993 (WVNS 1993h, 1994a); from Well 905 (WVNS 1993d); and from Well 834E (WVNS 1993f). Kent and Olean till thickness from difference between bedrock elevation (based on seismic data) and projected base of Kent recessional sequence (WVNS 1993f); upper Devonian bedrock thickness from Well 69 U.S. Geological Survey 1-5 located in the southwest section of the WNYNSC (WVNS 1993f).

[b] To convert meters to feet, multiply by 3.2808.

[c] Coarse sandy material was encountered in this well. It is unknown whether this deposit is equivalent to the sand and gravel layer on the North Plateau.

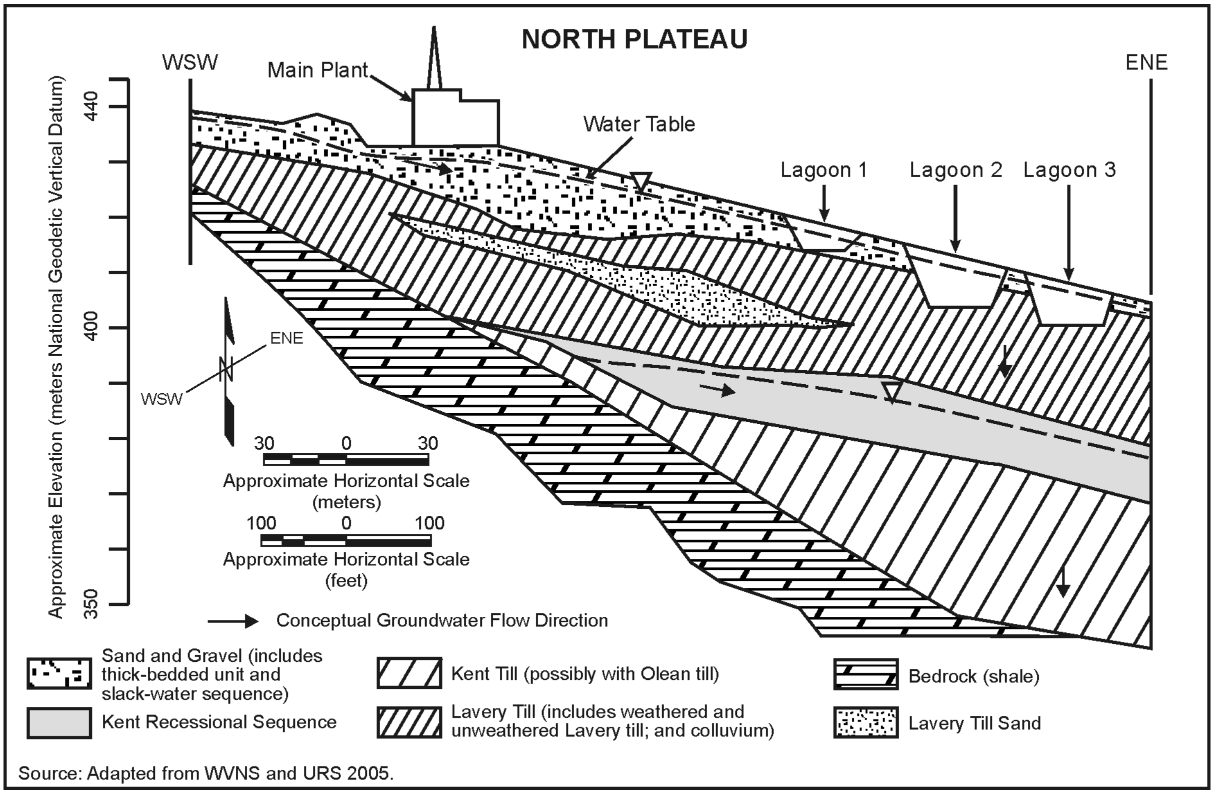


Figure 3–6 Generalized Geologic Cross-section through the North Plateau, and Colluvium (Vertical Exaggeration Approximately 2:1)

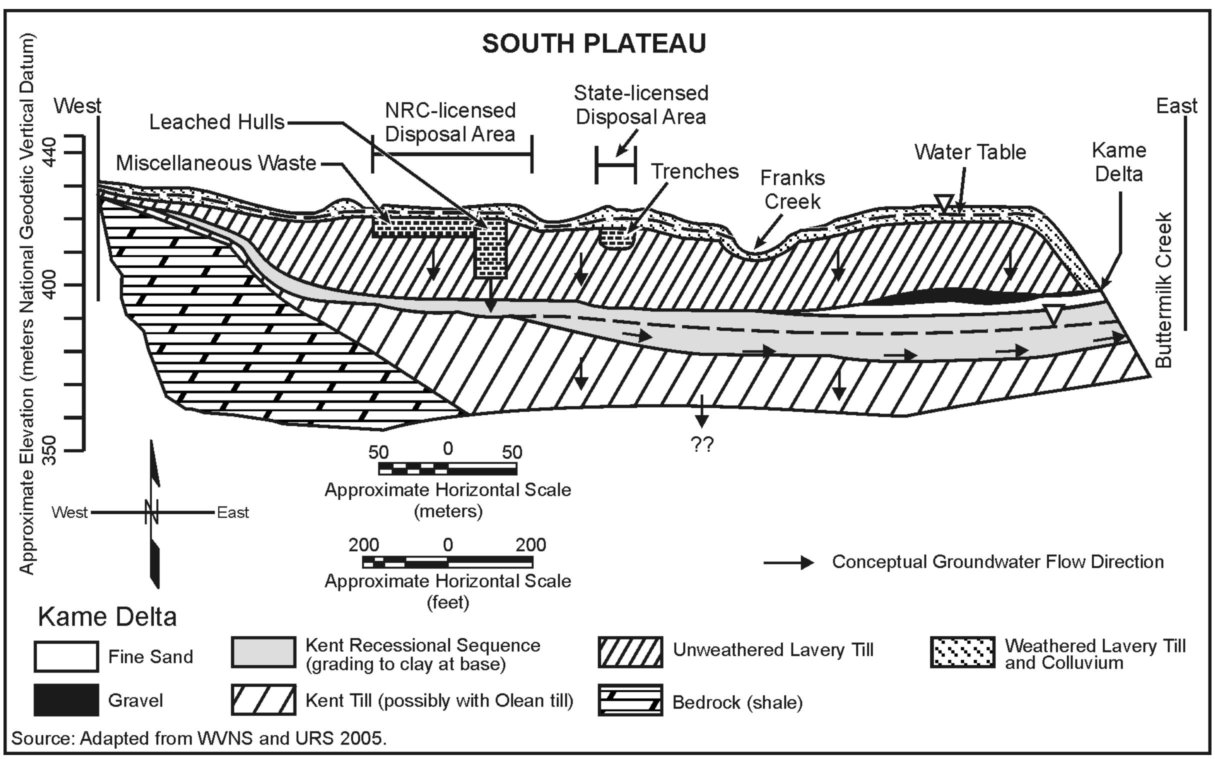
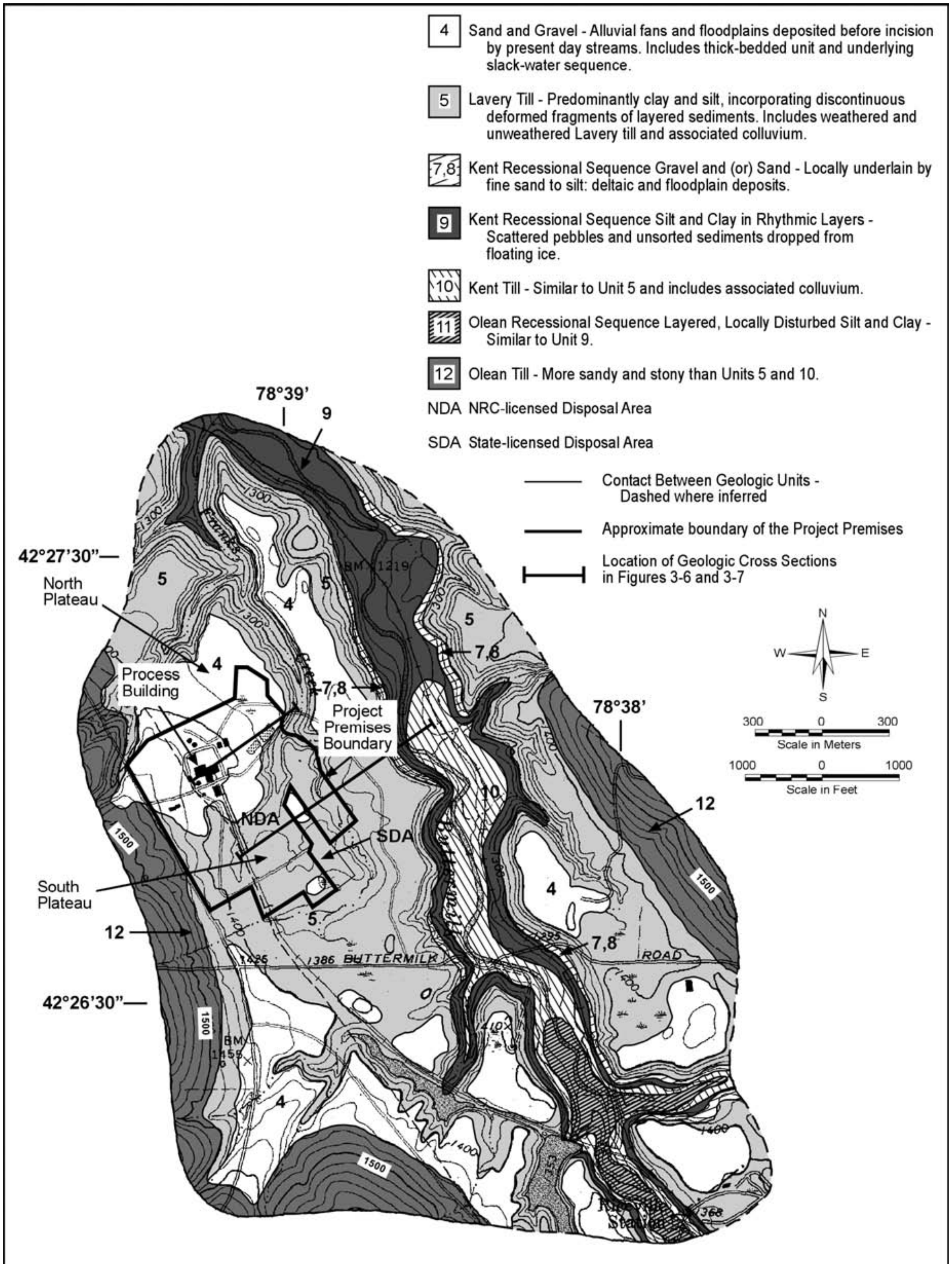


Figure 3–7 Generalized Geologic Cross-section through the South Plateau (Vertical Exaggeration Approximately 2.5:1)



Source: Modified from Prudic 1986.
Note: Topographic contours are in feet. Multiply by 0.3048 to convert to meters.

Figure 3–8 Topography and Surface Geology at the West Valley Demonstration Project Site and Vicinity

North Plateau

Surficial Units (Colluvium, Thick-bedded Unit, and Slack-water Sequence)—The surficial sand and gravel consists of an upper alluvial deposit, the thick-bedded unit, and a lower glaciofluvial gravel deposit, the slack-water sequence (**Figures 3–9** and **3–10**). The thick-bedded unit, the thicker and more extensive of the coarse deposits, is an alluvial fan that was deposited by Holocene streams entering the Buttermilk Creek Valley. The alluvial fan overlies the Lavery till over the majority of the North Plateau and directly overlaps the Pleistocene-age glaciofluvial slack-water sequence that occurs in a narrow northeast-trending trough in the Lavery till (Figures 3–9 and 3–10). The Main Plant Process Building and the adjacent facilities partially or fully penetrate the thick-bedded unit (WVNS 1993f, 1993d, 2004a). Holocene landslide deposits (colluvium) also overlies or is interspersed with the sand and gravel (WVNS 1993f) on steeper slopes. Fill material occurs in the developed portions of the North Plateau, and mainly consists of recompacted surficial sediment that is mapped with the sand and gravel (WVNS 1993d).

The slack-water sequence consists of Pleistocene glaciofluvial gravel that overlies the Lavery till in a narrow northeast trending trough across the North Plateau (WVNS 1993f, 1993d, 2004a). The slack-water sequence consists of undifferentiated thin-bedded layers of clay, silt, sand, and small gravel deposited in a glacial lake environment (WVNS 2004a).

The average textural composition of the surface sand and gravel is 41 percent gravel, 40 percent sand, 11 percent silt, and 8 percent clay classifying it as a muddy gravel or muddy sandy gravel (WVNS 1993d). The sand and gravel is thickest along a southwest to northeast trend across WMA 1 based on borehole observations. The total thickness ranges from approximately 9 meters (30 feet) along this trend to 12.5 meters (41 feet) near the northeastern corner of WMA 1. Locally thick sand and gravel deposits are inferred to correspond to channels in the underlying Lavery till. The sand and gravel thins to the north, east, and south where it is bounded by Quarry Creek, Franks Creek, and Erdman Brook, respectively, and to the west against the slope of the bedrock valley (WVNS 1993f, 1993d; WVNS and URS 2006). Recent (2007) reinterpretation of sandy intervals underlying the North Plateau has revised the extent of the Lavery till-sand and the slack-water sequence. The primary justification for the stratigraphic revision is based on the elevation of the encountered units as delineated from borings. As a result of the reinterpretation, the horizontal extent of the slack-water sequence has been expanded from previous delineations to encompass areas upgradient of the Main Plant Process Building and extended to conform to the surface of the underlying unweathered Lavery till. Since fewer borings are now considered to have encountered Lavery till-sand, the horizontal extent of the Lavery till-sand has been reduced (WVES 2007b). The hydrogeologic characteristics of the surficial sand units on the North Plateau are described in Section 3.6.2.1.

Lavery Till—The entire Project Premises are underlain by Lavery till. The till was deposited from an ice lobe that advanced into the ancestral Buttermilk Creek Valley through impounded lake waters (WVNS 1993d). The unweathered Lavery till consists of dense olive-gray, pebbly, silty clay and clayey silt that is typically calcareous. The till contains discontinuous and randomly oriented pods or masses of stratified sand, gravel, and rhythmically laminated clayey silt. The till underlying the North Plateau is predominantly unweathered and unfractured, owing to the emplacement of the overlying sand and gravel (WVNS 1993f). Weathered zones in the till underlying the North Plateau are generally less than 0.3 meters (1 foot) thick (WVNS and Dames and Moore 1997). The average textural composition of the unweathered Lavery till is 50 percent clay, 30 percent silt, 18 percent sand, and 2 percent gravel (WVNS 1993d). The till ranges in thickness from 9 to 12 meters (30 to 40 feet) beneath the process area (WMAs 1 and 3) (WVNS 1993f, WVNS and Dames and Moore 1997). The hydrogeologic characteristics of the unweathered Lavery till are described in Section 3.6.2.1.

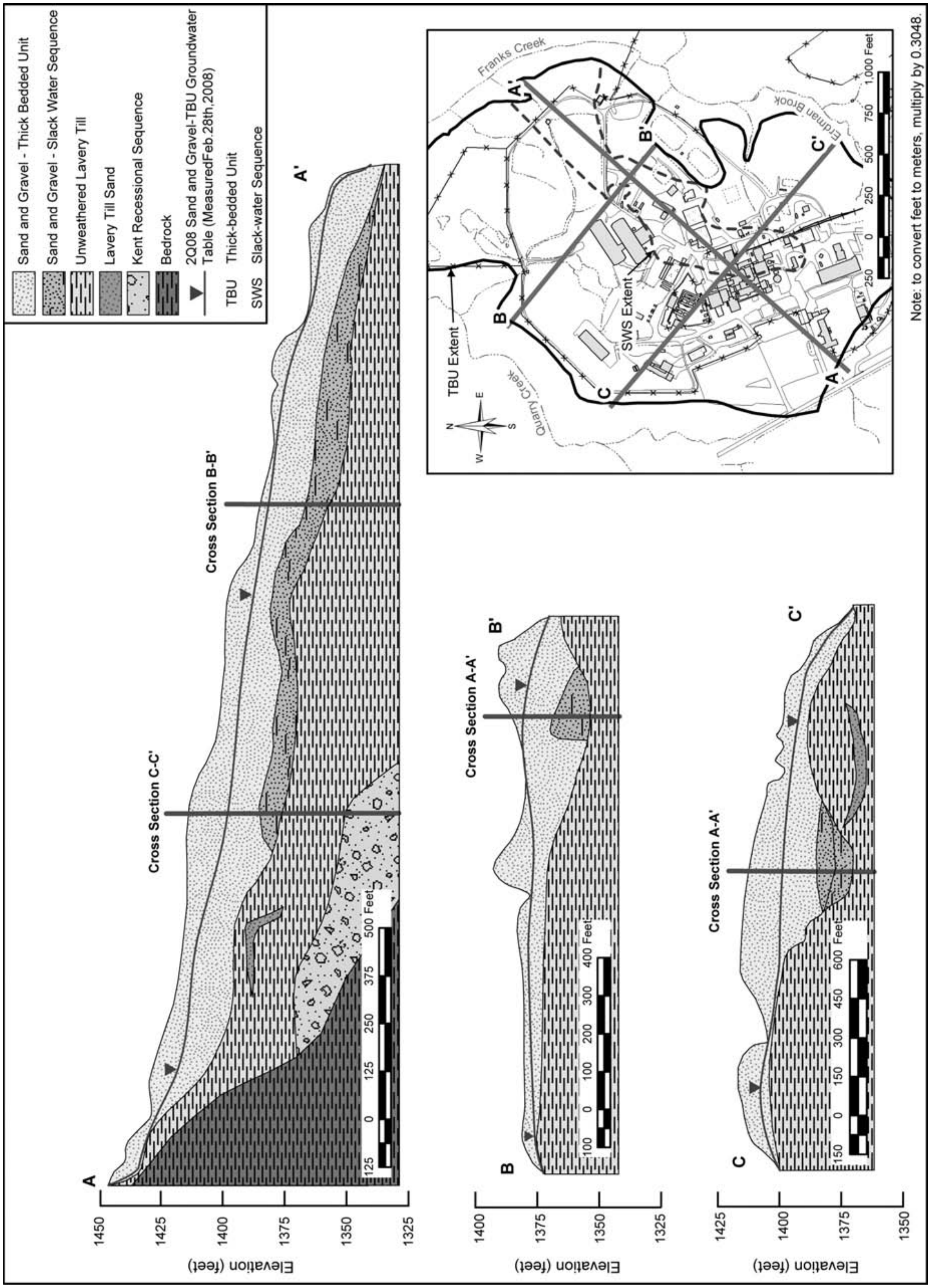


Figure 3–9 Slack-water Sequence in Profile

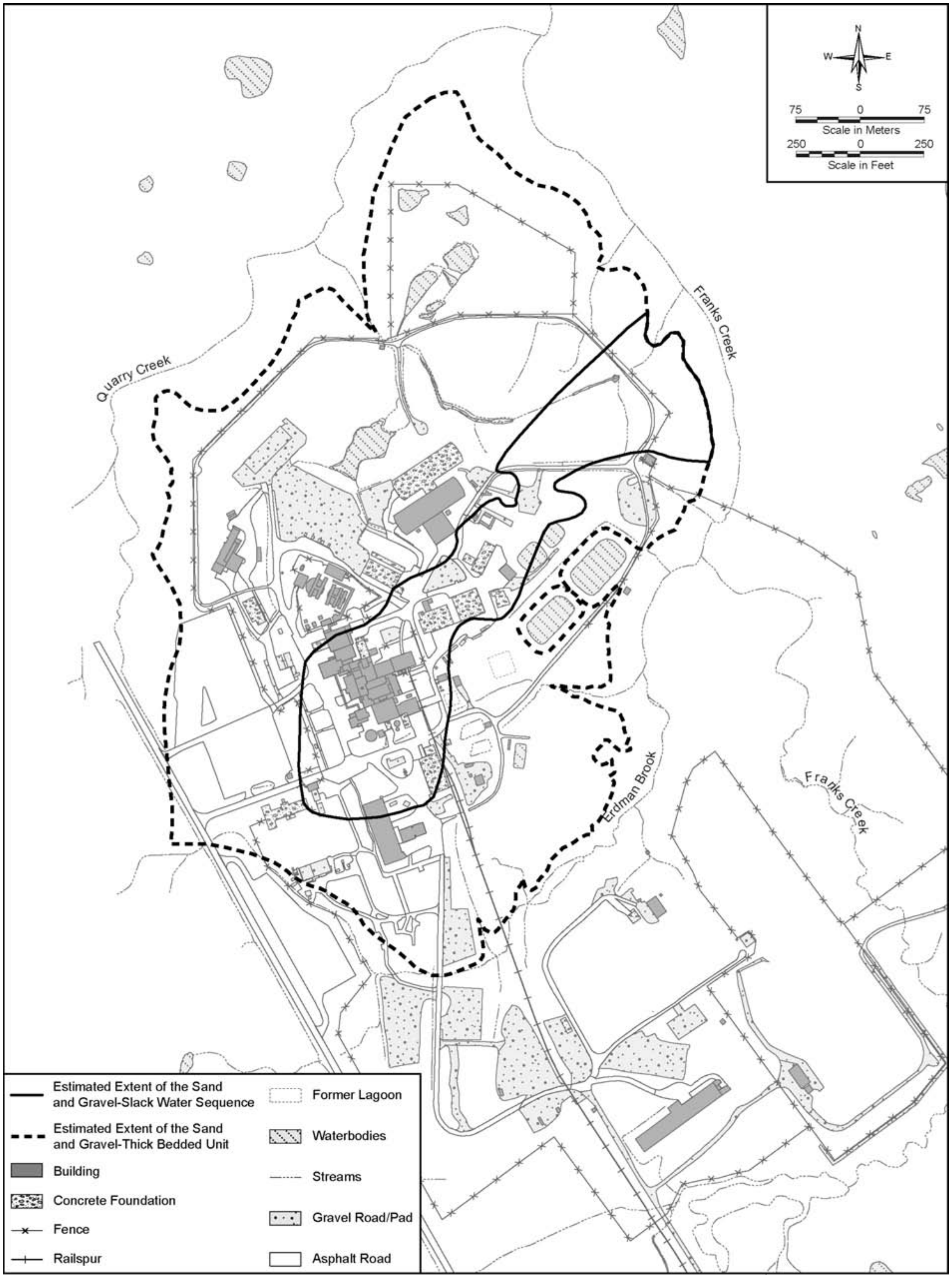


Figure 3–10 Horizontal Extent of the Thick-bedded Unit and the Underlying Slack-water Sequence on the North Plateau

Lavery Till-Sand—The Lavery till-sand is contained within the Lavery till on the North Plateau. The till-sand represents a localized, ice contact deposit resulting from the accumulation of stratified sediments entrained in debris-laden glacial meltwater. Because of dynamics in the glacial environment, transport of the coarser-grained sediment was terminated leaving the sand deposits to be incorporated into the finer-grained till during subsequent melting of the glacier. The till-sand is distinguished from isolated pods of stratified sediment in the Lavery till because borehole observations indicate that the sand is laterally continuous beneath the southern portion of the North Plateau (Figure 3–6) (WVNS 1993d, WVNS and Dames and Moore 1997). Recent (2007) reinterpretation of sandy intervals underlying the North Plateau has revised the extent of the Lavery till-sand and the slack-water sequence. Since fewer borings are now considered to have encountered Lavery till-sand, the horizontal extent of the Lavery till-sand has been reduced (WVES 2007b). The till-sand consists of 19 percent gravel, 46 percent sand, 18 percent silt, and 17 percent clay. Within the Lavery till, the till-sand occurs within the upper 6 meters (20 feet) of the till, and it ranges in thickness from about 0.1 to 4.9 meters (0.4 to 16 feet). The unit has been mapped as being up to 2.7 meters (9 feet) thick in the southeast corner of WMA 1 (WVNS 1993d). The hydrogeologic characteristics of the Lavery till-sand are described in Section 3.6.2.1.

Kent Recessional Sequence—The Lavery till is underlain by a complex association of gravel, sand, silt, and clay comprising the Kent recessional sequence (see Table 3–3). The Kent recessional sequence is comprised of alluvial, deltaic, and lacustrine deposits with interbedded till (WVNS 1993f, 1993d). The Project Premises are underlain by the Kent, except to the west where the walls of the bedrock valley truncate the sequence and the overlying Lavery till (see Figures 3–6 and 3–7). The Kent recessional sequence is not exposed on the WVDP Premises but occurs along Buttermilk Creek to the east of the site (WVNS 1993f, WVNS and URS 2005). The upper Kent sequence consists of coarse-grained sand and gravel that overlies lacustrine silt and clay (WVNS 1993d, WVNS and Dames and Moore 1997, WVNS and URS 2005). The basal lacustrine sediments were deposited in glacial lakes that formed as glaciers that blocked the northward drainage of streams. Some of the fine-grained deposits were eroded and re-deposited by subsequent glacial movement. Sand and gravel was later deposited from deltas formed where streams entered the glacial lakes and along the floodplains of streams that formed during ice-free episodes. Beneath the North Plateau, the Kent recessional sequence consists of coarse sediments that overlie either lacustrine deposits or directly overlie glacial till. The average textural composition of the coarse-grained Kent deposits is 44 percent sand, 23 percent silt, 21 percent gravel, and 12 percent clay. The composition of the lacustrine deposits is 57 percent silt, 37 percent clay, 5.9 percent sand, with 0.1 percent gravel. The Kent recessional sequence attains a maximum thickness of approximately 21 meters (69 feet) beneath the northeastern portion of the WVDP Premises (WVNS 1993d). The hydrogeologic characteristics of the Kent sequence are described in Section 3.6.2.1.

Kent Till, Olean Recessional Sequence, and Olean Till—Older glacial till and periglacial deposits of lacustrine and glaciofluvial origin underlie the Kent recessional sequence beneath the North and South Plateaus, extending to the top of the Upper Devonian bedrock (see Table 3–3) (WVNS 1993f, 2004a). The Kent till has characteristics similar to the Lavery till and was deposited during a glacial advance that occurred between 15,500 and 24,000 years ago. The Olean Recessional Sequence underlies the Kent till and has characteristics similar to the Kent recessional sequence. The Kent till and Olean Recessional Sequence are exposed along Buttermilk Creek southeast of the project (Figure 3–8). The Olean till contains more sand and gravel sized material than the Lavery and Kent tills. The Olean till was deposited between 32,000 and 38,000 years ago (WVNS 1993f) and is exposed near the sides of the valley overlying bedrock (Prudic 1986). The sequence of older glacial till and recessional deposits ranges up to approximately 91 meters (299 feet) in thickness beneath the North Plateau.

South Plateau

Substantive stratigraphic differences exist between the geologic conditions underlying the North and South Plateaus over the WVDP site area. The primary differences are the lack of sand and gravel deposits overlying the South Plateau till deposits, the absence of till-sand within the southern Lavery till, and the degree of weathering and fracturing in the till units of the South Plateau.

Weathered Lavery Till—The surficial unit underlying the South Plateau is the Lavery till, which is the host formation for buried waste in the SDA (WMA 8) and the NDA (WMA 7). Weathered Lavery till is generally exposed at grade or may be overlain by a veneer of fine-grained alluvium (WVNS 1993f). On the South Plateau, the upper portion of the Lavery till has been extensively weathered and is physically distinct from unweathered Lavery till. The till has been oxidized from olive-gray to brown, contains numerous root tubes, and is highly desiccated with intersecting horizontal and vertical fractures (WVNS 1993d, WVNS and URS 2006). Vertical fractures extend from approximately 4 to 8 meters (13 to 26 feet) below ground surface into the underlying unweathered till. The average textural composition of the weathered Lavery till is 47 percent clay, 29 percent silt, 20 percent sand, and 4 percent gravel. The thickness of the weathered Lavery till ranges from 0.9 meters (3 feet) to 4.9 meters (16 feet) across the South Plateau (WVNS 1993d, WVNS and URS 2006). The hydrogeologic characteristics of the weathered Lavery till underlying the South Plateau are described in Section 3.6.2.1.

Till Fractures—Glacial till throughout western New York commonly contains systematically oriented joints and fractures. The origin of these features may be from several mechanisms including adjustments related to glacial rebound; stresses in the Earth's crust; stress release related to movement on the Clarendon-Linden Fault System; and volumetric changes in the clay resulting from ion exchange or osmotic processes (WVNS 1993f).

Research trenching conducted by the New York State Geological Survey (Dana et al. 1979a) studied joints and fractures during a hydrogeologic assessment of the Lavery till. Based on trenching in an area to the east and southeast of the SDA, till joints and fractures were classified as: (1) prismatic and columnar joints related to the hardpan soil formation; (2) long, vertical, parallel joints that traverse the upper altered till and extend into the parent till possibly reflecting jointing in the underlying bedrock; (3) small displacements through sand and gravel lenses; and (4) horizontal partings related to soil compaction. Prismatic and columnar joints may represent up to 60 percent of the observed till fractures and were postulated to have formed under alternating wet/dry or freeze/thaw conditions. Fracture density was observed to be a function of moisture content and weathering of the till, with more pervasive fracturing occurring in the weathered, drier soil and till. Densely-spaced, vertical, fractures with spacing ranging from 2 to 10 centimeters (0.8 to 3.9 inches) were restricted to the weathered till. In contrast, the most vertically persistent fractures were observed in the relatively moist and unweathered till. Vertical fractures and joints in the weathered till were systematically oriented to the northwest and northeast, with spacing typically ranging from 0.65 to 2.0 meters (2 to 6.5 feet) and fractures extending to depths of 5 to 7 meters (16 to 23 feet). Trenching identified one vertical fracture extending to a depth of 8 meters (26 feet) (Dana et al. 1979a). Fracture spacing in the unweathered till increased with depth in conjunction with a decrease in the number of observed fractures.

Open, or unfilled, fractures in the upper portion of the Lavery till provide pathways for groundwater flow and potential contaminant migration. Tritium was not detected in two groundwater samples collected from a gravel horizon at a depth of 13 meters (43 feet), indicating that modern (post-1952) precipitation has not infiltrated to a discontinuous sand lens encountered in the Lavery till. Analysis of physical test results on Lavery till samples by the New York State Geological Survey concluded that open fractures would not occur at depths of 15 meters (50 feet) below ground surface due to the plasticity characteristics of the till (NYSGS 1979, Dana et al. 1979b).

Unweathered Lavery Till—The characteristics of the unweathered Lavery till beneath the South Plateau are similar to the till occurring beneath the North Plateau. The unweathered till consists of olive-gray, dense, pebbly silty clay and clayey silt that is typically calcareous. The till contains minor discontinuous and randomly oriented pods or masses of stratified sand, gravel, and rhythmically laminated clay and silt. The Lavery till was deposited from an ice lobe that advanced into the ancestral Buttermilk Creek Valley through impounded lake waters (WVNS 1993d). The average textural composition of the unweathered Lavery till is 50 percent clay, 30 percent silt, 18 percent sand, and 2 percent gravel (WVNS 1993d). The till ranges in thickness from 4.3 to 27.4 meters (14 to 90 feet) beneath the South Plateau (WVNS 1993f, WVNS and Dames and Moore 1997). The hydrogeologic characteristics of the unweathered Lavery till are described in Section 3.6.2.1.

Kent Recessional Sequence—The Kent recessional sequence beneath the South Plateau consists of fine-grained lacustrine deposits, with coarser sediments occurring as pods or lenses within the lacustrine deposits (WVNS 1993d). The sequence outcrops along the western bank of Buttermilk Creek, as shown in Figure 3–7. Coarse-grained sand and gravel associated with kame delta deposits overlie the lacrustrine deposits on the east end of the South Plateau and are exposed along the west bank of Buttermilk Creek (Figures 3–6 and 3–7). The Kent recessional sequence attains a thickness of approximately 13 meters (43 feet) beneath the South Plateau. The hydrogeologic characteristics of the Kent recessional sequence underlying the South Plateau are described in Section 3.6.2.1.

3.3.1.2 Bedrock Geology and Structure

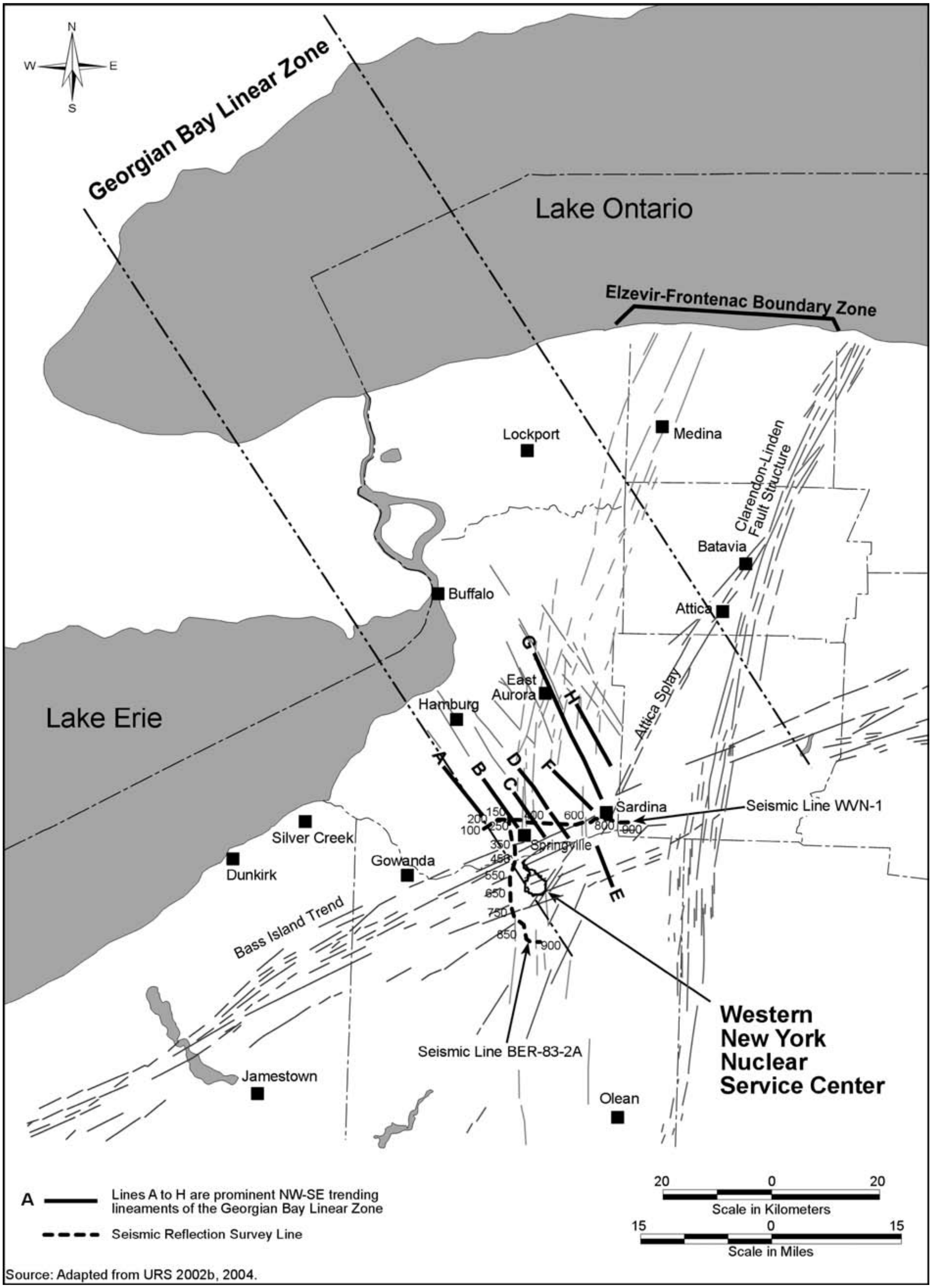
The Paleozoic bedrock section immediately underlying the WNYNSC consists primarily of Devonian and older sedimentary rocks (Figure 3–11). The Paleozoic strata in the area have been deformed into a series of low-amplitude folds that trend east-northeast to northeast as a result of low angle thrust faulting in the Paleozoic section that occurred during Alleghanian deformation of the Appalachian Mountains. The uppermost bedrock unit in the vicinity of the Project Premises and SDA is the Canadaway Group, which consists of shale, siltstone, and sandstone and totals approximately 300 meters (980 feet) in thickness. The regional dip of the bedrock layers is approximately 0.5 to 0.8 degrees to the south (Prudic 1986, WVNS 1993f). Locally, measurements of the apparent dip of various strata and two marker beds in selected outcrops along Cattaraugus Creek recorded a dip of approximately 0.4 degrees to the west near the northern portion of the WNYNSC (CWVNW 1993). The upper 3 meters (10 feet) of shallow bedrock are weathered to regolith with systematically-oriented, joints and fractures. As cited by Prudic (1986) and others and observed more recently in outcrop along Quarry Creek, the joints are not restricted to the upper 3 meters (10 feet) of the bedrock but are developed throughout and continue at depth (Engelder and Geiser 1979).

A number of Paleozoic bedrock structures and other regional features have been identified in western New York (**Figure 3–12**). The Clarendon-Linden fault zone extends southward from the Lake Ontario through Orleans, Genesee, Wyoming, and Allegany Counties, east of the WNYNSC. The fault zone is comprised of at least three north-south trending faults (**Figure 3–13**) (URS 2002b, WVNS 1992a) and is aligned with the eastern edge of the underlying Precambrian Elzevir-Frontenac Boundary Zone. Satellite imagery compiled in 1997 for NYSERDA indicates the presence of two prominent bands of north to northeast-trending lineaments with the eastern-most lineament coinciding with surface mapping and the inferred subsurface extent of the Clarendon-Linden fault zone (see Figure 3–12). The western band of north to northeast-trending lineaments is parallel to, and approximately 30 kilometers (19 miles) west of, a band of lineaments associated with the Clarendon-Linden fault zone and demarcates the western edge of the Elzevir-Frontenac Boundary Zone (URS 2002b, 2004). This structure continues into Cattaraugus County, where the lineaments become less abundant and less continuous. Seismic reflection profiles across this trend reveal faults affecting deeper Ordovician strata (URS 2004).

Age (millions of years)	System	Series	Group	Unit	Approximate Depth (meters)
Paleozoic Section	Devonian	Upper	Canadaway (shale, siltstone, minor sandstone)	Undifferentiated	
360				Perrysburg	330
			West Falls (shale, siltstone, sandstone)	Java	
				Nunda	
				Rhinestreet Shale	
			Sonyea	Middlesex Shale	
			Genesee (shale)		
		Middle		Tully Limestone	
			Hamilton (shale, sandstone, minor limestone)	Moscow	
				Ludlowville	
				Skaneateles	
				Marcellus	648
				Onondaga Limestone	
		Lower	Tristates	Oriskany Sandstone	
			Helderberg (limestone, dolostone)	Manlius	
408				Rondout	
	Silurian	Upper	Salina (shale, dolostone, minor anhydrite and halite)	Akron Dolostone	
				Camillus Shale	
				Syracuse	
				Vernon	894
			Lockport (dolostone)	Lockport	
			Clinton	Rochester Shale	
				Irondequoit (Packer shell)	
		Lower	Clinton	Sodus	
				Reynales	
				Thorold Sandstone	985
			Medina	Grimsby (sandstone, red shale)	
438				Whirlpool Sandstone	
	Ordovician	Upper		Queenston	1,477
				Oswego Sandstone	
				Lorraine	
				Utica Shale	
		Middle	Trenton-Black River (limestone, dolostone)	Trenton	
				Black River	
505		Lower	Beekmantown (limestone)	Tribes Hill/Chuctanunda	1,831
	Cambrian	Upper		Little Falls Dolostone	
				Galway (Theresa)	2,066
570				Potsdam Sandstone	2,118
	Precambrian	Middle	Grenville Basement Complex (crystalline rocks)		

Source: Modified from WVNS 1993f, NYSGS 1990, NYSDEC 2006a.
Note: Principal lithology in parenthesis except where otherwise specified.

Figure 3–11 Bedrock Stratigraphic Column for the West Valley Demonstration Project Premises and Vicinity



Source: Adapted from URS 2002b, 2004.

Figure 3–12 Selected Lineament Systems and Major Structural Features in Western New York

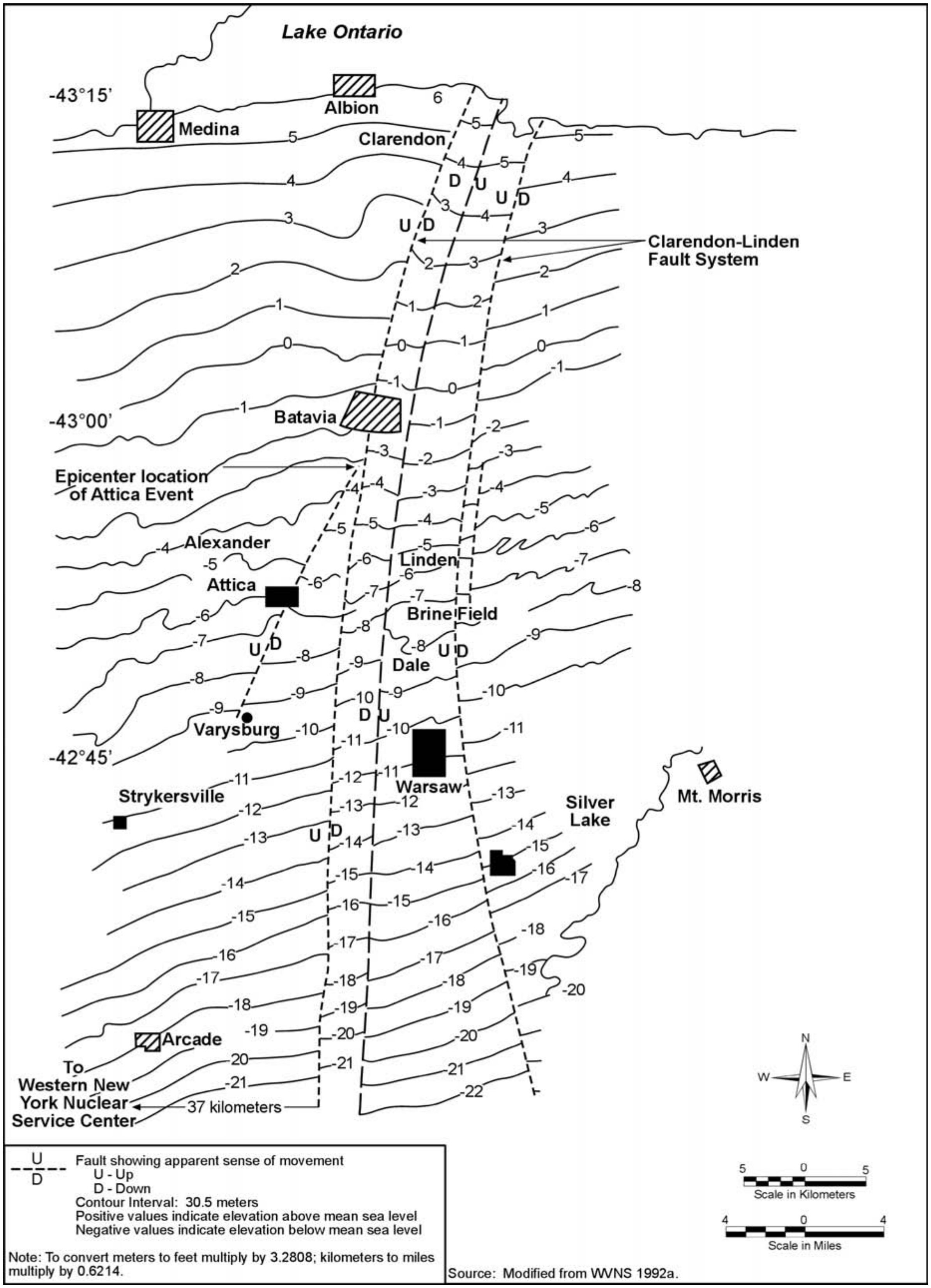


Figure 3–13 Clarendon-Linden Fault Zone Shown by Offsets of the Contours on Top of the Medina Group

Paleozoic Section

Seismic and stratigraphic data suggest that the Clarendon-Linden fault zone has been active since the early Paleozoic with a complicated movement history alternating between normal and reverse faulting (Fakundiny et al. 1978). Movement along the Clarendon-Linden fault zone has been attributed to reactivation of faults within the Elzevir-Frontenac Boundary Zone (URS 2002b).

The New York State Geological Survey (1976) suggested that surface displacement along the Clarendon-Linden fault zone in western New York was the result of smaller displacements occurring across numerous parallel or subparallel faults that may not be continuous along the entire length of the fault zone (URS 2002b). Jacobi and Fountain (2002) assessed the location and character of the Clarendon-Linden fault zone by integrating surface stratigraphic offsets, geologic structure, soil gas data, and lineament studies. The study documented that the Clarendon-Linden fault zone extends from the south shore of Lake Ontario to Allegany County and that the fault reaches the bedrock surface in the study area. North-striking lineaments that are believed to represent the surface expression of the fault segments are rarely over a few kilometers to tens of kilometers in length. Structurally, the fault zone is comprised of as many as 10 segmented north-striking parallel faults in the upper Devonian section. The fault segments are linked in the subsurface by northwest-striking and east-striking transfer zones. The fault segments and transfer zones form fault blocks that have semi-independent subsidence and uplift histories. The complex structure allows for fault segments to reactivate at different times and for tectonic stress to be accommodated on several different parallel faults (Jacobi and Fountain 2002, URS 2004).

The Attica Splay, a southwestern trending fault (traceable 10 kilometers [6 miles] southwest of Attica) branches from the western fault of the Clarendon-Linden fault zone near Batavia. The fault has been delineated through seismic reflection profiling as far southwest as Varysburg (Figure 3–13), located 37 kilometers (23 miles) from the WNYNSC (WVNS 1992a, 1993f). Well data indicate that the Attica Splay continues to the southwest, either as a fault or flexure, to Java, 30 kilometers (19 miles) northeast of the WNYNSC. The Attica Splay is the most active portion of the Clarendon-Linden fault zone (WVNS 1992a).

A seismic reflection survey completed in June 2001 (line WVN-1 on Figure 3–12) was approximately 29 kilometers (18 miles) long and located approximately 8 kilometers (5 miles) north of the WNYNSC. The seismic line was specifically located to investigate north, northwest, or northeast-trending structures in the Precambrian basement and overlying Paleozoic bedrock. Approximately 26 kilometers (16 miles) of reprocessed seismic reflection data was also reviewed that were collected in 1983 along a north-south section of U.S. Route 219 (line BER 83-2A on Figure 3–12). The two seismic lines were evaluated to identify structures that may be present at depth and to evaluate potential correlations between satellite-imaged lineaments and structures identified on the seismic lines (URS 2002b). The seismic reflection lines near the WNYNSC indicated the presence of high-angle faults in two stratigraphic intervals spanning the Precambrian to Devonian section and the Silurian to Devonian section. Several faults in the Precambrian to Devonian section were interpreted to continue upsection into Middle Devonian strata, including two west-dipping normal faults near Sardinia that may continue to the alluvium-bedrock boundary. The Sardinia faults may represent the southwest continuation of the Attica Splay into southeastern Erie County. A thin band of northeast-trending lineaments that extends from Batavia, New York and past Sardinia into Erie County may represent the surface expression of the Attica Splay (see Figure 3–13) (URS 2002b). The Clarendon-Linden fault zone is discussed in further detail in Section 3.5.

The Bass Island Trend is a northeast trending oil and gas producing structure that extends from Ohio through Chautauqua and Cattaraugus Counties into southern Erie County (URS 2002b). The structure is a regional fold that resulted from a series of thrust faults with a northwest transport direction ramping up-section from the Upper Silurian Salina Group into the Middle Devonian section (Jacobi 2002, URS 2002b). The faults associated with the Bass Island Trend are no longer active. Lineaments identified by satellite mapping generally coincide with the Bass Island Trend where it has been identified in southwestern Chautauqua and Erie County (Jacobi 2002) (see Figure 3–12). Bedrock mapping in the South Branch of Cattaraugus Creek, approximately 20 kilometers (12 miles) west of the Project Premises, delineated northeast-striking inclined bedding, folds, and faults that are associated with the Bass Island Trend (URS 2002b). Geologic mapping (Gill 1999, 2005) indicated that the subsurface structure is located approximately 8 kilometers (5 miles) northwest of the WVDP Site.

The Georgian Bay Linear Zone is a 30-kilometer- (19-mile-) wide structural zone that extends from Georgian Bay to the southeast across southern Ontario, western Lake Ontario, and into western New York. The zone has been delineated by a set of northwest-trending aeromagnetic lineaments and a 1997 satellite mapping investigation identified seven prominent northwest trending lineaments (lines A-H on Figure 3–12) that cross or potentially cross seismic line WVN-1. A variety of neotectonic structures and features have been identified in exposed bedrock and lakebed sediments within the zone. Earthquake epicenters in western Lake Ontario and in Georgian Bay appear to spatially align with the Georgian Bay Linear Zone (URS 2002b). The northwest-trending lineaments may represent the surface expression of faults occurring at depth along WVN-1 (URS 2002b).

Regional subsurface geologic mapping was conducted over portions of 18 towns and 4 counties surrounding the WNYNSC to potentially identify faulted subsurface layers from well logs. The particular area of concentration was north and northeast of the WNYNSC to assess structures possibly associated with the Attica Splay of the Clarendon-Linden fault zone. Three structure maps showing the elevation on the top of the Tully Limestone, the Onondaga Limestone, and the underlying Packer Shell horizon were prepared using well log and completion data for more than 720 wells from the New York State Department of Environmental Conservation (NYSDEC). The structure mapping showed no linear alignments to suggest that the main Clarendon-Linden Fault system, or the Attica splay of that fault system, intersects any portion of the WVDP site. Subsurface geologic mapping and interpretation of the Bass Island Trend structure indicates that this feature is located too far away from the site to have any direct impact on the subsurface geology (Gill 1999, 2005).

Precambrian Rocks

Precambrian age rocks of the Grenville Province comprise the basement rock at the site. The Grenville Province has been subdivided into the central gneiss belt, the central metasedimentary belt, and the central granulite terrain. The central metasedimentary belt is further divided into the Elzevir and Frontenac terrains with the boundary zone between the two terrains referred to as the Elzevir-Frontenac Boundary Zone. The Elzevir-Frontenac Boundary Zone is a 1.2-billion-year-old shear zone 10 to 35 kilometers (6 to 22 miles) in width, extending from southern Ontario into western New York. Seismic reflection data have interpreted the Boundary as a regional shear zone along which the Frontenac terrain was thrust to the northwest over the Elzevir terrain (URS 2002b). Seismic reflection profiling, aeromagnetic surveys, lineament studies, and other field surveys suggest that the central metasedimentary belt underlies the WNYNSC (URS 2002b).

3.3.1.3 Geologic Resources

Cattaraugus County's principal non-fuel mineral product consists of sand and gravel. Construction aggregate production for the six-county mineral district in which the WNYNSC is located totaled approximately 4.2 million metric tons (4.6 million tons) in 2002 (USGS and NYSGS 2003), roughly equivalent to 2.3 million cubic meters (3 million cubic yards) of material. More than 70 state-regulated commercial sand and gravel mines and gravel pits operate in Cattaraugus County, as well as a shale mine. Nearly 40 sand and gravel mines and gravel pits are operated in Erie County (NYSDEC 2005a). Surficial sand and gravel across the WNYNSC may be suitable for aggregate (sand and gravel) production.

Cattaraugus County is perennially one of the top oil and gas producing counties in New York. Active oil production wells are concentrated in the western portion of the county with the majority of the gas production from the south-central and southeast portion of the county (NYSDEC 2005a). A total of 427 gas wells and 1,399 oil wells produced approximately 28.3 million cubic meters (1 billion cubic feet) of natural gas and 17.5 million liters (4.6 million gallons) of oil in the county in 2002 (NYSDEC 2004a). There were 16 active gas wells and 2 active oil wells in Ashford Township that produced 640,000 cubic meters (22.6 million cubic feet) of natural gas and 421,000 liters (111,300 gallons) of oil in 2002.

3.3.2 Soils

Characteristics of the natural soil underlying the WNYNSC reflect the composition and textures of the Holocene alluvial and Pleistocene glacial deposits from which they are derived and consist of sand, gravelly silt and clay, clayey silt, and silty clay. The Churchville silt loam is found across the plateau areas, while the Hudson silt loam predominates in the Quarry Creek stream valley and the Varysburg gravelly silt loam predominates along the Franks Creek stream valley (WVNS 1993a). Churchville series soils generally consist of very deep, somewhat poorly drained soils that formed in clayey lacustrine sediments overlying loamy till. Hudson soils consist of very deep, moderately well drained soils formed in clayey and silty lacustrine sediments. The Hudson soils occur on convex lake plains, on rolling to hilly moraines and on dissected lower valley side slopes. Varysburg soils consist of very deep, well drained and moderately well drained soils on dissected lake plains. The Varysburg soils formed in gravelly outwash material and the underlying permeable clayey lacustrine sediments (USDA NRCS 2005). The Churchville and Hudson silt loams are prone to erosion, particularly on slope areas and when vegetative cover is removed (WVNS 1993a).

Soil Contamination

Soil underlying the waste management areas at the Project Premises has been impacted by radiological and chemical contamination associated with over 40 years of facility operations. Radiological soil contamination has resulted from operational incidents including airborne releases in 1968 that produced the Cesium Prong; liquid releases resulting in the North Plateau groundwater plume; waste burials; and spills during the transport or movement of contaminated equipment or materials. A site database documents spills that have occurred at the facility since 1989 and includes the location of each spill, notifications, and cleanup actions implemented for each incident.

The primary areas of radiologically contaminated soil are cesium-137 contamination associated with the Cesium Prong area; soils affected by the North Plateau strontium-90 groundwater plume; and radiologically contaminated soil associated with Lagoons 1 through 5 and the Solvent Dike (WMA 2). RCRA facility investigation sampling (WVNS and Dames and Moore 1997) identified additional areas of soil contamination exceeding radiological background levels located along drainage ditches; the Construction and Demolition Debris Landfill; the Demineralizer Sludge Ponds; subsurface soil beneath the Low-Level Waste Treatment Facility; and the Effluent Mixing Basins (WVNSCO 2004, WSMS 2008a). The volume of radiologically contaminated soil over the WVDP areas is estimated to be approximately 1,184,200 cubic meters (1,549,000 cubic yards), as shown in **Table 3–4**.

Chemical excursions from facilities have been infrequent and localized in extent. Migration of leachate consisting of 98 percent n-dodecane and 2 percent tributyl phosphate occurred from NDA Special Holes SH-10 and SH-11 in 1983 (WVNSCO 1985). Stabilization operations in 1986 resulted in the excavation and backfill of NDA Special Holes SH-10 and SH-11; exhumation of eight 3,785-liter (1,000-gallon) tanks containing solvent-impregnated absorbent; and removal and packaging of contaminated absorbent and soil. Interim measures consisting of a capped interceptor trench and a liquid pretreatment system were implemented by DOE to control potential migration of n-dodecane and tributyl phosphate from the NDA to Erdman Brook.

Table 3–4 Estimated Volumes of Contaminated Soil on the West Valley Demonstration Project Premises

Source	*Area*	*Estimated Soil Contamination Volume (cubic meters)*
WMA 1 Soil Removal	WMA 1	75,000
WMA 2 Closure	WMA 2	39,000
WMA 3 Soil Removal	WMA 3	1,000
WMA 4 Soil Removal	WMA 4	23,000
WMA 5 Closure	WMA 5	3,000
WMA 6 Closure	WMA 6	1,200
WMA 7 Closure	WMA 7	186,000
WMA 8 Closure	WMA 8	371,000
WMA 9 Closure	WMA 9	0
WMA 10 Closure	WMA 10	0
WMA 11 Closure	WMA 11	0
WMA 12 Closure	WMA 12	7,000
North Plateau Groundwater Plume	WMA-5; 12	417,000
Cesium Prong	WMA 3, 4, 5	61,000

Note: To convert cubic meters to cubic feet, multiply by 35.32.
Source: WSMS 2008a.

RCRA facility investigation soil sampling (WVNS and Dames and Moore 1997) for chemical constituents on the Project Premises identified localized chlorinated solvent, polynuclear aromatic hydrocarbon, and metal compounds occurring at concentrations below or slightly exceeding NYSDEC Technical and Administrative Guidance Memorandum 4046 soil cleanup objectives or site background levels (WVNS and Dames and Moore 1997; WVNSCO 2004, 2007). The low level chemical detections are consistent with anthropogenic activity and the industrial nature of the site. The RCRA facility investigation did not recommend further action for soil mitigation. Based on the RCRA facility investigation results, Corrective Measures Studies are ongoing (WVNSCO 2007) at six areas on the site to evaluate the potential need for further characterization, remediation, and/or monitoring:

- Construction and Demolition Debris Landfill
- NDA and the NDA Interceptor Trench Project
- SDA
- Lagoon 1
- Demineralizer Sludge Ponds
- Former Low-Level Waste Treatment Facility building (O2 Building), neutralization pit, interceptors, and the Low-Level Waste Treatment Facility building

Metals concentrations in RCRA facility investigation soil samples from these facility areas slightly exceed background or Technical and Administrative Guidance Memorandum 4046 criteria. Organic constituents consisting of chlorinated solvents, BTEX compounds, and semivolatile organic compounds, including polynuclear aromatic hydrocarbon compounds, represent chemicals of concern associated with subsurface soil at the NDA. Polynuclear aromatic hydrocarbon compound concentrations exceeding the Technical and Administrative Guidance Memorandum 4046 criteria have been detected in subsurface soil associated with Lagoon 1 (benzo[a]anthracene, benzo[a]pyrene, and chrysene) and the Demineralizer Sludge Pond (benzo(a)anthracene [692 micrograms per kilograms], benzo(a)pyrene [798.7 micrograms per kilograms], benzo(b)fluoranthene [1,286 micrograms per kilograms], and chrysene [990.5 micrograms per kilograms]). The source of polynuclear aromatic hydrocarbon soil contamination has been attributed to proximity to anthropogenic sources or buried asphalt (WVNSCO 2007). Chemical constituent concentrations at the remaining RCRA facility investigation Solid Waste Management Units were below the NYSDEC Technical and Administrative Guidance Memorandum 4046 soil cleanup objectives (WVNSCO 2007). Contamination of stream sediment is discussed in Section 3.6.1.

Cesium Prong

Uncontrolled airborne releases from the Main Plant Process Building ventilation system filters in 1968 released contaminated material through a 60-meter (200-foot) high plant stack. The releases carried contaminated material to portions of the WNYNSC and an offsite area. The contaminated area has been investigated using aerial and ground level gamma radiation surveying and soil sampling. The methods and results of these surveys are described in the *Site Radiological Surveys Environmental Information Document* (WVNS 1993c) and the *WNYNSC Off-Site Radiation Investigation Report* (Dames and Moore 1995). The data from a 1979 aerial survey showed cesium-137 levels elevated above background in the Cesium Prong on the Project Premises, on the balance of the site, and outside of the WNYNSC boundary (**Figure 3–14)**.

Sampling data from the Cesium Prong within the boundary of the WNYNSC is sparse. Four surface soil samples collected northwest of the Main Plant Process Building by NYSDEC in 1971 indicated cesium-137 activity ranging from 18.2 to 43.2 picocuries per gram. Strontium-90 activity in two of the samples ranged from 37 to 39 picocuries per gram. A subsequent cesium-137 survey (Dames and Moore 1995) conducted between 1993 and 1995 in an offsite area within the Cesium Prong consisted of surface and subsurface soil sampling to measure activity levels since the time of cesium-137 deposition. The 1995 survey included sample grid blocks in background areas, open fields and forested areas, and from areas where the surface had been disturbed by human activity, such as residential yards and tilled farmland.

Cesium-137 levels decreased with depth in the undisturbed grids, with 70 percent of the activity on average in the upper 5 centimeters (2 inches), 25 percent of the activity in the 5- to-10-centimeter (2- to-4-inch) layer, and 5 percent of the activity in the 10- to-15-centimeter (4- to-6-inch) layer (Dames and Moore 1995). Higher cesium-137 levels were associated with occurrences of organic humus on the ground surface. The maximum localized cesium-137 activity was 44 picocuries per gram. For five undisturbed grid blocks, average cesium-137 activity in the upper 5-centimeter (2-inch) layer ranged from 2.7 to 25.4 picocuries per gram compared to an average background activity of 0.68 picocuries per gram. The overall results indicated that disturbance of the surface layers had either removed cesium-137, covered it with clean soil, or blended it through the soil to varying degrees (Dames and Moore 1995).

Aerial surveys and soil sampling in the Cesium Prong indicate that contaminated soil occurs on the Project Premises and on the balance of the WNYNSC site north of Quarry Creek. The estimated volume of contaminated soil (i.e., exceeding 25 millirem per year for cesium-137) in these two areas is approximately 61,000 cubic meters (2,100,000 cubic feet) (WSMS 2008a). The volume was based on the extent of a calculated 25 millirem per year area estimated by decaying the activity level measured during the 1979 aerial survey, to account for the elapsed time since the survey. The volume calculation assumed a soil removal depth of 15 centimeters (6 inches).

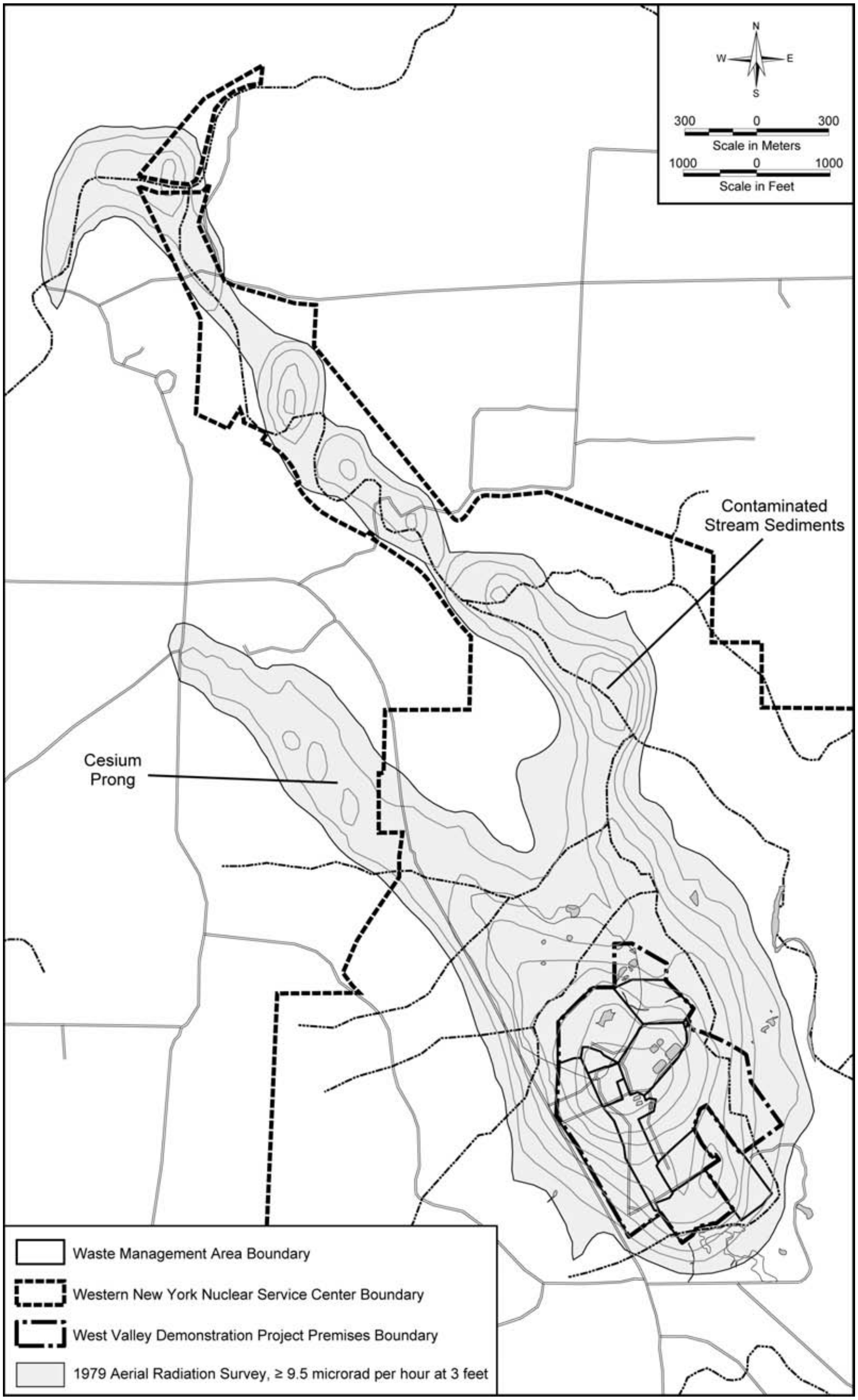


Figure 3–14 Area Affected by the Cesium Prong

3.4 Site Geomorphology

The site region continues to adjust to the glaciation and retreat process that ended 17,000 years ago. Since that time, glacial rebound of about 30 meters (100 feet) has occurred across the WNYNSC. As a result, the region is geomorphologically immature and stream profiles and patterns will continue to evolve in response to decelerating rebound and tilting (WVNS 1993f). Consequently, geomorphological studies at the WNYNSC have focused on the major erosional processes acting on Buttermilk Creek and Franks Creek drainage basins near the Project Premises and the SDA. This section describes these processes – sheet and rill erosion, stream channel downcutting and valley rim widening, and gully advance – and where they occur. A more thorough treatment and predictive analysis of these processes across the site is presented in Appendix F of this EIS.

3.4.1 Sheet and Rill Erosion

Sheet and rill erosion on overland flow areas and mass wasting on hillslopes have been monitored at 23 hillslope locations along the stream valley banks adjacent to the Project Premises (URS 2001, WVNS 1993a). Twenty-one erosion frames were originally placed on hillslopes that are close to plant facilities and contain a variety of soil types and slope angles. Two erosion frames were placed near the edges of stream valley walls to monitor potential slumping of large blocks of soil. The frames were designed to detect changes in soil depth at the point of installation and were monitored from September 1990 through September 2001. Soil gain or loss has been detected at the frame locations still in place as further described in Appendix F, Section F.2.1. The largest soil gain or loss, indicating the greatest amount of soil movement, has occurred at frames located on the north and east slopes of the SDA. These soil erosion measurements have been taken over too short a time span to be reliable for long-term projections; however, they indicate that the sheet and rill erosion process has removed small quantities of soil at a few locations within the Franks Creek watershed. Sheet and rill erosion monitoring locations are shown in **Figure 3–15**.

3.4.2 Stream Channel Downcutting and Valley Rim Widening

The three small stream channels (Erdman Brook, Quarry Creek, and Franks Creek) that drain the Project Premises and SDA are being eroded by the stream channel downcutting and valley rim widening processes. These streams are at a relatively early stage of development and exist in highly erodible glacial till material. These characteristics cause the streams to downcut their channels instead of moving laterally (WVNS 1993a).

Active stream downcutting can be observed at knickpoint locations along the longitudinal profile of the stream channels. A knickpoint is an abrupt change in the slope of the streambed (waterfall) that is caused by a change in base level. The stream erodes the knickpoint area by carrying the fine-grained sediment downstream and leaving the coarse-grained sediment (gravel and cobbles) at the base of the vertical drop. Stream turbulence from high-energy storm events agitates the accumulated gravel and cobbles and creates a scour pool. The knickpoint migrates upstream due to the movement of the gravel and cobbles by the erosing force of water, which erodes the knickpoint at its base. In addition, the channel is deepened by abrasion from the movement of gravel and cobbles downstream. As this process continues, the channel cross-section changes from a U-shaped, or flat-bottomed, floodplain with a low erosion rate to a V-shaped channel with a higher erosion rate (WVNS 1993i). **Figure 3–16** shows the locations of known knickpoints identified in a 1993 study; however, due to the dynamic nature of the downcutting process, the knickpoints have likely continued to migrate upstream since that time.

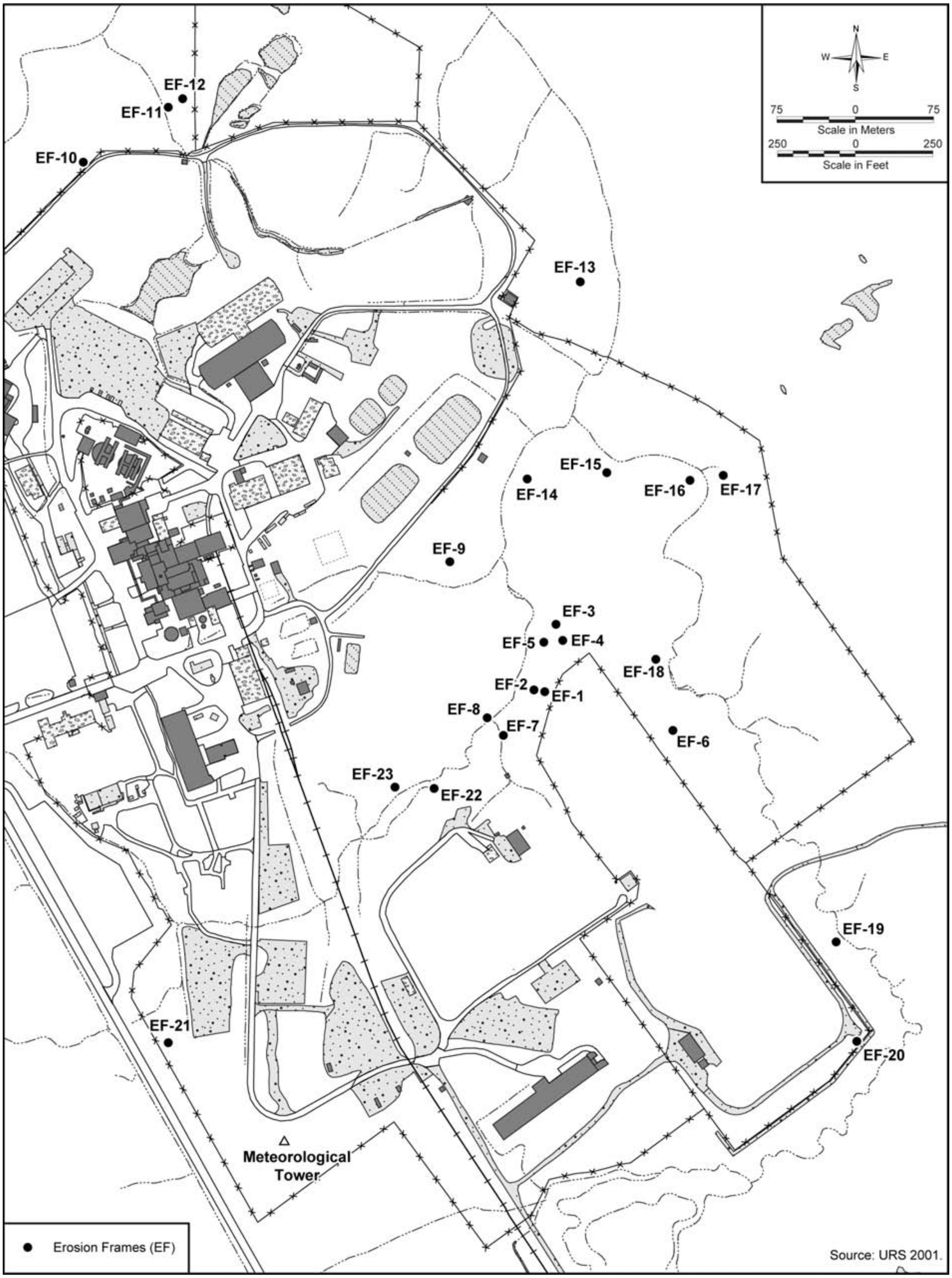


Figure 3–15 Location of Erosion Frame Measurements of Sheet and Rill Erosion

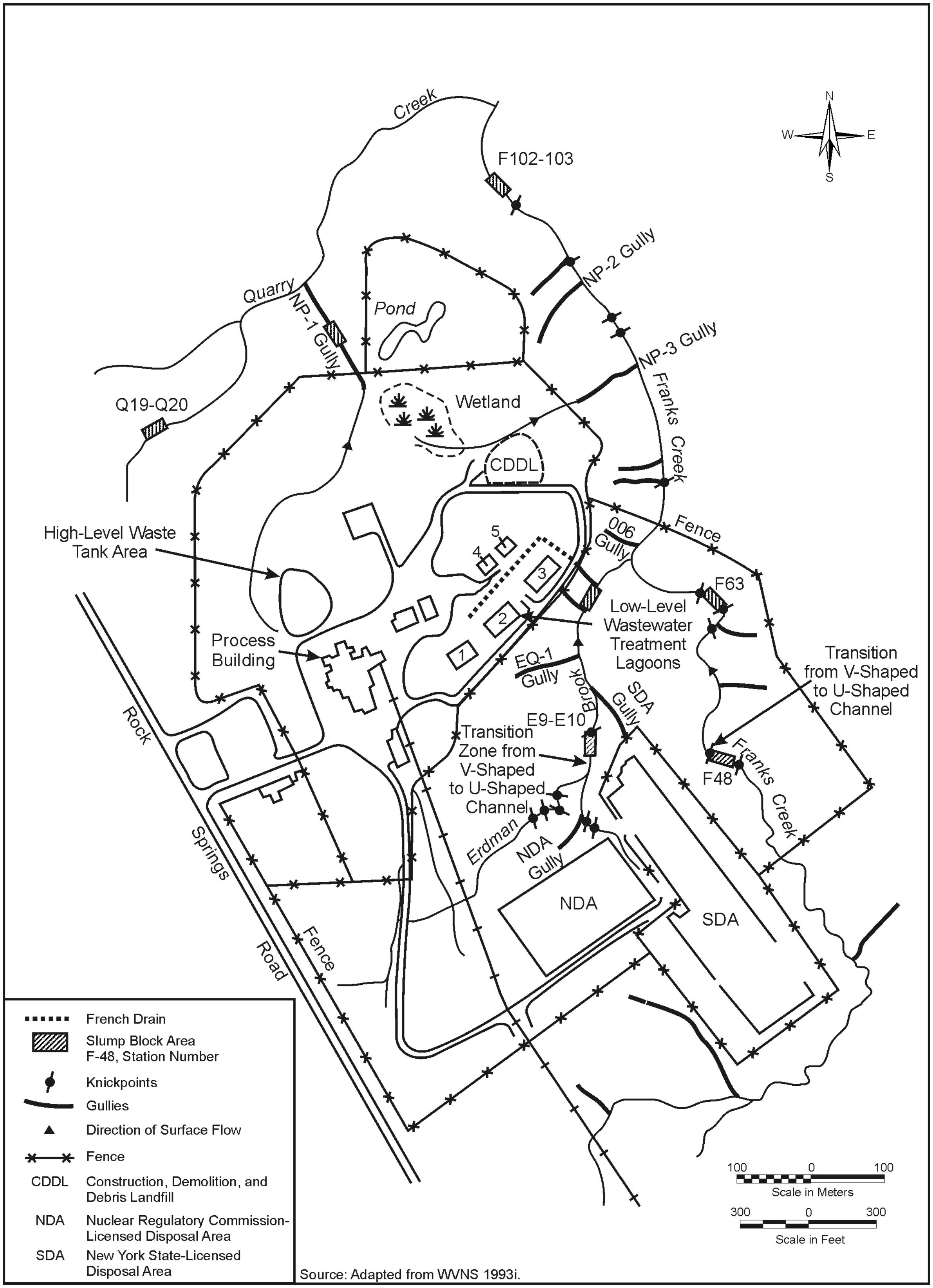


Figure 3–16 Gullies, Major Slump Blocks, Channel Transition, and Knickpoints in the Franks Creek Drainage Basin

As the downcutting progresses, the streambanks are undercut causing localized slope failures (i.e., slumps and landslides). This process commonly occurs at the outside of the meander loops and produces a widening of the stream valley rim (WVNS 1993i). While it is possible that an entire series of slump blocks on a slope can form at the same time, field observations have indicated that a single block initially forms. The redistribution of stresses and weight from the movement of the single block then adds to the forces already at work along the stream slope and eventually causing other slump blocks to form. Other factors that combine to affect slope stability include vegetative ground cover, local groundwater conditions, freeze-thaw cycles, and manmade loads (WVNS 1993a).

Three major slump block locations were initially identified on Franks Creek, one on Erdman Brook, and one on Quarry Creek. The blocks vary in length from about 1.5 meters (5 feet) to greater than 30 meters (100 feet) and tend to be about 1.0 to 1.2 meters (3 to 4 feet) in height and width when they initially formed (WVNS 1993a). These slump block locations are shown in Figure 3–15 at station numbers F48, F63, E9, F102, and Q19, and represent areas where the rim widening process is most active. Slump block movement is also potentially occurring on the Erdman Brook slope that forms the crest of the Low Level Waste Water Lagoon 3, also shown on Figure 3–15. Monitoring instrumentation is being used at this location to measure both shallow and deep-seated long-term creep (Empire Geo-Services 2006). The most erosion has occurred along a 67-meter (220-foot) length of slope along Erdman Brook north of the SDA (station number E9-E10); however, the rate of movement is not representative of the stream system as a whole because this portion of the stream is eroding through uncompacted fill, not native soil (WVNS 1993a). Slump block formation is an active mass wasting process at the WNYNSC.

3.4.3 Gullying

The steep valley walls of the stream channels within the Buttermilk Creek drainage basin are susceptible to gully growth. Gullies are most likely to form in areas where slumps and deep fractures are present, seeps are flowing, and the slope intersects the outside of the stream meander loop. Gully growth is not a steady-state process but instead occurs in response to episodic events, such as during thaws and after thunderstorms, in areas where a concentrated stream of water flows over the side of a plateau and in areas where groundwater movement becomes great enough for seepage to promote grain-by-grain entrainment and removal of soil particles from the base of the gully scarp–a process referred to as sapping. Sapping causes small tunnels (referred to as pipes) to form in the soil at the gully base, which contributes to gully growth by undermining and weakening the scarp until it collapses. Surface water runoff into the gully also contributes to gully growth by removing fallen debris at the scarp base, undercutting side walls, and scouring the base of a head scarp.

More than 20 major and moderate-sized gullies have been identified, with most shown in Figure 3–16. Some of these gullies have formed from natural gully advancement processes and others are the result of site activities. For example, runoff from the plant and parking lots directed through ditches to the head of a previously existing gully created a new gully at the upper reaches of the equalization pond outfall (WVNS 1993a). Several of the gullies are active and migrating into the edge of the North and South Plateaus. One of the active gullies was located on Erdman Brook north of the SDA and is referred to as the SDA Gully in Figure 3–16. It was advancing toward the SDA before it was reconstructed to mitigate erosion in 1995. The other two active gullies are located along Lower Franks Creek and are referred to as the NP-3 and 006 Gullies (Figure 3–16) (WVNS 1993a).

3.4.4 Erosion Rates

The erosion rates from the geomorphic processes described in the preceding sections have been measured at numerous locations throughout the drainage basins, as summarized in **Table 3–5**. Rates of sheet and rill erosion were directly measured using erosion frames along the stream valley banks adjacent to the WVDP

Premises. Rates of stream channel downcutting were determined from three indirect measurement methods (i.e., carbon-14 and optically stimulated luminescence age dating, measurement of stream channel longitudinal profile, and measurement of rate of slumping). The downcutting rates were translated into estimates of rates of stream valley rim widening using an estimate of stable slope angle for the stream valley and geometric considerations. Gully migration rates were determined using aerial photographs and the Soil Conservation Services' (now the Natural Resources Conservation Service) Technical Report-32 method (see Appendix F, Section F.2.3.3, of this EIS). These historical measurements are not predictions of future erosion rates for specific processes, but they do provide perspective by which to judge the reasonableness of erosion projections. Appendix F details erosion study observations to date and presents the results of predictive modeling of site erosion over the short- and long-term.

Table 3–5 Summary of Erosion Rates at the Western New York Nuclear Service Center

Location	*Erosion Rate (meters per year)*	*Author and Study Date*	*Method*
Sheet and Rill Erosion	0 to 0.0045	URS Corporation (2001)	Erosion frame measurements (11-year average rate)
Downcutting of Buttermilk Creek	0.0015 to 0.0021	La Fleur (1979)	Carbon-14 date of terrace – depth of stream below terrace
Downcutting of Buttermilk Creek	0.005	Boothroyd, Timson, and Dunne (1982)	Carbon-14 date of terrace – depth of stream below terrace
Downcutting of Buttermilk Creek	0.0032	USGS (2007)	Optically stimulated luminescence age dating of 9 terraces along Buttermilk Creek
Downcutting of Quarry Creek, Franks Creek, and Erdman Brook	0.051 to 0.089	WVNS 1993a	Difference from 1980 to 1990 in stream surveys
Downcutting of Franks Creek	0.06	WVNS 1993a	Stream profile, knickpoint migration 1955 to 1989
Buttermilk Creek Valley Rim Widening	4.9 to 5.8	Boothroyd, Timson, and Dana (1979)	Downslope movement of slump block over 2 years
Valley Rim Widening of Buttermilk and Franks Creeks and Erdman Brook	0.05 to 0.13	McKinney (1986)	Extrapolate Boothroyd data for 500 years
Erdman Brook Valley Rim Widening	0.02 to 0.04	WVNS 1993a	Downslope movement of stakes over 9 years
SDA Gully Headward Advancement [Reconstructed in 1995]	0.4	WVNS 1993a	Gully advancement-Soil Conservation Services' Technical Report-32 method
NP3 Gully Headward Advancement	0.7	WVNS 1993a	Gully advancement-Soil Conservation Services' Technical Report-32 method
006 Gully Headward Advancement	0.7	WVNS 1993a	Gully advancement-Soil Conservation Services' Technical Report-32 method

Note: To convert meters to feet, multiply by 3.2808.

3.5 Seismology

This section presents information about the hazard to the WNYNSC posed by earthquakes. The earthquake history of western New York and vicinity is described in Section 3.5.1. The historical record is an important element in determining the location, size, and frequency of earthquakes that might affect the WNYNSC. Although the earthquake record offers significant information about the earthquake potential of an area, the historic record is short relative to the time between large earthquakes (which can be thousands of years). The potential for earthquakes along faults and other tectonic features (even if they have not been discovered yet) is considered in Section 3.5.2. The historical seismicity and potential seismicity from tectonic features (both known and unknown) in western New York State are used to estimate the seismic hazard and liquefaction potential for the WNYNSC. Sections 3.5.3, 3.5.4, and 3.5.5 include estimates of the ground motion hazard as typified by peak horizontal ground acceleration (PGA), probabilistic seismic hazard curves (which describe the relationship between some measure of ground motion and the probability of exceeding some value), and liquefaction potential.

3.5.1 Earthquake History for Western New York State and Vicinity

Historical earthquakes are one indication of the number and size of seismic events that might occur in the future. Before the introduction of seismographic instrumentation, the magnitude of an earthquake was approximated by its effects and the damage that was inflicted. The scale used to measure the effects and damage from earthquakes is the Modified Mercalli Intensity (MMI) scale, which ranges from I (no damage) to XII (complete destruction) (**Table 3–6**). Many factors contribute to the damage caused by an earthquake, including distance from the event, the rate of attenuation in the earth, geologic site conditions, and construction methods. Between 1732 and 2004, the historical earthquake record for western New York documents 142 events within a 480-kilometer (300-mile) radius of the WNYNSC, with epicentral intensities of MMI-V to -VIII and moment magnitudes (**M**) up to **M** 6.2 (USGS 2008). At the WNYNSC, the intensity of shaking from these events was much less severe due to the distance from the event. Most regional earthquakes have occurred in the Precambrian basement and were not associated with identified geologic structures (URS 2002b).

Historic earthquakes within a radius of 480 kilometers (300 miles) to the WNYNSC and known to have produced intensities higher than MMI-III at the WNYNSC were the 1929 Attica and the 1944 Cornwall-Massena earthquakes which produced an estimated MMI-IV at the site (WVNS 2004a, 2006).

The 1929 Attica earthquake occurred on August 12 with an epicenter about 48 kilometers (30 miles) northeast of the WNYNSC. The earthquake produced MMI-VII shaking in the epicentral area and was felt over an area of about 130,000 square kilometers (50,000 square miles), including parts of Canada. In Attica, some 250-house chimneys collapsed or were damaged, and cracked walls and fallen plaster were common. Objects were thrown from shelves, monuments in cemeteries were toppled, and a number of wells went dry. The degree of damage to structures generally could be related to the type of design and construction. On the basis of the recorded damage, an MMI-VII and a body-wave magnitude (m_b) 5.2 was assigned to this event based on previous hazard analyses for the WNYNSC (WVNS 2004a). Other studies ascribe an MMI-VIII to the 1929 Attica earthquake (Stover and Coffman 1993, USGS 2005b).

Earthquakes smaller than the 1929 event have occurred frequently in the Attica area (December 1929, 1939, and 1955; July and August 1965; January 1966; and June 1967). The largest of these were the two most recent events with epicentral intensities of MMI-VI and magnitudes of m_b 3.9. These earthquakes likely resulted in intensities of MMI-III or less at the WNYNSC (USGS 2005c, WVNS 2004a). Earthquakes in the Attica, New York area have generally been ascribed to the Clarendon-Linden fault system although there is no definitive data that this is the case (WVNS 2004a, 2006).

The Cornwall-Massena earthquake occurred on September 5, 1944, with an epicenter 430 kilometers (267 miles) east-northeast of the site. It is the largest earthquake ever recorded within New York State. It produced MMI-VIII shaking at its epicenter and was felt over an area of about 450,000 square kilometers (174,000 square miles). At Massena, New York, the earthquake destroyed or damaged 90 percent of the chimneys, and many structures were rendered unsafe for occupancy. Many wells in St. Lawrence County, New York went dry, and water levels were affected in streams and wells as far away as Westchester County and Long Island, New York (WVNS 2004a). The magnitude of the earthquake has been estimated at m_b 5.8.

Table 3–6 The Modified Mercalli Intensity Scale of 1931, with Generalized Correlations to Magnitude, and Peak Ground Acceleration

Modified Mercalli Intensity [a]	*Observed Effects of Earthquake*	*Approximate Magnitude* [b, c]	*Class*	*Peak Ground Acceleration (g)* [d]
I	Usually not felt except by a very few under very favorable conditions.	Less than 3	Micro	Less than 0.0017
II	Felt only by a few persons at rest, especially on the upper floors of buildings.	3 to 3.9	Minor	0.0017 to 0.014
III	Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motorcars may rock slightly. Vibrations similar to the passing of a truck.			
IV	Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy object striking building. Standing motorcars rock noticeably.	4 to 4.9	Light	0.014 to 0.039
V	Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.			0.039 to 0.092
VI	Felt by all; many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.	5 to 5.9	Moderate	0.092 to 0.18
VII	Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.	6 to 6.9	Strong	0.18 to 0.34
VIII	Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, and walls. Heavy furniture overturned.	7 to 7.9	Major	0.34 to 0.65
IX	Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.			0.65 to 1.24
X	Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.			1.24 and higher
XI	Few, if any (masonry) structures remain standing. Bridges destroyed. Rails greatly bent.	8 and higher	Great	1.24 and higher
XII	Damage total. Lines of sight and level are distorted. Objects thrown into the air.	8 and higher	Great	1.24 and higher

[a] Intensity is a unitless expression of observed effects of earthquake-produced ground shaking. Effects may vary greatly between locations based on earthquake magnitude, distance from the earthquake, and local subsurface geology. The descriptions given are abbreviated from the Modified Mercalli Intensity Scale of 1931.
[b] Magnitude is a logarithmic measure of the strength (size) of an earthquake related to the strain energy released by it. There are several magnitude "scales" (mathematical formulas) in common use, including local "Richter" magnitude, body wave magnitude, moment magnitude (M), and surface wave magnitude. Each has applicability for measuring particular aspects of seismic signals and may be considered equivalent within each scale's respective range of validity. For very large earthquakes, the M scale provides the best overall measurement of earthquake size.
[c] Correlations back to Modified Mercalli Intensity should be used with caution as they reflect the base or threshold level of shaking experienced in an earthquake with the given magnitude.
[d] Acceleration is expressed as a percent relative to the earth's gravitational acceleration (g) (i.e., [g] is equal to 980 centimeters [32.2 feet] per second squared). Given values are correlated to Modified Mercalli Intensity based on measurements of California earthquakes only (Wald et al. 1999).

Sources: Compiled from USGS 2005a, 2005b; Wald et al. 1999.

Outside the western New York region, there is a zone of major seismic activity near LaMalbaie, Quebec, in the lower St. Lawrence River Valley. Large earthquakes occurred in the LaMalbaie area in 1638, 1661, 1663, 1732 and, most recently, in 1988 (USGS 2005c, WVNS 2004a, 2006). The earthquakes were felt over the entire eastern section of Canada and the northeastern United States. The 1988 M 5.8 earthquake did not produce intensities higher than MMI-III at the WVDP site. The intensity experienced at the site from the pre-1988 earthquakes is unknown but are not expected to have exceeded MMI-IV (WVNS 2004a, 2006).

3.5.2 Tectonic Features and Seismic Source Zones

Potential seismic sources such as active faults and seismic source zones are identified and described by scientists in their approaches to estimating seismic hazard. A *tectonic feature* considered to have seismic potential is a geologic structure such as a fault tens to hundreds of kilometers in extent that is either directly observable on the Earth's surface, or that may be inferred from geophysical investigations. A seismic source zone is an area in which the seismicity is considered to be on buried seismic sources that share similar seismic-tectonic characteristics. The seismicity in a seismic source zone is assumed to occur randomly with no clear association with any of the tectonic features that might be included in the seismic source model. Both tectonic features and seismic source zones are defined by characteristics such as earthquake recurrence rate (over the range of expected magnitudes) and the maximum magnitude that is likely to occur on the feature or within the area. In the northeastern United States, earthquakes not associated with an observable tectonic feature occur primarily in the Precambrian basement beneath the Paleozoic cover. These earthquakes represent either reactivation of preexisting faults or new ruptures in or near the old fault zones (Ebel and Tuttle 2002). The purpose of the seismic source zone is to account for the probability that an event might occur in an area with no history of earthquakes or on a previously unidentified tectonic feature. The maximum magnitude and recurrence rate for seismic source zones are derived from the historical seismicity within the zone, the type of crust that the zone represents, and other factors.

Tectonic features near the WNYNSC that have been identified in seismic hazard studies include the Clarendon-Linden fault system, which marks the eastern boundary of the Elzevir-Frontenac Boundary Zone; the main fairway of the Elzevir-Frontenac Boundary Zone; north-northeast trending lineaments that appear to define the surface expression of the western side of the underlying Elzevir-Frontenac Boundary Zone; and the Bass Island Trend. The Elzevir-Frontenac Boundary Zone is an interpreted tectonic region of Proterozoic crust that has been geophysically mapped in New York State. There is no clear association between seismicity and the western band of north, northeast-trending lineaments that demarcate the western limit of the Elzevir-Frontenac Boundary Zone. The Bass Island Trend is defined by a series of buried thrust faults and associated folds. Earthquake activity has not been recorded along the Bass Island Trend, suggesting that this structure is not seismically active (URS 2002b).

The Clarendon-Linden fault system is the most prominent tectonic feature near the WNYNSC and has been identified as the source of earthquakes in and around Attica, New York (Van Tyne 1975, Fakundiny and Pomeroy 2002, Jacobi and Fountain 1996). Induced seismicity associated with the Clarendon-Linden fault system has been correlated with high pressure injection of water into a brine well (Van Tyne 1975). Boyce and Morris (2002) suggested Paleozoic faulting involving repeated reactivation and upward propagation of basement faults and fractures into overlying strata as a source of seismicity. They hypothesize that movement along the Elzevir-Frontenac Boundary Zone resulted in movement on the Clarendon-Linden fault system. Ouassaa and Forsyth (2002) found no evidence that the complete upper crustal section above the Precambrian basement is faulted. The apparent offsets identified in seismic reflection survey data were alternately attributed to changes in basal Paleozoic strata deposited within the relief of an unconformity; the response of parts of the Paleozoic section to glacial rebound; the result of sediment compaction and non-deposition over topographic relief along the unconformity; or a combination of the above (Ouassaa and Forsyth 2002). Seismicity is not evident along the entirety of the Clarendon-Linden fault system.

Jacobi and Fountain (1996) estimated from the maximum recorded earthquake magnitude for the Clarendon-Linden fault system that "it is probable that no earthquake with a magnitude greater than 6 occurred along these faults in the past 10,000 years." They also concluded that the maximum credible earthquake for the study area is between magnitude 5.2 and 6 in the next 10,000 years, although they believe that there is a small probability that an earthquake larger than magnitude 6 could occur (Jacobi and Fountain 1996). Paleoseismological evidence of activity along the fault system during the Quaternary has not been identified. Tuttle et al. (1995, 1996) did not find historic or prehistoric liquefaction features in the liquefiable deposits in the area of the 1929 Attica earthquake and south of Attica along the fault zone. Various soft-sediment structures were observed, but all could be more reasonably attributed to glacial, sedimentological, or mass wasting processes (Tuttle et al. 1995, 1996; Young and Jacobi 1998). The lack of observed paleoliquefaction features may indicate that earthquakes larger than M 6 have not occurred along the Clarendon-Linden fault system during the last 12,000 years (Tuttle et al. 1995). However, smaller earthquakes may have occurred without leaving a detectable paleoliquefaction record. The 1929 Attica earthquake demonstrated that small to moderate earthquakes can occur on or near the fault system. Although the Clarendon-Linden fault system lacks paleoseismological evidence for Quaternary faulting, seismologic evidence indicates that the system was probably active during this century (Crone and Wheeler 2000).

3.5.3 Ground Motion Hazard Estimates

The most often used engineering measure of earthquake ground shaking is PGA. Thus in estimates of the ground shaking hazard at a site, the horizontal PGA is often estimated using either deterministic and probabilistic techniques. For DOE sites, the latter approach is required by DOE orders and standards. Earthquake-induced ground shaking can be expressed as the force of acceleration relative to the earth's gravity (expressed in units of "g").

In deriving estimates of ground shaking hazard, characterizations of the location, geometry, maximum magnitude, and sense of slip are made regarding relevant seismic source zones and tectonic features affecting the WNYNSC. The maximum earthquake has been alternately defined as the magnitude of the largest historically documented event (1929 Attica earthquake) for the WNYNSC or the maximum earthquake predicted to affect a given location based on the known lengths and histories of active faults or estimates for a given seismic source zone. The PGA estimates of Dames and Moore (1992) for the WNYNSC included the effects of ground amplification due to the presence of soil and unconsolidated sediments. Two important local geologic factors in site amplification are the thickness of soil and sediments and the shear-wave velocity of those materials.

Seismic Hazard Analyses 1970 to 2004

Earthquake hazard analysis has evolved since the construction of the WNYNSC in the 1960s from deterministic to probabilistic analyses. A fundamental difference between these approaches is that deterministic analyses do not consider the frequency of earthquake occurrence, whereas a probabilistic analysis accounts for frequency of occurrence for the full range of possible earthquakes that could affect a site.

In a deterministic analysis, ground motions are estimated for a specified earthquake scenario given the magnitude of the earthquake, distance between the source of the event and the site, and site condition. Probabilistic seismic hazard analysis is a methodology used to estimate the frequency that various levels of earthquake-induced ground motion will be exceeded at a given location (Savy et al. 2002). This frequency can be expressed as an annual probability or a probability in a given exposure period. For example, the International Building Code uses a 2 percent probability of exceedance in 50 years. This is the same as a return period of 2,475 years.

It should be noted that the input parameters used in either deterministic or probabilistic analyses are subject to a high degree of uncertainty. In the central and eastern United States, the short time record of historical earthquake events; the general absence of surface expression of causative faults; and a lack of understanding of the relationship between candidate geologic features and mid-plate or passive continental margin earthquakes contribute to this uncertainty.

Seismic hazard analyses have been developed for the WNYNSC since 1970. The estimated PGA values are summarized in **Table 3–7**.

Table 3–7 Seismic Hazard Estimates

Study Author and Year	*Return Period (years)*	*Peak Horizontal Ground Acceleration (g)*	*Site Condition*
Dames and Moore (1970)	Deterministic	0.12	Soil
EDAC (1975)	135	0.042	Soil
NRC (1977)	Deterministic	0.10 to 0.13	Unknown
TERA (1981)	100 / 1,000	0.06 / 0.14	Soil
Dames and Moore (1983)	33 - 333	< 0.07	Rock
Dames and Moore (1992)	1,000	0.07	Soil
USGS (2002)	500 / 2,500	0.03 / 0.11	Rock

Dames and Moore (1970) identified the Clarendon-Linden fault system and the St. Lawrence River Valley as the major regional seismic source zones comprising potentially important sources of future earthquakes. The study noted the occurrence of several small shocks in the region that could not be associated with known geologic structure. Such events were attributed to local stress-related crustal re-adjustments or to some structural feature not identifiable from existing data. The maximum credible earthquake predicted to affect the WNYNSC was assumed to be the largest documented historical event (WVNS 1992a) for the region (1929 Attica event). Dames and Moore (1970) suggested a design-basis earthquake PGA of 0.12 g, based on an earthquake of MMI VII-VIII occurring about 37 kilometers from the site near the Clarendon-Linden fault.

EDAC (1975) identified five different regional source zones (Clarendon-Linden structure, Adirondacks, the Eastern Mesozoic Basins / Appalachian fold belts, the Ohio River Valley, and the Anna, Ohio area). The most important in terms of hazard posed to the WNYNSC was Source 1 which combined a structure trending east-west across the Niagara Peninsula with the Clarendon-Linden structure. The maximum magnitude was assumed to be equal to the largest historic event, the 1929 Attica event. EDAC obtained a PGA value of 0.042 g for any time period greater than or equal to the return period of 135 years (EDAC 1975).

The Nuclear Regulatory Commission (1977) used the Central Stable region as a source of uniform seismicity for the WNYNSC hazard assessment. The hazard model was deterministic although the mean rate of occurrence of an intensity greater than or equal to the site intensity was determined, then converted into a PGA with no uncertainty. The NRC determined PGA values of 0.10 - 0.13g (NRC 1977).

TERA Corporation (1981) identified four zones (Buffalo-Attica zone, background source zone, Southern St. Lawrence zone, Central Appalachian Fold Belt) that were believed to contribute to the seismicity of the site region. The Buffalo-Attica zone (Source 1) was divided into three sub-zones because of the proximity of the zone to the site. Zone IA consisted of the Clarendon-Linden structure and an inferred westward trending structure. Zone lB included only the Clarendon-Linden structure. Zone IC covered a wider area that assumes that the Buffalo-Attica source extends to the site. Source 2 was described as a background source zone defined as the host region for the West Valley Site. Source 3 was termed the Southern St. Lawrence zone typified by continuous, moderate seismicity. The Central Appalachian Fold Belt, a zone of low activity, comprised Source 4. TERA used a probabilistic methodology that explicitly considered the uncertainties associated with zonation, the selection of the maximum earthquake, and the determination of the recurrence relationship for the WVDP site. The best-estimate hazard curve determined from the study indicated a PGA of 0.06g for the site with a return period of 100 years, and a 0.14g for a 1,000-year return period (TERA 1981).

Dames and Moore (1983) assigned probabilities ranging from 0.05 to 0.25 to seven different source zone models, each with different source zones and maximum magnitudes. The maximum magnitude for the dominant model (Hadley and Devine 1974) was M 6.3 ± 0.5 (Dames and Moore 1983, WVNS 1992a) with uncertainty in the maximum magnitude accounted for by equally weighting three values including the best-estimate and ± 0.5 magnitude units. Two attenuation relationships were used in the determination of the PGA at the site. Dames and Moore (1983) estimated an 84th percentile PGA of 0.07 g for a return period of 33 to 333 years.

Dames and Moore (1992) applied the Electric Power Research Institute/Seismicity Owners Group (EPRI/SOG) probabilistic seismic hazard methodology to develop seismic hazard estimates for the WNYNSC. The EPRI/SOG methodology incorporated historical earthquake catalog information and the expert opinions of six teams of earth scientists who described source zones with associated maximum magnitudes and seismicity patterns for the eastern United States. For most of the teams, the main contributor to the seismic hazard for the WNYNSC was the Clarendon-Linden fault source acting in combination with a background source. Including site amplification effects, the calculated median PGA value was 0.07g for a return period of 1,000 years (WVNS 1992a).

In the most recent and comprehensive seismic hazard evaluation of the site, URS (2004) performed a site-specific probabilistic seismic hazard analysis for a hard rock site condition. Site response analyses of the North Plateau and the South Plateau areas were performed to incorporate the effects of the general soil conditions in those portions of the WNYNSC site into the ground motion hazard estimates. The specific tasks performed in this study were: (1) based on available data and information, identify all potential seismic sources in the region surrounding the site that may significantly contribute to its seismic hazard; (2) characterize the location, geometry, orientation, maximum earthquake magnitude, and earthquake recurrence of these seismic sources based on available data and information; (3) assess the effects of the subsurface geology on strong ground shaking at the site; and (4) estimate the horizontal ground motions for selected annual probabilities of exceedance by performing a probabilistic seismic hazard analysis.

In the study, 19 seismic sources were characterized and included in the probabilistic analysis: 15 regional seismic source zones and four fault systems or fault zones. The fault systems or fault zones included: the Clarendon-Linden fault zone, the Charleston fault zone, the New Madrid fault system, and the Wabash Valley fault system. Gaussian smoothing of the historical seismicity was also incorporated into the analysis.

Based on the possible association with contemporary seismicity, URS (2004) assigned a high probability that the Clarendon-Linden fault zone is active. The best estimate maximum magnitudes for the Clarendon-Linden fault zone ranged from about **M** 6 to 7. Because of the short, discontinuous nature of the individual fault sections in the Clarendon-Linden fault zone (from a few kilometers to several tens of kilometers), it was judged unlikely that earthquakes of **M** 7 or larger can be generated by the Clarendon-Linden fault zone. The best estimate recurrence interval for the fault is based on the observations that **M** > 6 earthquakes have been absent along the Clarendon-Linden fault zone in the past 12,000 years. If a relatively uniform recurrence intervals for **M** ≥ 6 earthquakes on the Clarendon-Linden fault zone is assumed, and there are no data to argue either way, then the preferred recurrence interval was 10,000 years.

To estimate ground motions, six state-of-the-art ground motion attenuation relationships for hard rock site conditions in the CEUS were used. Based on the probabilistic seismic hazard analysis and the input of the seismic source model and attenuation relationships, PGA and 0.1 and 1.0 sec horizontal spectral accelerations were calculated for three DOE-specified return periods (or annual exceedance probabilities), as shown in **Table 3–8**.

Table 3–8 Site-specific Mean Spectral Accelerations on Hard Rock (g's)

Return Period (years)	*Peak Horizontal Ground Acceleration*	*0.1 Sec Spectral Acceleration*	*1.0 Sec Spectral Acceleration*
500	0.04	0.07	0.02
1,000	0.05	0.11	0.03
2,500	0.10	0.20	0.06

Source: URS 2004.

The largest contributor to the hazard at the site was the Clarendon-Linden Fault Zone at almost all return periods. The seismicity within the Southern Great Lakes seismic source zone (includes the site) is the second most important contributor to the mean PGA hazard. These observations are not surprising since the Clarendon-Linden Fault Zone is the only significant source in the site region and the historical seismicity is at a relatively low level. At 1.0 sec spectral acceleration, the contributors to hazard are the same. The New Madrid fault system does not contribute significantly to the hazard at the site.

A site response analysis was also performed to estimate the ground motions at the WNYNSC site incorporating the site-specific geology, which includes about 30 to 50 meters (100 to 165 feet) of fill, soil, and glacial till over Paleozoic bedrock. Using a random vibration theory-based equivalent-linear site response approach and the available geotechnical data from the Waste Tank Farm and Vitrification Building, ground motions were calculated for the ground surface at the North Plateau and South Plateau areas. The results for two return periods are shown in **Table 3–9**.

Table 3–9 Site-specific Mean Spectral Accelerations on Soil (g's) for North Plateau Areas and South Plateau

Return Period (years)	*Peak Horizontal Ground Acceleration*	*0.1 Sec Spectral Acceleration*	*1.0 Sec Spectral Acceleration*
500	0.05/0.03	0.09/0.08	0.04/0.05
2,500	0.14/0.11	0.24/0.22	0.11/0.14

Source: URS 2004.

The U.S. Geological Survey has developed state-of-the-art probabilistic National Hazard Maps since 1996 based on historic seismicity and information on active faults. Their map values are summarized in Table 3–7 for a firm rock site condition.

Estimates of the peak horizontal ground acceleration values at the WNYNSC presented in this section show a range of values from 0.07 to 0.14g at a return period of 1,000 years. The site adopted a design-basis earthquake with a horizontal peak horizontal ground acceleration of 0.10 g and a return period of 2,000 years. The design-basis earthquake was established in 1983 using a probabilistic assessment consistent with analyses for a typical nuclear power plant in the eastern United States. The design-basis earthquake was quantified in engineering terms using the NRC Regulatory Guide 1.60 response spectra (WVNS 2004a, 2006).

3.5.4 Liquefaction Potential

Liquefaction describes the behavior of unconsolidated, saturated soil and sediment that are induced to the consistency of a heavy liquid or reach a liquefied state as a consequence of excess porewater pressure and decrease in effective stress. Liquefaction typically occurs where earthquake motion increases hydrostatic stresses in loose, saturated, granular soil or sediment. Earthquake-induced soil liquefaction may have potentially damaging effects on the integrity of facilities including situations where the structure itself may survive design-basis ground accelerations only to be damaged by ground failure. The greatest potential for liquefaction occurs when the water table is within 3 meters (10 feet) of the surface. Geological deposits such as the sand and gravel layer on the North Plateau have the greatest potential for earthquake-induced liquefaction. Clay-rich deposits of glacial till, such as those found at the WNYNSC, are generally not prone to liquefaction. There has been no evidence identified of earthquake-induced liquefaction in the last 12,000 years, either at the site of the 1929 Attica earthquake, where most of the modern seismicity in western New York is concentrated, or along the Clarendon-Linden fault (Tuttle et al. 2002).

Evidence of seismically induced ground failure, such as liquefaction, slumping, and fissuring, has not been observed on or near the WNYNSC. This lack of evidence is consistent with the epicentral intensities of historic earthquakes occurring within a radius of 480 kilometers (300 miles) of the WNYNSC and their projected intensity (MMI-IV) at the WVDP. Seismic intensity of MMI-IV or less are typically associated with peak ground accelerations of less than 0.05 g and would not typically produce liquefaction in the soil materials at the site (WVNS 2004a, 2006).

Methods for evaluating liquefaction potential (Seed et al. 1983, Liao et al. 1988) using data from standard penetration testing were applied to soil samples from 28 monitoring well locations on the North Plateau (WVNS 1992a). Standard penetration testing data were analyzed to estimate the probability of liquefaction at the WNYNSC resulting from a magnitude 5.25 event corresponding to a peak ground acceleration of 0.15 g. The potential for liquefaction in the sand and gravel layer underlying the Construction and Demolition Debris Landfill is estimated to be about 20 percent, 30 percent near the old meteorological tower in WMA 10, and less than 1 percent in the area near the former Chemical Process Cell Waste Storage Area in WMA 5. There are no foundations or steep slopes near these locations. The potential for liquefaction associated with stronger earthquakes is larger; however, the probability of such an earthquake at the WNYNSC is low based on the historical record. Near the old meteorological tower in WMA 10, the liquefaction potential increases to 60 percent (high) for a magnitude 7.5 earthquake. The liquefaction potential for all other sites would remain below 50 percent for such an event. A magnitude 7.5 event is larger than the maximum credible earthquake estimated for this region.

The liquefaction potential for the Lavery till and the Kent recessional units is less than that for the overlying sand and gravel. Cohesive, clay-rich glacial till, such as the Lavery till, are not easily liquefied (WVNS 1992a). Standard penetration test results from eight wells completed in the Kent recessional unit under the South Plateau indicate that there is less than a one percent chance of liquefaction from a horizontal ground acceleration of 0.15 g (WVNS 1993g). The areas of greatest liquefaction potential on the WNYNSC do not contain facilities with large inventories of radioactive material. Liquefaction poses less of a hazard to the waste-containing areas (NDA, SDA) on the South Plateau because of their encapsulation in clayey till.

3.6 Water Resources

Water enters the area of the Project Premises and SDA as a result of precipitation (i.e., rain and snow), surface runoff from higher elevations, or groundwater infiltration from areas of higher head. Water exits the Project Premises and SDA by surface runoff, evapotranspiration (i.e., evaporation or transpiration from plants), or groundwater flow. Most of the water exits by evapotranspiration and surface runoff (WVNS 1993g).

3.6.1 Surface Water

Two perennial streams drain the WNYNSC: Cattaraugus Creek and one of its tributaries, Buttermilk Creek (see **Figure 3–17**). Buttermilk Creek roughly bisects the WNYNSC and flows generally north at an average rate of 1.8 cubic meters (64 cubic feet) per second to its confluence with Cattaraugus Creek at the northernmost end of the WNYNSC boundary. Cattaraugus Creek then flows generally west and empties into Lake Erie, about 64 kilometers (40 miles) downstream of the WVDP Premises. The Project Premises and SDA are entirely within the Buttermilk Creek drainage area of 76 square kilometers (29 square miles) that also encompasses most of the WNYNSC (WVNS 2004a).

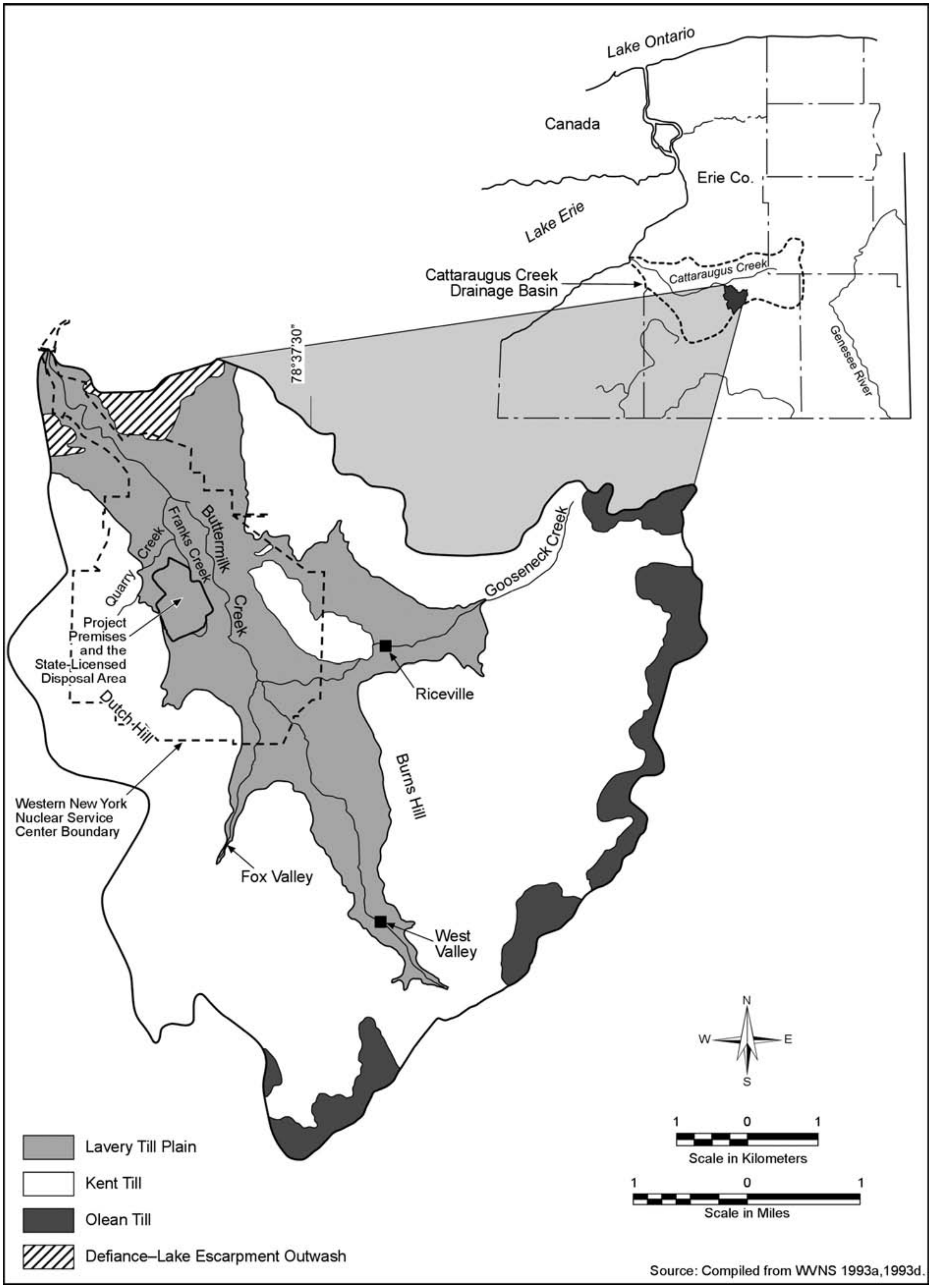


Figure 3–17 Buttermilk Creek Drainage Basin

Three small intermittent streams drain the Project Premises and SDA: Erdman Brook, Quarry Creek, and Franks Creek (see Figure 3–1). Erdman Brook and Quarry Creek are tributaries to Franks Creek, which flows into Buttermilk Creek. Erdman Brook, the smallest of the three streams, receives runoff from the central and largest portion of the Project Premises and the SDA, including the disposal areas (WMAs 7 and 8), the Low-Level Waste Treatment Facility and Lagoons 1 through 5 (WMA 2), the Main Plant Process Building area (WMA 1), the central Project Premises (WMA 6), and a major part of the parking lots (WMA 10). Quarry Creek receives runoff from the High-Level Radioactive Waste Tank Farm and vitrification area (WMA 3), the north half of the northern parking lot (WMA 10), and the waste storage area (WMA 5). Franks Creek receives runoff from the east side of the Project Premises and the SDA, including the Radwaste Treatment System drum cell (WMA 9), part of the SDA (WMA 8), and the Construction and Demolition Debris Landfill (WMA 4) (WVNS 2004a, 2006).

New York assigns water classifications to all waters in the state, defining the best usages of each waterbody. The classification is the legal basis for water quality protection programs. Cattaraugus Creek, in the immediate downstream vicinity of the WNYNSC, is identified as a Class "B" receiving water. Franks Creek, Quarry Creek, and segments of Buttermilk Creek under the influence of site water effluents, are identified as Class "C" (WVNS and URS 2007). Class "B" waters are best used for primary and secondary contact recreation and fishing and are to be suitable for fish propagation and survival. The best usage of Class "C' waters is fishing, but these waters are also intended to be suitable for fish propagation and survival as well as for primary and secondary contact recreation, although other factors may limit the use for these purposes (NYSDEC 1998a). None of the streams on the WNYNSC is on the state's current Clean Water Act Section 303(d) list as being impaired relative to attaining water quality standards and designated uses (NYSDEC 2004b).

The site maintains a State Pollutant Discharge Elimination System permit (NY0000973) issued by NYSDEC for the discharge of nonradiological liquid effluents to Erdman Brook and Franks Creek, and which specifies the sampling and analytical requirements for each outfall. The NYSDEC issued a modified permit to DOE with an effective date of September 1, 2006, and an expiration date of February 1, 2009 (NYSDEC 2004c, WVNS and URS 2007). This modified permit covers five primary outfalls (see **Figure 3–18**): outfall 001 (WNSP001, discharge from the Low-Level Waste Treatment Facility and the North Plateau groundwater recovery system via Lagoon 3); outfall 007 (WNSP007, discharge from the Sanitary and Industrial Wastewater Treatment Facility); outfall 008 (WNSP008, groundwater French drain effluent from the perimeter of the Low-Level Waste Treatment Facility storage lagoons); outfall 116 (WNSP116, a location in Franks Creek used to monitor compliance with the instream total dissolved solids limit from upstream sources and to adjust discharges from Lagoon 3 and the need for augmentation water); and outfall 01B (WNSP01B, an internal monitoring point for the liquid waste treatment system evaporator effluent) (NYSDEC 2004c, WVNS and URS 2007). While still in the State Pollutant Discharge Elimination System permit, outfall 008 (WNSP008) is no longer active, but is maintained as a potential point source. This outfall discharged groundwater and surface water runoff directed from the northeast side of the site's Low-Level Waste Treatment Facility lagoon system through a French drain to Erdman Brook until the outfall was capped off in May 2001 (WVNS and URS 2007). In addition to the five existing outfalls, the modified permit authorized discharges from 20 stormwater outfalls to include associated monitoring requirements and discharge limits. These 20 outfalls receive stormwater runoff from inactive waste disposal areas, areas where materials or wastes are stored or handled, and areas where construction or structure dismantlement or other soil disturbance activities may be performed. Among other changes, the modified permit added new requirements for reporting water treatment chemical usage, added monitoring for chemical substances used for weed control, and a new requirement to prepare and implement a Stormwater Pollution Prevention Plan (NYSDEC 2004c, WVNS and URS 2006). During 2006, none of the 1,060 effluent samples collected exceeded permitted values, for a compliance rate of 100 percent (WVNS and URS 2007).

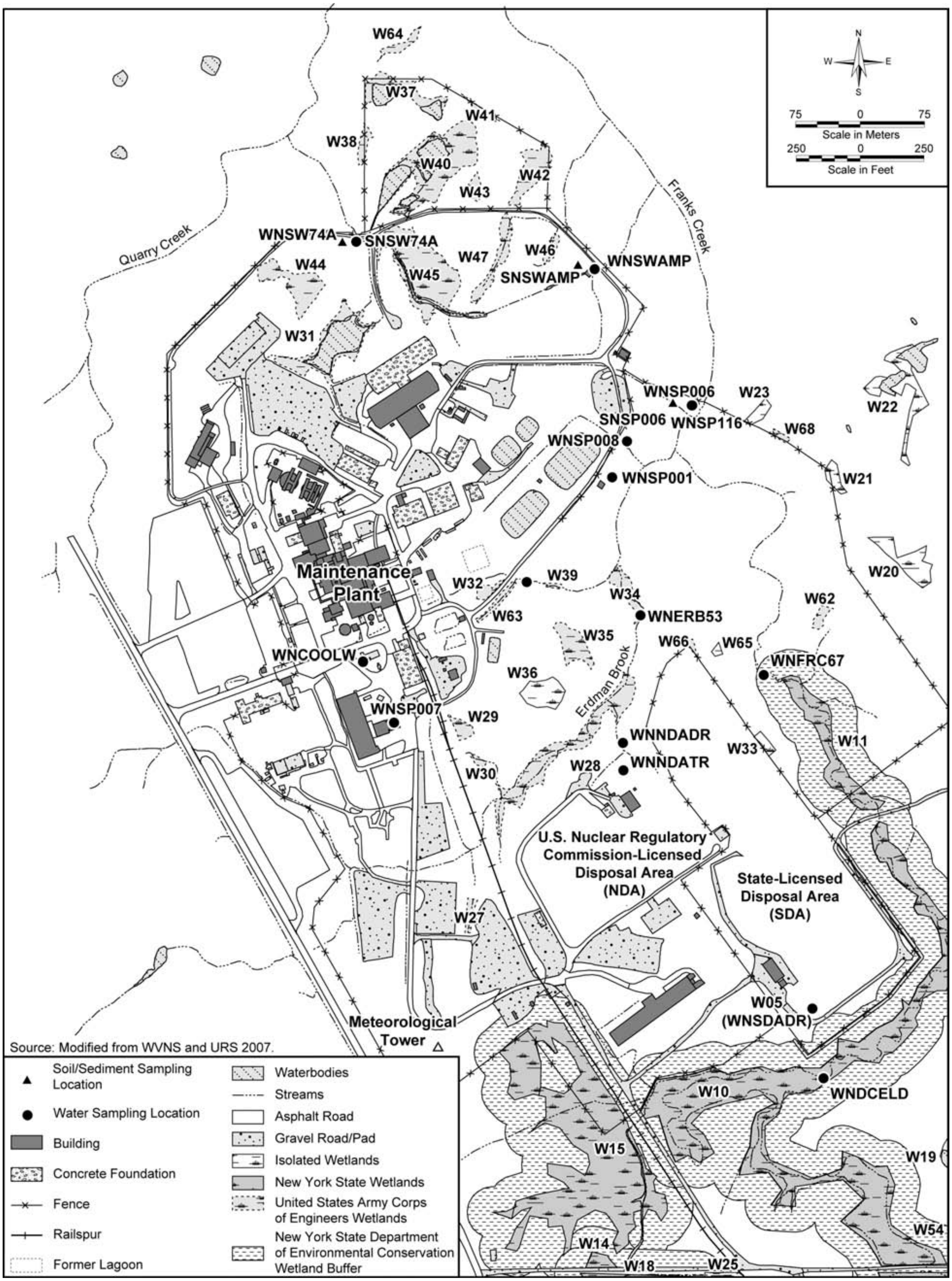


Figure 3–18 Onsite Surface Water and Soil/Sediment Sampling Locations

In September 2005, a new State Pollutant Discharge Elimination System Permit (NY0269271*)* was issued to NYSERDA for stormwater discharges from the SDA. The permit has an effective date of November 1, 2005, and an expiration date of October 31, 2010. This permit covers six outfalls (W01–W06) and specifies associated monitoring requirements and discharge limits. The permit also requires preparation and implementation of a Storm Water Pollution Prevention Plan (NYSDEC 2005b).

Two water supply reservoirs (part of WMA 12) are located south (upstream) of the Project Premises and the SDA. Figure 3–2 shows the location of these reservoirs that were formed by blocking two intermittent tributaries to Buttermilk Creek with earthen dams. The reservoirs drain numerous streams over a 1,255-hectare (3,000-acre) area. A short canal connects the reservoirs; the south reservoir drains to the north reservoir, which discharges into Buttermilk Creek through a sluice gate water level control structure. An emergency spillway is also located on the south reservoir (WVNS 2004a, 2006). Overtopping of the emergency spillway was originally designed to occur in the event of a 25-year storm (Dames and Moore 1986). However, some of the available storage in the reservoirs has been lost to sedimentation. In 1996, the spillway was regraded and stabilized using a geosynthetic to control erosion. Gabions are located at the top of the slope (WVNS 2004a). Other than the two water supply reservoirs and wastewater treatment lagoons in WMA 2, several small ponds are located across the WNYNSC including former borrow pits (Northern Borrow Pits) located in the northeast corner of the Project Premises (WVNS 2004a, WVNS and URS 2005). These ponds do not receive liquid effluent, but they were monitored for selected nonradiological and radiological parameters until 2005 (WVNS and URS 2006).

The streams draining the Project Premises and the SDA exhibit large flow variations. Peak streamflows occur either in spring from a heavy rainfall on snow cover with a frozen ground or in summer from thunderstorms. In the past, streamflow monitoring equipment was located at the Franks Creek-Quarry Creek confluence, the Erdman Brook-Franks Creek confluence, and at Erdman Brook just below the NDA. Peak flows measured on March 27, 1991, for the period from 1990 to 1991 were 9.6 cubic meters (340.3 cubic feet) per second at the confluence of Quarry Creek and Franks Creek, 4.6 cubic meters (161 cubic feet) per second where Franks Creek leaves the Project Premises, and more than 1.7 cubic meters (60 cubic feet) per second in Erdman Brook. Peak flow measured at the U.S. Geological Survey gauge station at the Bond Road Bridge over Buttermilk Creek (which operated from 1962 to 1968) was 111 cubic meters (3,910 cubic feet) per second on September 28, 1967 (WVNS 2004a).

Otherwise, the only current flow measurement equipment is a parshall flume at monitoring point WNSP006 in Franks Creek, just downstream from outfall 001 (WNSP001). Data for this location is used to generate the total dissolved solids compliance calculation for outfall 116 (WNSP116). Measurements are only taken when Lagoon 3 discharges, and are reported in monthly discharge monitoring reports to NYSDEC. Since 1991, there have been hydraulic changes to the watershed with increased discharges into Erdman Brook and Franks Creek. For example, discharges at outfall 001 (WNSP001) have increased (primarily due to North Plateau Plume pump and treat mitigation) by roughly 15 million liters (4 million gallons) per year since the original period when in-stream flow was measured (Malone 2006).

Flood levels for the 100-year storm (see **Figure 3–19**) show that no facilities on the Project Premises or the SDA are in the 100-year floodplain. This is partly attributable to the fact that Cattaraugus and Buttermilk Creeks, as well as Franks Creek, Quarry Creek, and Erdman Brook, are located in deep valleys such that floodwaters would not overtop their banks flooding the plateau areas where facilities are located. Indirect flood effects, including streambank failure and gully head advancement from high streamflows in the short term, could impact Lagoons 2 and 3 (WMA 2), the NDA, and site access roads in several locations (WVNS 2004a, 2006). No 500-year floodplain map is currently available for the creeks bordering the Project Premises and the SDA.

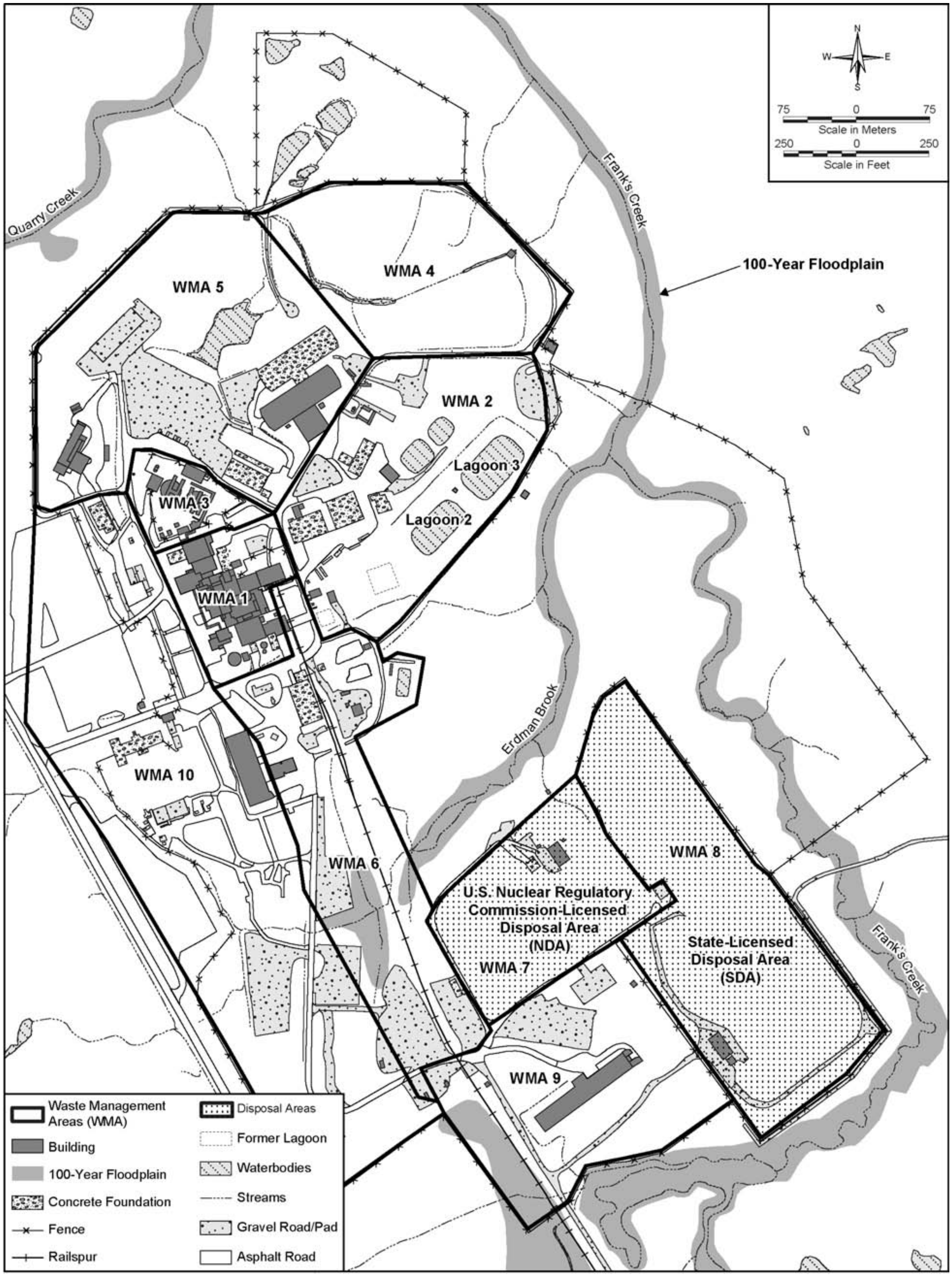


Figure 3–19 100-Year Floodplain Near the Project Premises

An analysis of the probable maximum flood based on probable maximum precipitation has been performed for this EIS (see Appendix M for more detail). The probable maximum flood is generally more conservative than the 500-year flood because it is defined as the flood resulting from the most severe combination of meteorological and hydrologic conditions (DOE 2002c). The results of this analysis indicate that the probable maximum flood floodplain is very similar to the 100-year floodplain, particularly in areas adjacent to the industrialized or developed portions of the site including areas where waste is stored or buried (URS 2008b). Most of the stream channels near the industrialized area have relatively steep sides and the probable maximum flood flow remains in these channels. The probable maximum flood floodplain is wider than the 100-year floodplain in areas where the topography is relatively flat such as the extreme upper reaches of Erdman Brook and Franks Creek. It is possible that the integrity of the northern slope of the SDA could be compromised (WVNS 2004a, 2006, 2007).

3.6.1.1 Contaminant Releases and Water Quality

Several onsite surface water monitoring locations are maintained for sampling both radiological and nonradiological constituents (see Figure 3–18). Among these, WNSP006 is the Project Premises' main drainage point and is located immediately downstream of outfall 001 (WNSP001) in Franks Creek. The northeast swamp (WNSWAMP) is sampled to monitor surface water drainage and emergent groundwater from the northeastern portion of the site's North plateau. The north swamp (WNSW74A) monitoring point is sampled to monitor drainage including emergent groundwater to Quarry Creek from the northern portion of the North Plateau. Comparative samples are also collected from an upstream background monitoring location (Buttermilk Creek at Fox Valley Road, WFBCBKG) (**Figure 3–20**). WNSP006 is located more than 4.0 kilometers (2.5 miles) upstream from Thomas Corners Bridge (WFBCTCB), the last monitoring point before Buttermilk Creek leaves the WNYNSC and before the public has access to the creek waters. In 2006, two sets of grab samples for nonradiological parameters were collected from each of the aforementioned locations. Samples were specifically analyzed for selected organic and inorganic constituents and selected anions, cations, and metals. At surface water monitoring locations WFBCTCB, WNSP006, and background reference location WFBCBKG, the maximum concentrations of total iron exceeded the state water quality standards. The elevated iron concentrations are attributable to elevated background concentrations, runoff from industrial activities, fine sediments from placement of quarried materials delivered from offsite sources, and natural silts and fine sediments from soil erosion. With the exception of iron, the other nonradiological constituents remained within the range of historical values. Monitoring results for other nonradiological parameters are detailed in the *Annual Site Environmental Report* (WVNS and URS 2007). In 2005 the sampling frequency of the offsite soil locations shown in Figure 3–20 was changed from annual to once every three years. These locations were last sampled in 2004 and are scheduled for sampling in 2007.

In addition to monitoring facility effluents for nonradiological constituents in accordance with permitted levels, radiological constituents (radionuclides) in facility effluents, as well as in onsite and offsite surface water, are monitored as part of the site environmental monitoring program. Waterborne radiological releases are from two primary sources that include discharges from the Low-Level Waste Treatment Facility via Lagoon 3 and from groundwater seepage on the North Plateau that is contaminated with strontium-90 from prior operations. The discharge from the Low-Level Waste Treatment Facility from Lagoon 3 outfall 001 (WNSP001) into Erdman Brook is the primary controlled point source of radioactivity released to surface waters from the Project Premises. There were six batch releases from the Lagoon 3 outfall in 2006 totaling about 39.3 million liters (10.4 million gallons). In total, discharges from Lagoon 3 contained an estimated 0.05 curies of tritium and 0.012 curies of gross alpha and beta-emitting radionuclides. These releases are further detailed by individual radionuclide in the *Annual Site Environmental Report* (WVNS and URS 2007).

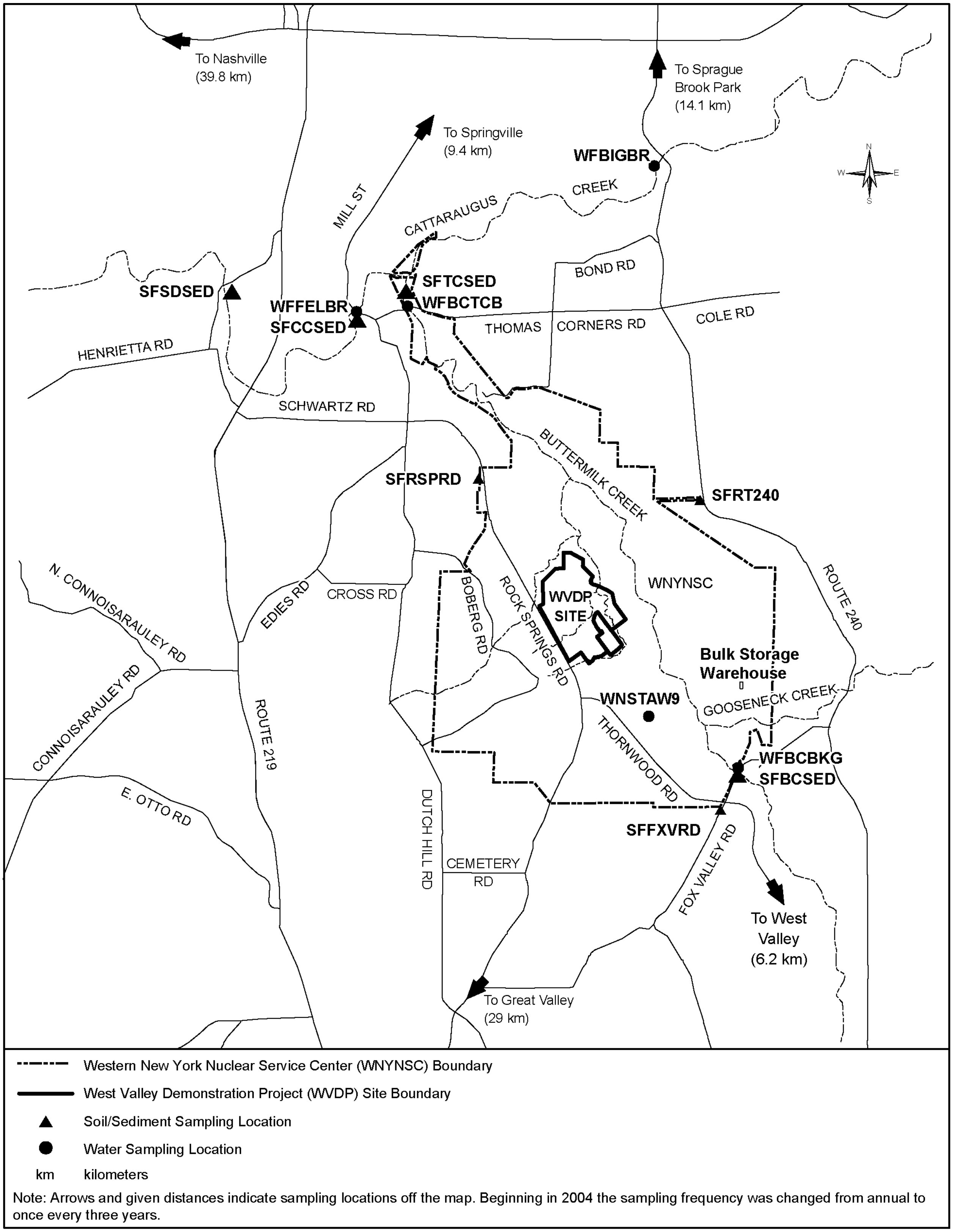


Figure 3–20 Offsite Surface Water and Soil/Sediment Sampling Locations

Several sets of state and Federal regulatory guidelines and standards are incorporated into the site monitoring programs (WVNS 2006). State guidelines and standards include New York State Water Quality Standards and Guidelines from 6 NYCRR Parts 701-704, New York State Department of Health Standards of Raw Water Quality from 10 NYCRR 170.4, and New York State Department of Health Maximum Contaminant Level Sources from 5 NYCRR 5-1.52. Federal guidelines and standards include U.S. Environmental Protection Agency Maximum Contaminant Level Sources and Maximum Contaminant Level Goals (non-enforceable) from 40 CFR Part 141, and DOE Derived Concentration Guides from DOE Order 5400.5.

Based on the results of routine monitoring for radiological constituents in 2006 at location WNSP006, gross beta, strontium-90, uranium-233/uranium-234, and uranium-238 average concentrations exceeded the range of the respective background values, but did not exceed applicable DOE Derived Concentration Guides[1], as summarized in **Table 3–10**. At the northeast swamp (WNSWAMP), average gross beta, and strontium-90 concentrations of $2.32 \pm 0.01 \times 10^{-6}$, and $1.21 \pm 0.01 \times 10^{-6}$ microcuries per milliliter, respectively, exceeded background ranges in 2006. The average strontium-90 concentration also exceeded the DOE Derived Concentration Guide. At the north swamp (WNSW74A), average gross beta and strontium-90 concentrations of $1.95 \pm 0.14 \times 10^{-8}$ and $6.17 \pm 0.36 \times 10^{-9}$ microcuries per milliliter, respectively, exceeded background in 2006. The elevated gross beta concentrations at the north and northeast swamp location are attributable to strontium-90 in groundwater seepage (WVNS and URS 2007).

Table 3–10 Radiological Parameters Exceeding Background Ranges in Surface Water Downstream of the Project Premises at Franks Creek (WNSP006) in 2005

Parameter	*Average Concentration (Location WNSP006)*	*Background Range (Location WFBCBKG)*	*DOE Derived Concentration Guide* [a]
Gross Beta	$4.18 \pm 0.30 \times 10^{-8}$	$1.61 \times 10^{-9} – 7.34 \times 10^{-9}$	1.0×10^{-6} [b]
Strontium-90	$1.31 \pm 0.17 \times 10^{-8}$	$2.74 \times 10^{-10} – 1.16 \times 10^{-9}$	1.0×10^{-6}
Uranium-233/Uranium-234	$2.58 \pm 1.20 \times 10^{-10}$	$7.47 \times 10^{-11} – 2.19 \times 10^{-10}$	5.0×10^{-7}
Uranium-238	$1.95 \pm 1.04 \times 10^{-10}$	$3.74 \times 10^{-11} – 1.25 \times 10^{-10}$	6.0×10^{-7}

[a] DOE ingestion-based Derived Concentration Guides for 100 millirem per year dose limit are provided as a guideline for radiological results.
[b] Gross beta as strontium-90.
Note: All units in microcuries per milliliter. Values are reported based on a 95 percent confidence level with the plus-or-minus (±) sign marking the confidence interval in which there is a 95 percent probability that the true value lies.
Source: WVNS and URS 2006.

Surface waters are also routinely monitored for radiological and other indicator constituents at several points around the NDA (WMA 7) and SDA (WMA 8) by DOE (see Figure 3–18). For the NDA, monitoring point WNNDATR is a sump at the lowest point in the collection trench system that intercepts groundwater from the northeastern and northwestern sides of the NDA. Water collected underground at this location is pumped to the Low-Level Waste Treatment Facility for treatment prior to discharge at outfall 001 (WNSP001). Surface water drainage downstream of the NDA is monitored at WNNDADR. Further downstream is monitoring point WNERB53 in Erdman Brook which represents surface waters from the NDA before they join with drainage from the Main Plant Process Building and lagoon areas. Strontium-90 and associated gross beta were elevated with respect to background (WFBCBKG) in 2006 at all three NDA monitoring locations but below the DOE Derived Concentration Guide for strontium-90. Tritium was also elevated with respect to background at WNNDATR and WNNDADR, and gross alpha and iodine-129 were elevated at WNNDATR. Residual soil contamination from past waste burial activities is thought to be the source of the strontium-90 activity. Tritium

[1] It should be noted that the definition of a Derived Concentration Guide, per DOE 5400.5, is "the concentration of a radionuclide in air or water that, under conditions of continuous exposure for 1 year by one exposure mode (i.e., ingestion of water, submersion in air, or inhalation), would result in an effective dose equivalent of 100 millirem."

concentrations have generally decreased over time at both WNNDATR and WNNDADR, which may be partially attributable to radioactive decay (WVNS and URS 2007).

For the SDA, semiannual sampling is performed from one of the six designated stormwater outfalls in accordance with the SDA SPDES Permit. Immediately south of the SDA point WNDCELD is sampled to monitor surface drainage from the area around the drum cell. To the north, location WNFRC67, in Franks Creek, is sampled to monitor drainage downstream of the drum cell and the eastern and southern borders of the SDA. In addition to routine samples collected by the site, samples are collected and analyzed by the New York State Department of Health (NYSDOH) at the two stream sampling points that receive drainage from the South Plateau, WNFRC67 and WNERB53 (see Figure 3–18) (WVNS and URS 2007).

In 2006, offsite surface water quality continued to be monitored at two locations, one on Buttermilk Creek and one on Cattaraugus Creek, in addition to the upstream background monitoring location on Buttermilk Creek at Fox Valley Road (WFBCBKG) and at a background location on Cattaraugus Creek at Bigelow Bridge (WFBIGBR). Average gross beta ($6.51 \pm 9.25 \times 10^{-10}$ microcuries per milliliter) concentration at the Thomas Corners Bridge location (WFBCTCB) in Buttermilk Creek, but downstream of the WVDP, exceeded the Buttermilk Creek background range. At the Felton Bridge (WFFELBR) offsite location, downstream of the point where Buttermilk Creek enters Cattaraugus Creek, the average gross alpha concentration of $1.43 \pm 0.99 \times 10^{-9}$ microcuries per milliliter and average gross beta concentration of $6.40 \pm 1.68 \times 10^{-9}$ microcuries per milliliter exceeded the Cattaraugus Creek background ranges of 3.59×10^{-10} to 9.42×10^{-10} microcuries per milliliter and 2.8×10^{-9} to 3.62×10^{-9} microcuries per milliliter, respectively. This is the first point accessible by the general public, and these elevated concentrations may be attributed to small amounts of radioactivity moving from the site via Franks Creek. Taking into account seasonal fluctuations, gross beta activity has remained relatively constant at this location over the last decade (WVNS and URS 2007).

Drinking water, derived from the onsite reservoir system upstream of the Project Premises and SDA, is monitored at the distribution point and at other site tap water locations to verify compliance with EPA and NYSDOH regulations. Samples are collected and analyzed for metals, nitrate, fluoride, cyanide, principal organic contaminants, residual chlorine, and biological constituents. Results indicated that in 2006, the Project's drinking water continued to meet MCLs and drinking water standards of the EPA, NYSDOH, and the Cattaraugus County Health Department (WVNS and URS 2007).

3.6.1.2 Stream Sediment Contamination

Surface water and stream sediment quality downstream from the Project Premises and SDA has been impacted by past fuel reprocessing operations, primarily from previous discharges from Lagoon 3 (WMA 2) between 1966 and 1972. During this time, a yearly average of 0.7 curies of alpha emitters, 65 curies of beta emitters, and 3,500 curies of tritium were released from Lagoon 3 to Erdman Brook, which flows into Franks Creek. Subsequent radioactive discharges from Lagoon 3 were related to treatment of SDA leachate from 1975 to 1981 and from facility operations from 1972 to the present. Several of the discharged radionuclides, particularly cobalt-60, strontium-90, cesium-134, and cesium-137, have an affinity to become chemically sorbed to silt and accumulate in the streambeds. It is assumed that stream sediments within WMA 12 between the Lagoon 3 outfall on Erdman Brook and the confluence of Franks Creek and Quarry Creek is contaminated (WSMS 2008a). However, results from a 1990s RCRA facility investigation and current monitoring indicate additional contamination downstream from the confluences, as discussed below.

Soil and sediment from three onsite drainage channels are sampled annually to track waterborne movement of contaminants. Stream sediments in onsite and offsite creeks continue to be monitored for radiological constituents. Onsite monitoring locations include Franks Creek where it leaves the security fence (SNSP006) to the northeast of Lagoon 3, the north swamp drainage swale (SNSW74A) in WMA 5, and the northeast swamp drainage swale (SNSWAMP) in WMA 4. These are locations where liquid effluents leaving the site are most likely to be radiologically contaminated. Results are compared to land-use-specific threshold levels for decommissioning and decontamination of contaminated sites, established in accordance with the 2002 Memorandum of Understanding between the NRC and EPA, and to results from an upstream "background" location (Buttermilk Creek at Fox Valley Road, SFBCSED) that has not received WVDP effluents. In 2006, the NRC, in a decommissioning guidance document (NRC 2006), provided concentration screening values (NUREG-1757 value) for common radionuclides in soils that could result in a dose of 25 millirem per year. For 2006 cesium-137 concentrations at locations SNSP006 and SNSWAMP, measured at $2.33 \pm 0.14 \times 10^{-5}$ and $2.62 \pm 0.22 \times 10^{-5}$ microcuries per gram respectively, were higher than both the industrial/commercial level and the NUREG-1757 value. The strontium-90 concentrations at these two locations, $4.14 \pm 0.54 \times 10^{-7}$ and $2.96 \pm 0.13 \times 10^{-6}$ microcuries per gram, also exceeded both the industrial/commercial level and the NUREG-1757 value. These observations are indicative of contamination from historical releases. It also exceeded the 10-year averaged concentration from the Buttermilk Creek background site of $3.41 \pm 2.77 \times 10^{-8}$ microcuries per gram. No other radiological constituent concentrations exceeded the applicable respective threshold level or NUREG-1757 values, but all three onsite locations exceeded comparable background concentrations for more than one radionuclide (WVNS and URS 2007).

Sediments are collected off site at three locations downstream of the Project Premises and SDA, including Buttermilk Creek at Thomas Corners Road (SFTCSED) immediately downstream of site effluents, Cattaraugus Creek at Felton Bridge (SFCCSED), and Cattaraugus Creek at the Springville dam (SFSDSED). This third location is behind the Springville dam where significant sediments accumulate, including sediments that may have adsorbed radionuclides from the site. The 10-year averaged concentrations from a fourth location (SFBISED, Bigelow Bridge) are used as the upstream Cattaraugus Creek background for comparison purposes with the two Cattaraugus Creek locations. At the downstream Buttermilk Creek location (SFTCSED), the cesium-137 concentration of $7.44 \pm 0.59 \times 10^{-7}$ microcuries per gram significantly exceeded the 10-year averaged background concentration of $3.59 \pm 2.75 \times 10^{-8}$ microcuries per gram in 2006. The uranium-235/uranium-236 concentration ($7.32 \pm 4.55 \times 10^{-8}$ microcuries per gram) measurably exceeded the background concentration of $5.03 \pm 3.52 \times 10^{-8}$ microcuries per gram. The concentrations of cesium-137, gross beta emitters, potassium-40, uranium-233/uranium-234, and uranium-238 isotopes at the first Cattaraugus Creek location (SFCCSED) exceeded their respective background concentrations in 2006 as well as gross beta emitters, potassium-40, uranium-233/uranium-234, uranium-238, and total uranium isotopes at the Springville dam location (SFSDSED). Most notably, the cesium-137 concentration at Cattaraugus Creek location SFCCSED was $1.80 \pm 0.31 \times 10^{-7}$ microcuries per gram as compared to a background concentration of $3.73 \pm 2.27 \times 10^{-8}$ microcuries per gram (WVNS and URS 2007). No offsite strontium-90 sediment concentrations exceeded background for 2006.

Stream sediments were also collected from Franks Creek, Erdman Brook, Quarry Creek, and drainages at the North Plateau as part of a 1990s RCRA facility investigation (WVNSCO 1994). Three sampling locations – ST01, ST02, and ST03 – were located downstream of the WVDP along Franks Creek and Buttermilk Creek. The data for these locations are available from the soils characterization environmental document (WVNSCO 1994) and indicate levels of gross alpha and gross beta activities also exceeding background.

3.6.2 Groundwater

As detailed in Section 3.3.1.1, the stratigraphic units of the North and South Plateaus are different, which is reflected in the hydrologic characteristics and hydraulic properties of the units that are used to define the hydrogeologic system and associated groundwater flow regime of the WNYNSC site and vicinity. In summary, on the North Plateau, the surficial sand and gravels are underlain by the Lavery till. The Lavery till on the North Plateau further contains the Lavery till-sand unit, a lenticular unit of limited extent. There is no sand and gravel unit at the surface on the South Plateau. The uppermost unit on the South Plateau is the weathered Lavery till which is underlain by the unweathered Lavery till. The stratigraphy below these upper units on the North and South Plateaus is the same. The underlying units, presented in descending order, are the Kent recessional sequence, the Kent till, Olean till, and shale bedrock.

In the following sections, the hydrostratigraphy of the North and South Plateaus is summarized to include a description of the saturated zone, direction of groundwater flow, and the distribution and nature of groundwater contamination as derived from historical studies through the present. More detailed data on and analysis of the hydrostratigraphic units and their properties as defined in support of the three-dimensional groundwater modeling, water balance information, and the long-term performance assessment is presented in Appendix E.

3.6.2.1 Hydrostratigraphy of the North and South Plateaus

Surficial Sand and Gravel (Thick-bedded Unit and Slack-water Sequence)

The deposits comprising the surficial sands and gravels on the North Plateau include an alluvial deposit (thick-bedded unit) and a lower glaciofluvial gravel and associated basal lacustrine deposit (slack-water sequence) that attain a maximum thickness of 12.5 meters (41 feet) near the center of the North Plateau (see Section 3.3.1.1). The surficial sands and gravels are further classified as an unconfined near-surface water-bearing unit (WVNS and Dames and Moore 1997).

The extent of the surficial sands and gravels is limited as it pinches out along the north, east, south, and west perimeters of the Plateau where it is incised by Quarry Creek (north), Franks Creek (east), Erdman Brook (south), and by the slope of the bedrock valley (west) (WVNS and Dames and Moore 1997, WVNS and URS 2006). The depth to the water table ranges from 0 meters (0 feet) where the water table in the sands and gravels intersects the ground surface and forms swamps and seeps along the periphery of the North Plateau to as much as 6 meters (20 feet) beneath portions of the central North Plateau where the unit has been mapped as the thickest (WVNS 1993d). Groundwater in the sands and gravels demarcates the upper aquifer beneath the WVDP site (WVNS 2004a). Long-term water level trends suggest a pattern of high water levels from fall through spring and low water levels during the summer. Water levels are typically highest in the spring after snow melt and spring precipitation and lowest in summer when evapotranspiration is greatest and the volume of precipitation is relatively low (WVNS and Dames and Moore 1997). Precipitation occurring from December to April is lost mainly to rapid runoff and infiltration. For the warmer periods of May through November, precipitation is lost mainly to infiltration and subsequent evapotranspiration (WVNS 1993e).

Groundwater in the sands and gravels generally flows radially to the northeast across the North Plateau from the southwestern margin of the unit near Rock Springs Road toward Franks Creek, as shown in **Figure 3–21**. Groundwater near the northwestern and southeastern margins of the unit diverges from the predominant northeast flow path and flows toward Quarry Creek and Erdman Brook, respectively (see Figure 3–21). Flow is mostly horizontal, since the low hydraulic conductivity of the underlying Lavery till precludes any significant downward flow (WVNS 1993d, WVNS and Dames and Moore 1997, WVNS and URS 2006). Analyses of slug test data estimated average or mean horizontal hydraulic conductivity value of 4.2×10^{-4} centimeters per second (14 inches per day) for the sands and gravels while not distinguishing between the thick-bedded unit and slack-water sequence subunits (WVNS 1993d). This estimate combined with a hydraulic gradient of 0.031, and an effective porosity of 0.22, was used to calculate a groundwater velocity of 18.6 meters (61 feet) per year (WVNS 1993d, WVNS and Dames and Moore 1997). It is notable that field testing over the last few years has utilized automated data acquisition and the mean hydraulic conductivity (horizontal) for the thick-bedded unit has been estimated to be higher at 6×10^{-3} centimeters per second (200 inches per day) (WVNS and URS 2006). Using this range of hydraulic conductivities, the estimated groundwater velocity could be up to 260 meters (850 feet) per year.

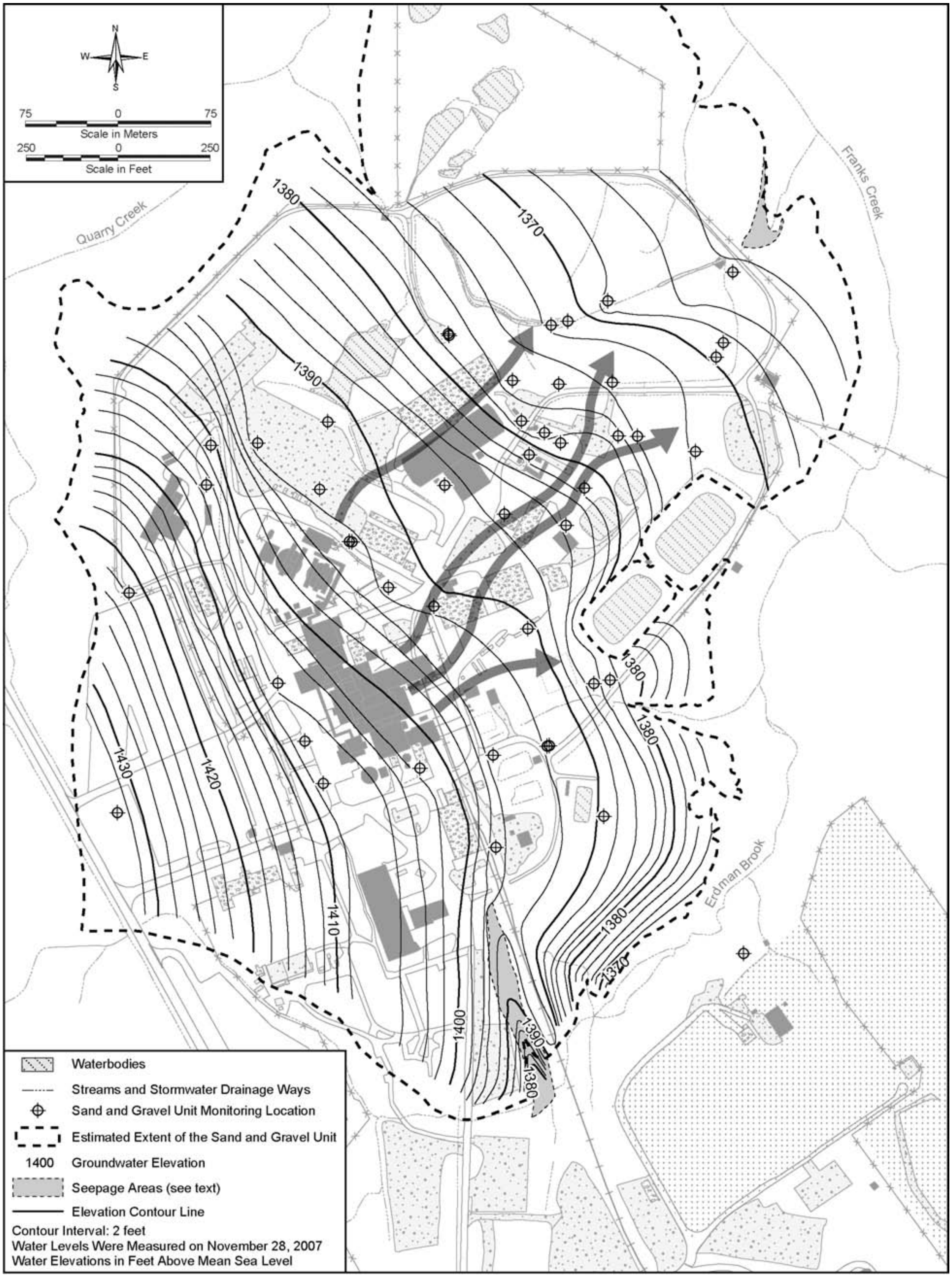


Figure 3–21 Groundwater Elevation and Flow in the Sand and Gravel Unit

Appendix E provides the results of statistical and geostatistical characterizations of all of the thick-bedded unit hydraulic conductivity data—early and recent—provide to support this EIS. These analyses demonstrate a significant difference between the earlier and more recent thick-bedded unit data, and determine the latter to be lognormally distributed with a minimum variance unbiased estimate (MVUE) of the mean of 1.6×10^{-2} centimeters (0.0063 inches) per second.

There are anthropogenic influences on the groundwater flow in the thick-bedded unit. The high-level radioactive waste tanks (WMA 3) and the Main Plant Process Building (WMA 1) locally impede groundwater flow through the sands and gravels. The high-level radioactive waste tanks and some areas of the Main Plant Process Building were excavated and constructed through the sand and gravel into the underlying till. The excavated areas near the high-level radioactive waste tanks and possibly near the Main Plant Process Building were backfilled with lower permeability materials thereby impeding groundwater flow. Water is periodically pumped from the sand and gravel layer (thick-bedded unit) near the high-level radioactive waste tanks to maintain a groundwater elevation of about 418 to 420 meters (1,372 to 1,378 feet) above mean sea level (WVNS 1993d, WVNS and Dames and Moore 1997). Groundwater flow was also locally influenced by a French drain consisting of a 15-centimeter- (4-inch-) diameter perforated pipe located 3 meters (9.8 feet) below the ground surface along the northwest boundary of Lagoons 2 and 3 and the northeast boundary of Lagoon 3 (WMA 2). This drain was intended to prevent groundwater infiltration into Lagoons 2 and 3 and drained portions of the sand and gravel unit, discharging the intercepted groundwater into Erdman Brook via outfall 008 (WNSP008) (WVNS 1993d, WVNS and Dames and Moore 1997). This discharge point was capped off in 2001, and is periodically inspected to ensure that it does not discharge (WVNS and URS 2006).

Water balances have been estimated for the surficial sand and gravel unit (Yager 1987, WVNS 1993d, 1993e). Using data developed by Kappel and Harding (1987), Yager developed a two-dimensional numerical model for the surficial sand and gravel on the North Plateau for the year 1983. As a part of the study Yager developed water budgets for the sand and gravel unit—one from the data and one from the model. Using the data of Kappel and Harding, the total annual recharge to the sand and gravel was 66 centimeters (26 inches) per year with approximately 50 centimeters (20 inches) per year from precipitation, 12 centimeters (5 inches) per year from inflow from adjacent bedrock near Rock Springs Road, and 4 centimeters (2 inches) per year from leakage from the Main Plant's outfall channel discharging into Erdman Brook. The estimated total discharge was less at 59 centimeters (23 inches) per year. Discharge to seeps and springs accounted for 21 centimeters (8 inches) per year, streams and channels 13 centimeters (5 inches) per year, discharge to the french drain (now closed off) and low-level waste treatment system 2 centimeters (1 inch) per year, evapotranspiration 18 centimeters (7 inches) per year, vertical leakage into the Lavery till 1 centimeter (0.4 inch) per year and change in storage 4 centimeters (2 inches) per year.

Yager's steady-state flow model water budget estimated a total recharge of 60.1 centimeters (24 inches) per year with 46.0 centimeters (18 inches) per year from the infiltration of precipitation, 10.4 centimeters (4 inches) per year from the bedrock inflow, and 3.7 centimeters (1 inch) per year from the outfall leakage. Model-derived discharge estimates from the sand and gravel were evapotranspiration at 20.0 centimeters (8 inches) per year, stream channels at 12.2 centimeters (5 inches) per year, french drain and low-level-waste treatment system at 4.3 centimeters (2 inches) per year, and seeps and springs at 23.5 centimeters (9 inches) per year.

In 1993, seasonal fluctuations from 35 wells installed in the sand and gravel were used to arrive at a spatially averaged annual recharge to the North Plateau (WVNS 1993d). The estimated recharge was 17.3 centimeters (7 inches) per year. The difference between this value and the recharge derived by Yager was attributed to differences in the hydraulic conductivities used in the calculations – Yager's model hydraulic conductivities (~0.001-0.01 centimeters per second) being greater by approximately an order of magnitude. In a review of the 1993 report, Yager notes also that the 1993 calculations do not consider the effects of groundwater discharge from the North Plateau and hence, underestimate the recharge (Yager 1993). Also in 1993, waterbudget and hydrological analyses for the North Plateau arrived at a total steady-state annual precipitation of 100.1 centimeters (39 inches) per year, runoff at 25.5 centimeters (10 inches) per year, infiltration at 74.7 centimeters (29 inches) per year, drainage below 4 meters (13 feet) (recharge) at 15.8 centimeters (6 inches) per year, and evapotranspiration at 56.0 centimeters (22 inches) per year (WVNS 1993e). The estimate, 15.8 centimeters (6 inches) per year, of the recharge from precipitation in this study is also significantly less than those made by Yager – 50 centimeters (20 inches) per year and 46 centimeters (18 inches) per year. Yager's 1993 review suggests that the runoff may have been over-estimated and recharge underestimated in these calculations (Yager 1993). Other analyses performed in the study produced North Plateau recharge estimates in the range of 5 centimeters (2 inches) per year to 12 centimeters (5 inches) per year.

Recognition and characterization of slack-water sequence or slack-water sequence as a distinct subunit within the North Plateau surficial sand and gravel has occurred primarily over the last 10 years. The slack-water sequence exhibits higher observed horizontal hydraulic conductivities (1×10^{-3} centimeters per second to 1×10^{-1} centimeters per second [0.0004 inches per second to 0.04 inches per second]) (see Appendix E). Numerous thin horizontal clay layers occur in the slack-water sequence and hence, vertical hydraulic conductivities may be much less than the horizontal hydraulic conductivity. Observed water-levels on the North Plateau and modeling studies suggest that the slack-water sequence is an important conduit in the transport of contamination from the vicinity of the Main Process Building to discharge locations on the northern portion of the plateau (Yager 1987, WVNSCO 2002).

Unweathered Lavery Till Unit

The unweathered Lavery till underlies the sand and gravel unit on the North Plateau and the weathered Lavery till on the South Plateau. The Lavery till ranges in thickness from about 9 meters (30 feet) on average beneath the Main Plant Process Building area (WMA 1), to 21 meters (70 feet) beneath portions of WMA 5, and up to 37 meters (120 feet). The till is thickest between Franks and Buttermilk Creeks. The unweathered Lavery till is largely a silty clay to clayey silt till (WVNS 1993f, WVNS and Dames and Moore 1997). Groundwater in the unweathered Lavery till generally flows vertically downward toward the underlying Kent recessional sequence (Prudic 1986, WVNS 1993d, WVNS and Dames and Moore 1997). This unit is perennially saturated and has relatively low hydraulic conductivity in the vertical and horizontal dimension and thus functions as an effective aquitard (WVNS and Dames and Moore 1997). Estimates of horizontal and vertical hydraulic conductivity from previous laboratory studies were 3.8×10^{-8} centimeters per second (1.3×10^{-3} inches per day) and 6.2×10^{-8} centimeters per second (2.1×10^{-3} inches per day), respectively. These results were consistent with field estimates. Recent testing indicates a mean hydraulic conductivity of 3.5×10^{-8} centimeters per second (0.001 inches per day), consistent with the earlier estimates (WVNS and URS 2006). However, the unweathered Lavery till has been treated as isotropic in models incorporating it. Analyses of available hydraulic conductivity data for the unweathered Lavery till in support of the groundwater modeling effort produces similar estimates. The observed hydraulic gradient in the unweathered Lavery till is close to unity. Assuming a unit vertical hydraulic gradient, an isotropic hydraulic conductivity of 2×10^{-8} to 8×10^{-8} centimeters per second (6.8×10^{-4} to 2.7×10^{-3} inches per day), and effective porosity of 0.15 to 0.30, the estimated vertical groundwater velocity ranges from 0.02 to 0.16 meters per year (0.07 to 0.55 feet per year).

Weathered Lavery Till Unit

On the South Plateau, the Lavery till is exposed at the ground surface or is overlain by only a thin veneer of alluvium and is weathered and fractured to a depth of 0.9 to 4.9 meters (3 to 16 feet) (see Section 3.3.1.1). This unit (weathered Lavery till) is unique to the South Plateau. On the North Plateau, the weathered unit is much thinner or nonexistent (WVNS 1993d, WVNS and URS 2006). Groundwater in the weathered Lavery till unit generally flows to the northeast across the South Plateau from higher elevations at Rock Springs Road toward lower elevations in the stream valleys of Erdman Brook and Franks Creek. In the area of the NDA (WMA 7) and SDA (WMA 8), the prevailing groundwater flowpath is interrupted by the trenches, drains, and engineered features of these facilities (WVNS 1993d, WVNS and Dames and Moore 1997). In addition, both horizontal and vertical components are involved with groundwater flow through the weathered Lavery till as groundwater can move laterally and then downward into the underlying unweathered Lavery till (WVNS and URS 2006). Recent testing indicates an average horizontal hydraulic conductivity of 2.0×10^{-5} centimeters per second (0.7 inches per day). The highest conductivities are associated with dense fracture zones found within the upper 2 meters (7 feet) of the unit (WVNS and URS 2006). Statistical analyses of available hydraulic conductivity data for the weathered Lavery till in support of the groundwater modeling effort produces higher estimates, 2×10^{-4} to 5×10^{-4} centimeters per second (see Appendix E). However, the physical and geohydrological character of the weathered Lavery till is quite variable, reflecting extreme variations in extent of weathering, fracturing, and biointrusions. Hydraulic conductivities in the field for the weathered Lavery till range from the 10^{-8} centimeters per second (10^{-4} inches per day) values representative of the unweathered till to 10^{-3} centimeters per second (34 inches per day) where the material is highly modified by the processes mentioned.

Lateral groundwater movement in the weathered Lavery till is largely controlled by topography as expressed in the weathered till/unweathered till interface and the low permeability of the underlying unweathered Lavery till. The range of hydraulic conductivities and variation in gradients lead to horizontal velocity estimates on the order of feet per year to tens of feet per year. This flow may continue a short distance before slower vertical movement through the underlying unweathered till occurs, or in some circumstances, may continue until the groundwater discharges at the surface in a stream channel. Models for the South Plateau developed by Prudic (Prudic 1986) and by Bergeron (Bergeron and Bugliosi 1988) support only moderate lateral movement through the weathered till until flow become directed downward into the unweathered Lavery till. Using these models as a starting point, Kool and Wu (Kool and Wu 1991) examined how changes in the hydraulic conductivity, vertical anisotropy and horizontal anisotropy in the hydraulic conductivity can impact flow through the weathered Lavery till. Kool and Wu then arrived at the conclusion that such factors can lead to greater lateral flow through the weathered till. Fractures in the till were not explicitly modeled but is certainly a source of anisotropies in the hydraulic conductivity.

Lavery Till-Sand Unit

This intra-till unit occurs within the upper 6 meters (20 feet) of the Lavery till across portions of the North Plateau. It has been mapped as continuous beneath portions of the Main Plant Process Building area and adjacent areas and further described in Section 3.3.1.1. Groundwater elevations in wells screened in the three separate till-sand zones have been monitored since 1990 (WVNS 1993d). Water level elevations in the main Lavery till-sand are above the top of the unit, indicating that both saturated and artesian (confining or semi-confining) conditions exist (WVNS 1993d, WVNS and Dames and Moore 1997).

Groundwater flows through this unit in an east-southeast direction toward Erdman Brook. However, surface seepage locations from the unit into Erdman Brook have not been observed (WVNS and Dames and Moore 1997, WVNS and URS 2006). This lack of seepage indicates that the till-sand is largely surrounded by the Lavery till. While fractures in the Lavery till may allow groundwater in the till-sand to discharge along the north banks of Erdman Brook, this process is occurring at a very slow rate. As a result, recharge to and discharge from the till-sand is likely controlled more by the physical and hydraulic properties of the Lavery till (WVNS 1993d). Discharge occurs as percolation to the underlying Lavery till. Recharge occurs as leakage from the overlying Lavery till and from the overlying sand and gravel unit, where the overlying Lavery till layer is not present (WVNS 1993d, WVNS and Dames and Moore 1997). Estimates of horizontal hydraulic conductivity for the Lavery till-sand range from 1.3×10^{-4} centimeters per second (4.4 inches per day) from slug tests to 6.2×10^{-5} centimeters per second (2.1 inches per day) based on particle size analysis (WVNS 1993d, WVNS and Dames and Moore 1997). Field testing over the last 5 years indicates a mean hydraulic conductivity of approximately 1×10^{-3} centimeters per second (34 inches per day) (WVNS and URS 2006). Statistical analyses of available hydraulic conductivity data for the Lavery till-sands performed in support of the groundwater modeling effort produce similar values.

Kent Recessional Sequence Unit and Kent Till

Gravel, sand, silt, and clay of the Kent recessional sequence unit underlies most of the Project Premises (WVNS and Dames and Moore 1997). The unit thickens from west to east across the entire Project Premises, with the thickest portion mapped beneath the northeast corner of WMA 5. Beneath the North Plateau, coarse sediments mainly comprise the unit and either overlie finer lacustrine deposits or directly overlie older tills, while finer sediments mainly comprise the unit beneath the South Plateau, as further described in Section 3.3.1.1. The unit outcrops along the west bank of Buttermilk Creek to the east and southeast of the site (WVNS 1993d). Groundwater flow in the Kent recessional sequence is toward the northeast and Buttermilk Creek (WVNS 1993d, WVNS and URS 2006). Recharge to the Kent recessional sequence comes from both the overlying till and the adjacent bedrock valley wall. Discharge occurs at bluffs along Buttermilk Creek and to the underlying Kent till (WVNS 1993d, WVNS and Dames and Moore 1997).

The upper interval of the Kent recessional sequence, particularly beneath the South Plateau, is unsaturated; however, the deeper lacustrine deposits are saturated and provide an avenue for slow northeast lateral flow to points of discharge in the bluffs along Buttermilk Creek. The unsaturated conditions in the upper sequence are the result of very low vertical permeability in the overlying till, and thus there is a low recharge through the till to the Kent recessional sequence. As a result, the recessional sequence acts as a drain to the till and causes downward gradients in the till of 0.7 to 1.0, even beneath small valleys adjacent to the SDA (WMA 8) on the South Plateau (WVNS 1993d, WVNS and Dames and Moore 1997). Previous estimates of hydraulic conductivity for the unit have varied greatly. Particle-size analysis suggested a horizontal hydraulic conductivity of 8.4×10^{-5} centimeters per second (2.9 inches per day) for the coarser sediments to 8.4×10^{-6} centimeters per second (0.29 inches per day) for the lacustrine sediments. Some field testing indicated even lower hydraulic conductivities. Using an average hydraulic conductivity of 4.5×10^{-6} centimeters per second (0.15 inches per day), a hydraulic gradient of 0.023, and a porosity of 0.25, a horizontal velocity for the Kent recessional sequence of 0.12 meters (0.4 feet) per year was calculated (WVNS 1993d, WVNS and Dames and Moore 1997). Recent testing supports a mean hydraulic conductivity for the unit of approximately of 8.0×10^{-5} centimeters per second (2.7 inches per day) (WVNS and URS 2006). Using this hydraulic conductivity value would yield an average groundwater velocity of approximately 2.3 meters (7.6 feet) per year. Analyses of available hydraulic conductivity data in the Kent recessional sequence material performed in support of the groundwater modeling effort produce higher values (see Appendix E).

As discussed in Section 3.3.1.1, the Kent till underlies the Kent recessional sequence unit beneath both the North and South Plateaus. The Kent till (and Olean till) is lithologically similar to the Lavery till, and it has been assumed that it does not provide a ready pathway for contaminant movement (WVNS 1997, WVNS and URS 2006). The potential for movement through the deeper units is discussed in more detail in Appendix E.

Bedrock Unit

Outcrops of the Devonian shales and siltstones underlying the Project Premises are limited to the areas along the upper reaches of Quarry Creek and sparsely vegetated hilltops west of the site. Regional groundwater in the bedrock tends to flow downward within the higher hills, laterally beneath lower hillsides and terraces, and upward near major streams. The upper 3 meters (10 feet) of bedrock has been both mechanically and chemically weathered and contains abundant fractures and decomposed rock, which makes this layer more hydraulically transmissive than the underlying competent bedrock. Hydraulic conductivity in the weathered zone has been estimated at 1×10^{-5} centimeters per second (0.3 inches per day). Wells completing in this zone yield 40 to 60 liters per minute (10.6 to 15.9 gallons per minute) and corresponds to the regional bedrock aquifer. The hydraulic conductivity of the underlying competent rock has been estimated at 1×10^{-7} centimeters per second (0.003 inches per day). The difference in conductivities between these two zones suggests preferential flow through the weathered portion, which would be directed downslope within the weathered zone toward the axis of the buried valley underlying the WNYNSC (WVNS 1993d, WVNS and Dames and Moore 1997).

North Plateau Groundwater Contamination

Groundwater in portions of the sand and gravel unit in the North Plateau is radiologically contaminated as a result of past operations. The most significant area of groundwater contamination is associated with the North Plateau Groundwater Plume, which extends from WMA 1 to WMA 4, as shown in **Figure 3–22**. The New York State Department of Environmental Conservation first reported elevated measurements of radioactivity from samples collected from a spring-fed ditch located due north of the Main Plant Process Building (WVES 2007b) and later determined that the most likely source of the contamination was the spring, recharged by the surficial sand and gravel aquifer (WVES 2007b). Monitoring of offsite discharges and groundwater, at specific sampling locations, continued through the early 1990s. At that time a more comprehensive evaluation of groundwater conditions at the site was conducted to support the WVDP RCRA facility investigation. In 1993 elevated gross beta concentrations were detected in surface water samples from the northeast swamp ditch located along the north side of the CDDL, near the northeast edge of the plateau aquifer (WVES 2007b). Topography and groundwater elevations in this area suggested that contaminated groundwater was the probable source of the impacted surface water.

In 1994 a Geoprobe® soil and groundwater investigation was initiated to characterize the lateral and vertical extent of the elevated groundwater gross beta concentrations on the north plateau and to determine the isotopes present (WVNSCO 1995). The highest gross beta concentrations in soil and groundwater were found in areas south of the fuel receiving and storage area and southeast of the Main Plant Process Building. Strontium-90 and its daughter product, yttrium-90, were identified as the major contaminants present. On the basis of these data and an evaluation of potential sources, leaks from process lines within the Main Plant Process Building that occurred during NFS fuel reprocessing operations were identified as likely sources of the contamination. Elevated gross beta concentrations (greater than 1,000 picocuries per liter) comprised a groundwater plume extending northeastward from the southwest corner of the Main Plant Process Building to the southwest corner of the CDDL. The vertical extent appeared limited with the body of the plume found in the surficial sand and gravel. **Figure 3–23** shows a series of strontium-90 concentration isopleths (greater than 1,000 picocuries per liter) at increasing depths in the sand and gravel as inferred from the 1994 data.

In 1997 a second Geoprobe® investigation indicated some advancement of the plume's leading edge near the western portion of the CDDL, and provided additional definition of the relatively narrow eastern plume lobe (WVNSCO 1999a). The report also noted the existence of a narrow layered geologic subunit within the sand and gravel unit, suggesting that this subunit appears to provide a preferential flowpath for plume migration. This narrow subunit was later defined as the "slack-water sequence," and the remaining portion of the sand and gravel unit was designated the "thick-bedded unit." Earlier Yager had noted the higher hydraulic conductivities in the surficial sand and gravel in that vicinity and the existence of an old stream channel eroded into the top of the Lavery till (Yager 1987).

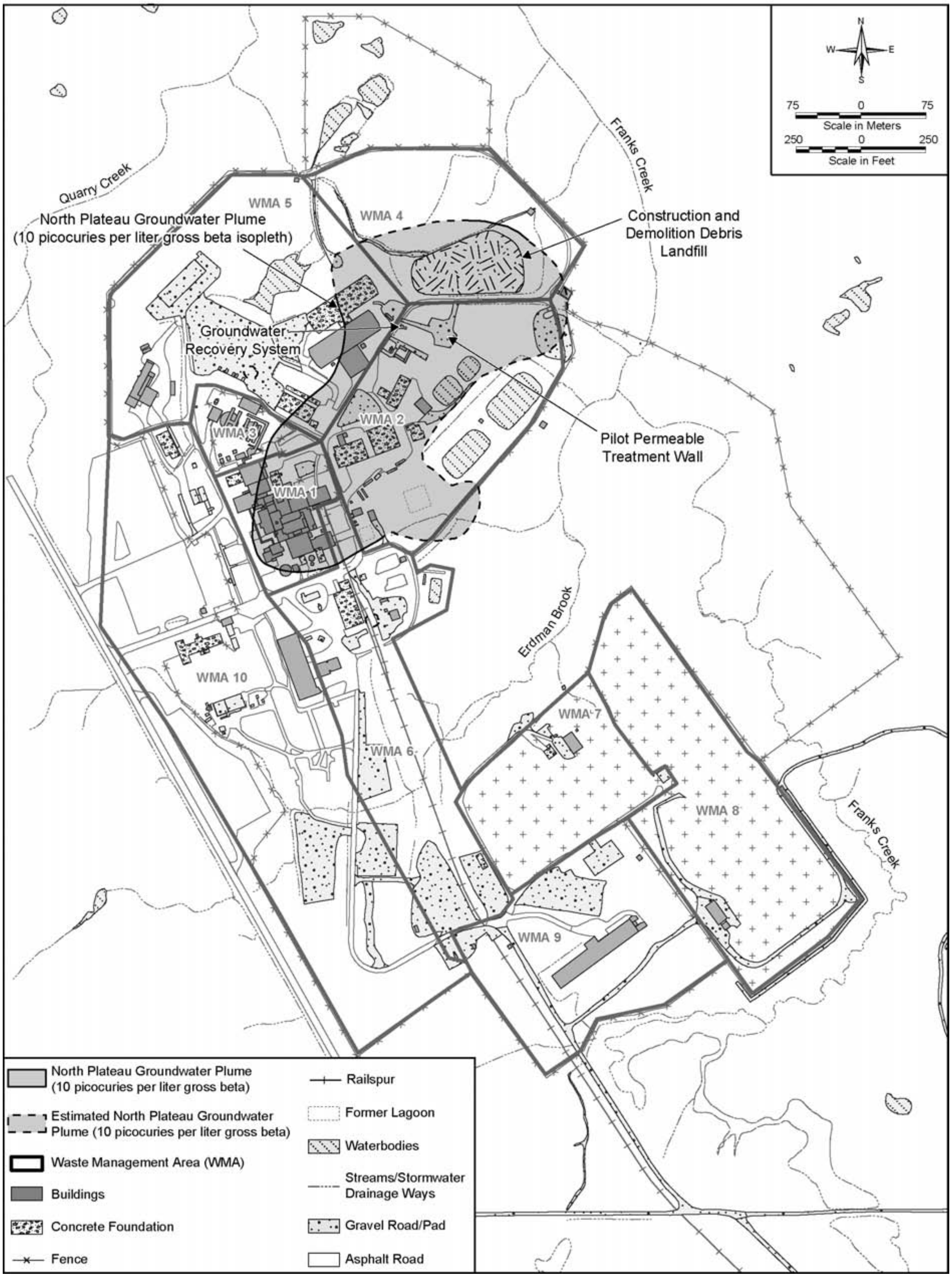
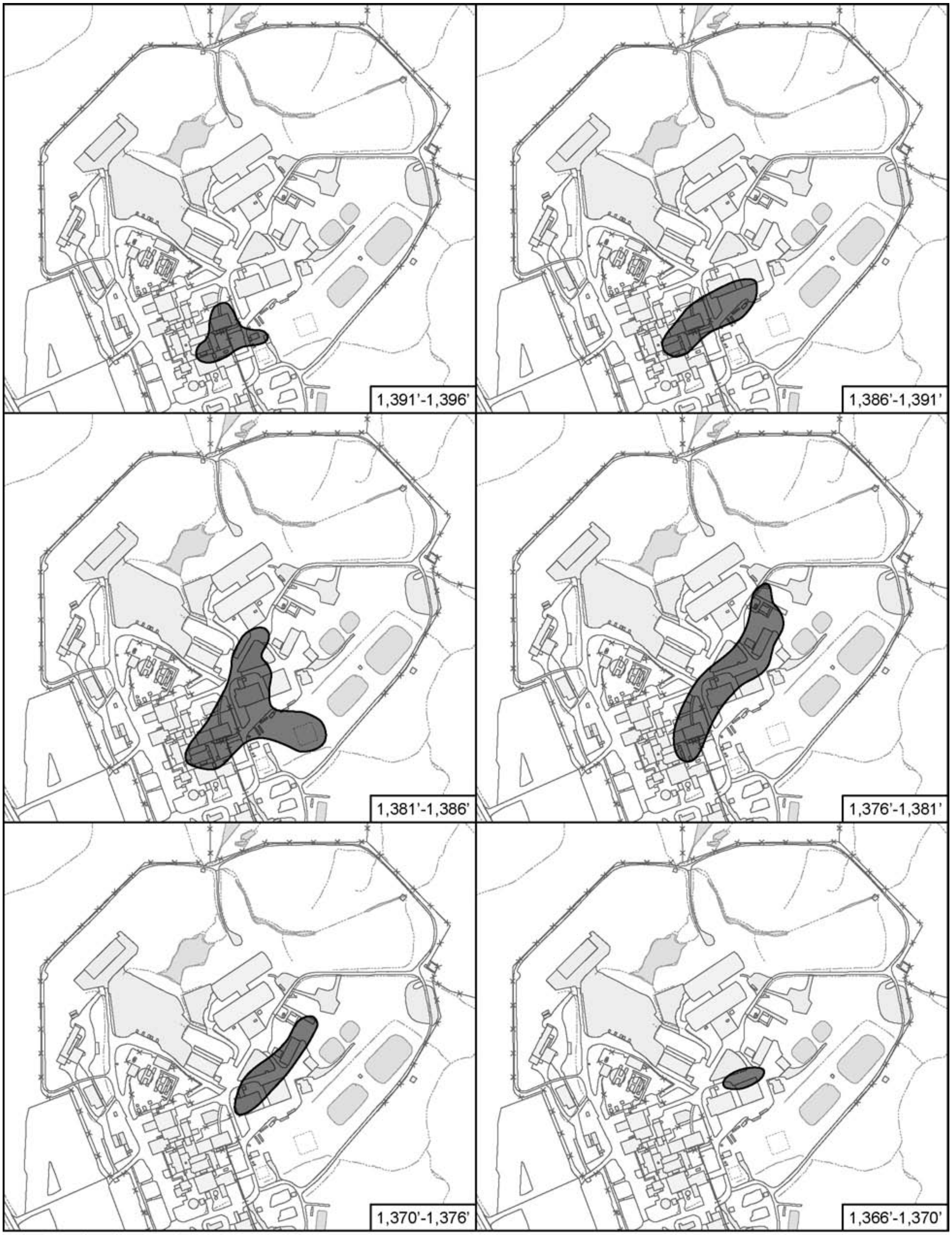


Figure 3–22 Extent of the North Plateau Groundwater Plume Showing the Gross Beta Concentrations Greater than or Equal to 10 Picocuries per Liter



Note: Elevation above sea level indicated in feet.

Figure 3–23 Vertical Distribution of North Plateau Strontium-90 Plume in 1994 Geoprobe Study

In 1998, the area in the vicinity of the probable source was investigated (WVNSCO 1999a). This Geoprobe® study confirmed that the probable source was located near the southwest corner of the Main Plant Process Building. Strontium-90 concentrations in soil and groundwater samples collected during the investigation generally were lower than those measured in 1994, suggesting radiological decay and plume migration in the interim.

In 2001, 43 test borings were completed and 33 monitoring wells were installed near the leading edge of the plume in the vicinity of a pilot project, the permeable treatment wall (WVNSCO 2002). A number of hydraulic conductivity tests (both slug tests and pump tests) were performed providing detailed hydrostratigraphic information that was used to evaluate contaminant migration across the North Plateau. This information was also used to implement groundwater flow and contaminant transport models for the strontium-90 groundwater plume (WVES 2007b).

The current monitoring program for the strontium-90 plume includes 74 active wells and the permeable treatment wall riser that are sampled biweekly, monthly or quarterly for gross beta and/or strontium-90 (WVES 2007b). Water levels are also measured at these locations and at 10 piezometers surrounding the pilot permeable treatment wall. Data collected as part of the sitewide quarterly Groundwater Monitoring Program are also used to monitor the plume. The previous monitoring program included more frequent sampling, as well as isotopic analysis for strontium-90 at all North Plateau monitoring locations. In January 2005, the number of wells sampled monthly for strontium-90 was reduced to 12 wells. Quarterly strontium-90 sampling at the remaining 61 locations monitored monthly was replaced with quarterly gross beta sampling. Monitoring of the pumping wells remained on a biweekly schedule. Gross beta data can be used in lieu of direct strontium-90 analyses because historical monitoring has established that approximately one-half of the gross beta activity measured in the plume is attributable to strontium-90. The remaining activity is attributable to short-lived yttrium-90. The special sampling for water quality parameters in groundwater surrounding the permeable treatment wall was no longer required after the pilot permeable treatment wall evaluation was completed. Consequently, sampling from selected monitoring points near the pilot permeable treatment wall for calcium, potassium, and strontium was discontinued in January 2005. At the same time as the analytical sampling was reduced, the frequency of water level measurements at all North Plateau monitoring wells was also reduced from biweekly to monthly.

As shown in Figure 3–22, the North Plateau Groundwater Plume is currently a 200-meter- (600-foot-) wide by 500-meter- (1,640-foot-) long zone of groundwater contamination that extends northeastward from the Main Plant Process Building in WMA 1 to the Construction and Demolition Debris Landfill in WMA 4, where it splits into western and eastern lobes. Strontium-90 and its decay product yttrium-90 are the principal radionuclides in this plume, with both radionuclides contributing equal amounts of beta activity. The highest strontium-90 concentrations have been found in groundwater on the east side of the Main Plant Process Building (WSMS 2008a). Another portion of the plume extends approximately 100 meters (330 feet) east of the main body of the plume, where it continues beneath and to the east of Lagoon 1 in WMA 2. While the primary source of strontium-90 contamination in this portion of the plume is the Main Plant Process Building, former Lagoon 1 and to a lesser extent the old interceptors may also have been contributors (WVNS and URS 2007). Generally, mobile radionuclides such as tritium, strontium-90, iodine-129, and technetium-99 were able to migrate with the groundwater along the northeast groundwater flow path in the North Plateau. Less-mobile radionuclides, such as cesium-137, americium-241, plutonium isotopes, the curium isotopes, and neptunium-237 are expected to have remained beneath the immediate source area because of the high cesium sorptive capacity of the minerals in the sand and gravel unit (WSMS 2008a). While the chemical speciation is an important factor in the mobility of radionuclides, carbon-14 may exhibit a potentially unique dependence on the carbonate chemistry of the groundwater. The North Plateau Groundwater Plume is further described in Appendix C, Section C.2.13.

In November 1995, a groundwater recovery system was installed to mitigate the movement of strontium-90 contamination in groundwater in the western lobe of the plume and reduce groundwater seepage northeast of the Main Plant Process Building. Three recovery wells and associated groundwater recovery facility, referred to as the North Plateau Groundwater Remediation System, installed near the leading edge of the western lobe of the groundwater plume, extract groundwater from the underlying sand and gravel unit (see Figure 3–22). This groundwater is then treated at the Low-Level Waste Treatment Facility using ion-exchange to remove strontium-90. After the groundwater is processed, it is discharged to Lagoon 4 or 5 of the Low-Level Waste Treatment Facility and ultimately to Erdman Brook. Approximately 163 million liters (43 million gallons) of groundwater have been treated by the system since 1995, including about 16 million liters (4.1 million gallons) in 2005 (WVNS and URS 2006).

A pilot-scale permeable treatment wall was constructed in 1999 in the eastern lobe of the plume (see Figure 3–22). This passive, in situ remediation technology consists of a trench that is backfilled with clinoptilolite, a natural zeolite selected for its ability to adsorb strontium-90 ions from groundwater. The wall extends vertically downward through the sand and gravel unit to the top of the underlying Lavery till and is approximately 9 meters (30 feet) long by 2 meters (7 feet) wide (WVNS and URS 2006). The permeable treatment wall is further described in Appendix C, Section C.2.13.

As noted above, additional test borings and monitoring well installations had been completed in the vicinity of the permeable treatment wall during the fall of 2001 to obtain improved definition of hydrogeologic conditions. Monitoring and evaluation of water levels and radiological concentrations upgradient, within, and downgradient of the wall continued during 2004. The evaluation concluded that complex hydrogeologic conditions and disturbances from the installation are influencing groundwater flow into and around the pilot permeable treatment wall (WVNS and URS 2006). As part of WNYNSC site-wide groundwater surveillance monitoring, groundwater samples were collected as scheduled from 69 onsite locations in 2005, including 63 monitoring wells, 5 seepage points, and 1 sump/manhole. This groundwater surveillance encompasses the five hydrogeologic units previously described. The 2005 groundwater program continued to indicate that strontium-90 is still the major contributor to elevated gross beta values in the North Plateau Plume. In 2005, 12 wells in the sand and gravel unit had gross beta concentrations that exceeded the DOE Derived Concentration Guide for strontium-90 (1.0×10^{-6} microcuries per milliliter [1,000 picocuries per liter]), as shown in **Figure 3–24**. The media or source of the water is nonspecific, therefore the Derived Concentration Guides may be applied to groundwater. Derived Concentration Guides are applicable to ingested water. The source of the plume's activity can be traced to the soils beneath the southwest corner of the Main Plant Process Building, as discussed above. Lagoon 1, formerly part of the Low-Level Waste Treatment Facility, has been identified as a source of the gross beta activity at the remaining wells (wells 8605 and 111) (WVNS and URS 2006). Figure 3–24 also presents isocontours for groundwater monitoring results for 1994, 2001, and 2007, to illustrate changes in the configuration of the plume's core area.

While elevated tritium concentrations (as compared to background) continued to be detected in several wells in 2005, essentially all sand and gravel monitoring locations where tritium concentrations have been elevated in the past now exhibit decreasing trends. Decreasing tritium concentrations are the result of the radiological decay and/or dilution of residual tritium activity associated with previous historical site fuel reprocessing operations. As a result, tritium concentrations at many locations are currently close to or within the background range of between 1.18×10^{-8} to 2.63×10^{-7} microcuries per milliliter (WVNS and URS 2006).

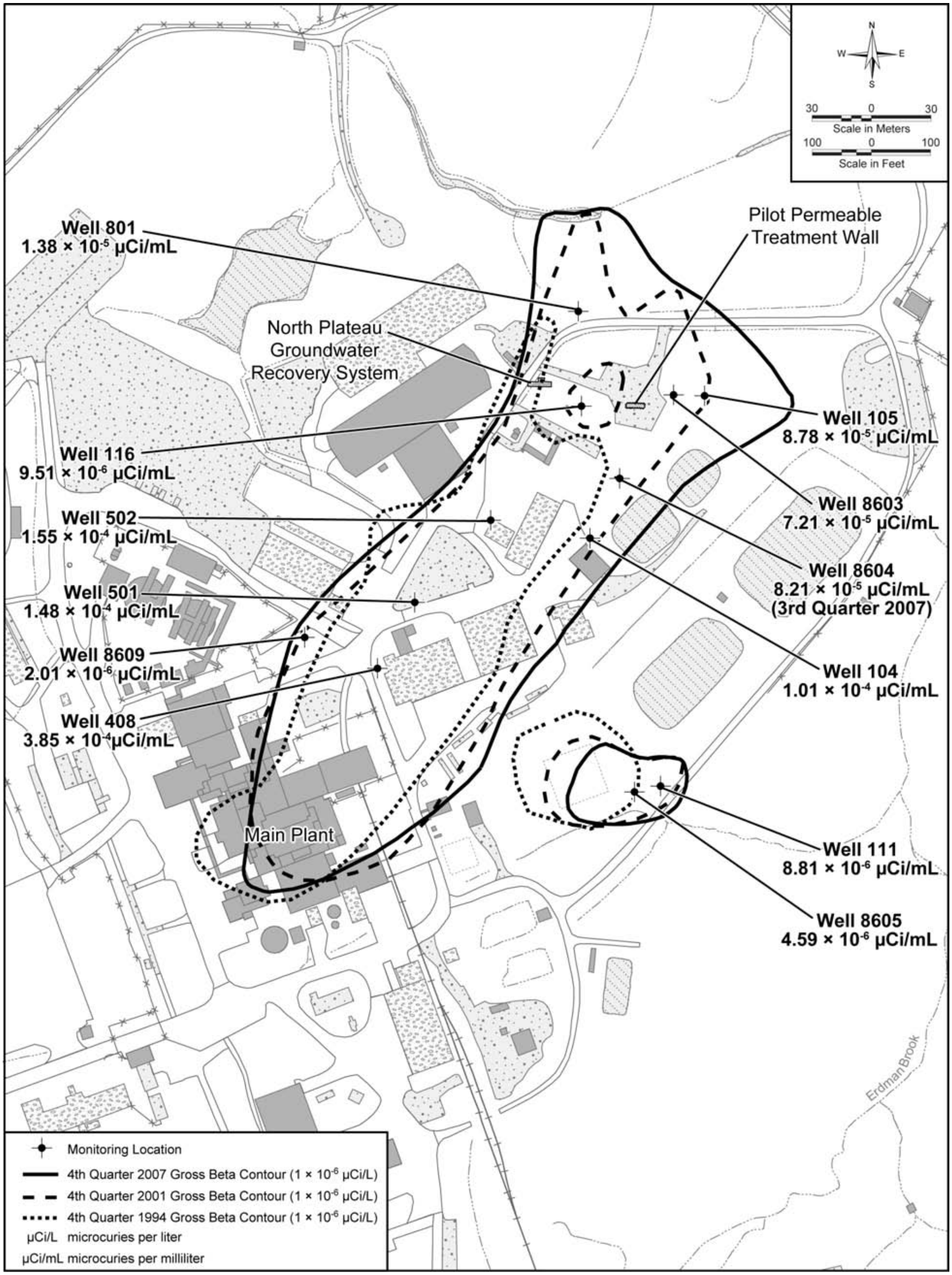


Figure 3–24 Extent of Core Area of North Plateau Gross Beta Plume in Sand and Gravel Unit

In addition to collecting samples from wells, groundwater was routinely collected from seeps on the bank above Franks Creek along the northeastern edge of the North Plateau. With the exception of one location (SP11), gross beta concentrations from all seep monitoring locations were less than or similar to those at the background seep location during 2005. At SP11 gross beta concentrations show an increasing trend since early 1999 and somewhat larger increases during 2001 through 2005. The North Plateau plume—predominantly strontium-90—is upgradient from the seep and the gross beta discharged into drainage ditches at SP11 is believed to be to a result of reinfiltration of strontium-90 contaminated water that has surfaced from the plume (WVNS 2006). Although the observed activity is elevated above background, it is still well below the DOE Derived Concentration Guide.

Again in 2005, volatile and semivolatile organic compounds were sampled at specific locations that have shown historical results above practical quantitation limits (WVNS and URS 2006). With the exception of the compounds 1,1-dichloroethane, 1,1,1-trichloroethane, and dichlorodifluoromethane at well 8612 and tributyl phosphate from well 8605 near former Lagoon 1, results are consistently nondetectable. The presence of volatile organic compounds in this area is presumed to be the result of wastes buried in the CDDL (WVNS and URS 2006). In the past, volatile organic compounds were repeatedly detected at a few additional monitoring locations, such as wells 803 and 8609 and seepage monitoring locations GSEEP and SP12, but recent analytical results from these monitoring locations have not detected those volatile organic compounds. Volatile organic compounds have not been positively detected at GSEEP since 1993, or at SP12 since 2002 (WVNS and URS 2006).

The WNYNSC does not use groundwater for drinking or operational purposes, nor does it discharge effluent directly to groundwater. No public water supplies are drawn from groundwater downgradient of the WNYNSC or from Cattaraugus Creek downstream of the WNYNSC. However, groundwater upgradient of the WNYNSC is used for drinking water by local residents, as further discussed in Section 3.6.2.3 (WVNS and URS 2006).

South Plateau Groundwater Contamination

On the South Plateau, radioactively contaminated groundwater has resulted from waste disposal and management activities at the NDA (WMA 7) and SDA (WMA 8). At both the NDA and SDA, radioactive waste was disposed of in trenches and holes within the Lavery till. Leachates exist in both the NDA and SDA disposal holes and trenches (Kool and Wu 1991, Bergeron et al. 1988) and are contaminated with both radiological and chemical constituents leached from the buried wastes (Prudic 1986, Blickwedehl et al. 1989).

The SDA 1100-series wells along the perimeter of the SDA are sampled on a semi-annual basis as a part of routine groundwater monitoring activities by NYSERDA. Analytical parameters monitored semiannually include gross alpha, gross beta, tritium, and field water quality parameters (conductivity, pH, temperature and turbidity). Analytical parameters monitored annually included gamma-emitting radionuclides by gamma spectroscopy, four beta-emitting radionuclides (carbon-14, iodine-129, strontium-90 and technetium-99) and volatile organic compounds. There was only one positive radionuclide detection in 2006—strontium-90 at 1107A at 4.21E-09±0.55E-09 microcuries per milliliter (NYSERDA 2006b). Control charting of strontium-90 results for this well was initiated in 2003 because five positive detections previously had been reported, but the 2006 result did not exceed the reporting criteria. All volatile organic compound results in 2006 were reported as "not detected," and thus the volatile organic compound data are not included in this report. The 2006 water quality measurements were consistent with historical results.

A trench system was previously constructed along the northeast and northwest sides of the NDA to collect groundwater that potentially contaminated with a mixture of n-dodecane and tributyl phosphate. No n-dodecane and tributyl phosphate was detected in groundwater near the NDA in 2005. Groundwater elevations are monitored quarterly in and around the trench to ensure that an inward gradient is maintained, thereby minimizing outward migration of potentially contaminated groundwater. Gross beta and tritium concentrations in samples from location WNNDATR, a sump at the lowest point of the interceptor trench, and from downgradient well 909 screened in the Lavery till continued to be elevated with respect to background monitoring locations on the South Plateau. Concentrations were still well below DOE Derived Concentration Guides. During 2005, gross beta and tritium concentrations at WNNDATR were similar to those seen during 2004. Overall, gross beta concentrations are slightly increasing with time, while tritium concentrations have significantly decreased over the last 10 years. Radiological indicator results at well 909 have historically fluctuated. In general, upward long-term trends in both gross beta and tritium were discernible until 1999, when both trends declined, followed by relatively consistent results during recent years. Concentrations of both gross beta and tritium during 2005 were similar to those seen during 2004. Residual soil contamination near well 909 is the suspected source of elevated gross beta concentrations, which are slightly higher than those at WNNDATR (WVNS and URS 2006).

Two water quality and three radiological indicators are routinely determined in the Kent recessional sequence groundwaters at six wells as a component in the site groundwater monitoring program (WVNS and URS 2007). The water quality indicators measured are conductivity and pH and the radiological indicators are gross alpha, gross beta, and tritium. In 2005, the radiological indicator concentrations were well below their respective applicable standards and guidelines, and the pH remained within the range indicated in the standards. No comparison for the conductivity is given and the standards listed in Appendix E of the 2006 *Annual Site Environmental Report* (WVNS and URS 2007) do not include standards for that parameter.

3.6.2.2 Cattaraugus Creek Basin Aquifer System

The hydrologic units underlying the WNYNSC are part of the Cattaraugus Creek Basin Aquifer System. The EPA has designated this system a sole or principal source of drinking water (EPA 1987). A sole-source aquifer determination can be made if it is established that the aquifer in question provides at least 50 percent of the drinking water consumed in the area overlying the aquifer. Such a designation requires that EPA review federally assisted projects that could contaminate such aquifers through a recharge zone and create a significant hazard to public health. The aquifer's area encompasses approximately 842 square kilometers (325 square miles) of the southernmost part of the Lake Erie-Niagara River drainage basin in New York State, including portions of Cattaraugus, Erie, Wyoming, and Allegany Counties. The boundary of both the designated area and aquifer service area is the drainage divide of the Cattaraugus Creek Basin (see Figure 3–17). For purposes of the sole-source aquifer determination, the area is considered to include the entire townships of Freedom and Yorkshire and parts of Arcade, Sardinia, Concord, Ashford, Centerville, Rushford, Farmersville, Machias, Ellicottville, East Otto, Otto, Persia, Collins, Java, Wethersfield, and Eagle Townships in New York (EPA 2003).

Because the Cattaraugus Creek Basin is covered with permeable sediments, the recharge zone, where water percolates directly to the aquifer, includes the entire areal extent of the Cattaraugus Creek Basin Aquifer. This means that all projects with Federal financial assistance constructed in this basin are subject to EPA review to ensure that they are designed and constructed so as not to create a significant hazard to public health.

On a regional basis, the aquifer system consists of: (1) surficial, unconfined sand and gravel deposits; (2) confined sand and gravel lenses separated from the unconfined deposits above by relatively impermeable clay till and lacustrine sediments; and (3) fractured shale bedrock (EPA 2003). This comprises the whole of the approximately 80-meter- (250-feet-) thick hydrostratigraphic sequence defined beneath the North and South Plateaus of the WNYNSC, including the saturated Holocene deposits, the Kent recessional sequence, the Kent and Lavery tills, and the upper fractured portions of the Canadaway Group.

3.6.2.3 Offsite Drinking Water

A 1985 survey of offsite groundwater use indicated 151 private wells located in the vicinity of the site (WVNS 2006). The types of well installations found in the survey included dug wells, drilled wells, augered wells, well-points and springs. Wells are screened in both the shale bedrock and in alluvial gravel deposits. Groundwater samples are collected routinely from nine offsite residential supply wells that represent the closest unrestricted use of groundwater near the site as a part of the routine groundwater monitoring program (WVNS and URS 2007). Results from the radiological and chemical analyses of these samples have been indistinguishable from background. None of the wells draw from groundwater units that underly the site.

3.7 Meteorology, Air Quality, and Noise

3.7.1 Meteorology

The general climate of the region in which the WNYNSC is located is classified as humid continental, which is predominant over the northeastern United States and common for mid-latitudes. Meteorological conditions at the WNYNSC, which is 427 meters (1,400 feet) above mean sea level, are greatly influenced by the Great Lakes to the west and by the jet stream (polar front), where warm and cold air masses collide. Wind speeds in the region are generally light, with the strongest winds occurring during the winter months associated with the frequent passage of cold fronts. Precipitation is moderate and relatively evenly distributed throughout the year, with only slightly more precipitation falling during the summer season due to thunderstorms (NOAA 2007, WVNS 1993e).

Local and regional topographic features influence the climate at the WNYNSC. The difference in elevation (400 meters [1,310 feet]) between the Lake Erie shoreline and the WNYNSC affects precipitation, wind direction, and wind speed. Atmospheric dispersion at the site is affected by local mountain (upslope) and valley (downslope) winds (WVNS 1993e).

Climatological data (temperature, wind speed, wind direction, and the standard deviation of the wind direction [sigma theta]) have been collected at the WNYNSC since 1983. The meteorological tower is located in WMA 10 south of the Administration Building and Annex Trailer Complex as shown in Figure 3–1. The onsite meteorological tower is located to the south of the parking areas, inside the fenceline, near Rock Springs Road. It is located about 91 meters (300 feet) south-southwest from a warehouse, the nearest major structure, in an area that is mostly grass covered. The onsite meteorological tower is used to collect wind speed, wind direction, and temperature data at 60-meter (197-foot) and 10-meter (33-foot) elevations. Dewpoint, precipitation, and barometric pressure are also monitored at this location (DOE 2003e). Wind speed and wind direction are also monitored at an offsite location about 8 kilometers (5 miles) south of the Project Premises at a 10-meter (33-foot) elevation (WVNS and URS 2007). The climatological baseline presented here is based on 5 years of WNYNSC meteorological data (1998 to 2002) and is representative of meteorological conditions at the WNYNSC. A more detailed climatological data record dating back more than 50 years is available from the Buffalo National Weather Service station, which is located 71 kilometers (44 miles) northwest of the site. These data include regional airflow, upper airflow patterns, and temperature. However, surface airflow data at this National Weather Service station may not be comparable to similar data measured at the WNYNSC because of terrain differences between these locations and the close proximity of the Buffalo National Weather Service station to Lake Erie (WVNS 1993e).

The shifting boundaries of the jet stream subject the western New York region to extreme seasonal temperature variations. Further to the west and closer to the lakes, the mean temperatures are very similar, although disparities in the temperatures between Lake Erie and the WNYNSC are a result of differences in the elevation

(NOAA 2007, WVNS 1993e). The maximum temperature recorded on the site over the 5-year period, 1998 through 2002, was 32.7 degrees Centigrade (91 degrees Fahrenheit) in August, and the minimum was -23.6 degrees Centigrade (-10 degrees Fahrenheit) in January. Comparatively, the maximum temperature at the Buffalo National Weather Service over the 55-year period was 37.2 degrees Centigrade (99 degrees Fahrenheit), and the minimum was -28.9 degrees Centigrade (-20 degrees Fahrenheit) (NRCC 2003a, 2003b).

Annual precipitation is distributed evenly throughout the year, with more snow than rain in the winter. The site is not subject to flooding because it is located at a topographic high point within the region. Mean total water equivalent precipitation at the WNYNSC averages approximately 102 centimeters (40 inches) per year. The WNYNSC region receives an annual average of 3 meters (10 feet) of snowfall, with snow squalls totaling 0.3 to 0.9 meters (1 to 3 feet) over a 2- to 3-day period common (WVNS 1993e). Rains resulting from warm fronts are usually light but last for several days; cold fronts often cause heavier rainfall in shorter periods.

Wind speed and direction is affected by local terrain that produces a sheltering effect and lower wind speeds on the WNYNSC, as well as a more seasonal variation in direction than at the National Weather Service station in Buffalo. During an average month, the predominant wind direction is from the northwest during the late fall through early spring and from the south-southeast in the spring through most of the fall. The exception to this is July, where the predominant direction is northwest. At the National Weather Service station in Buffalo, the predominant wind direction only varies from the southwest to west throughout the year. Hourly averaged wind speeds are approximately 2.2 meters per second (5 miles per hour) on an annual basis, with the highest average wind speeds occurring in January and February and the lightest in August. The climatological average wind speeds at National Weather Service Buffalo depict a similar pattern, but are significantly higher overall, averaging 5.3 meters per second (11.9 miles per hour) annually. Most of this increase can be attributed to the National Weather Service averaging methodology, which uses 1-minute averages to represent hourly values. The peak hourly averaged wind speed measured at WNYNSC during the 5-year period was 11.1 meters per second (24.8 miles per hour). At the National Weather Service station in Buffalo, the peak instantaneous wind gust over the last 50 years (1948 to 1998) was 40.7 meters per second (91.0 miles per hour) (NRCC 2003c, 2003d; NWS 2003).

Severe weather at the WNYNSC occurs as straight-line winds and tornadoes. The dominant straight-line high-wind directions are from the southwest (67 percent) and the west (23 percent) (Fujita et al. 1979). Normally, higher wind speeds occur in winter and early spring months. Thunderstorms occur in this region approximately 30 days per year, most often in June, July, and August. Severe thunderstorms with winds greater than 22.4 meters per second (50 miles per hour) occur in western New York State. Remnants of tropical cyclones occasionally affect the western New York region, but the impact from these cyclones is usually increased local rainfall and rarely damaging winds (WVNS 1993e).

The frequency and intensity of tornadoes in western New York are low in comparison to many other parts of the United States. An average of about two tornadoes of short and narrow path length strike New York each year. From 1950 to 1990, 17 tornadoes were reported within 80 kilometers (50 miles) of the WNYNSC (WVNS 2004a). The probability of a tornado striking a 2.6-square kilometer (1-square mile) section of the WNYNSC was estimated to occur once every 10,000 years. For wind speeds less than or equal to 54 meters per second (121 miles per hour) (or a hazard probability level of 2.5×10^{-5}), straight-line winds are the more likely cause; for higher wind speeds, tornadoes are more likely. Straight-line winds are the dominant form of severe weather at recurrence intervals of less than 100,000 years (McDonald 1981).

Favorable atmospheric dispersion conditions exist during periods of moderate to strong winds, unstable conditions, and maximum mixing heights. Mean morning mixing heights vary from 850 meters (2,788 feet) during winter to 450 meters (1,476 feet) in the summer; mean afternoon mixing heights are highest during summer (approximately 1,600 meters [5,249 feet]) and lowest during winter months (approximately 850 meters

[2,788 feet] [Holzworth 1972]). Actual daily mixing heights will vary due to local wind and terrain influences. However, the most favorable dispersion conditions will occur during non-overcast daytime hours when wind speeds are moderate to strong.

3.7.2 Ambient Air Quality

3.7.2.1 Nonradiological Releases

New York State is divided into nine regions for assessing state ambient air quality. The WNYNSC is located in Region 9, comprising Niagara, Erie, Wyoming, Chautauqua, Cattaraugus, and Allegany Counties. The EPA has both primary and secondary National Ambient Air Quality Standards designed to protect human health and welfare from adverse effects from the six criteria pollutants: carbon monoxide, sulfur dioxide, nitrogen dioxide, ozone, particulate matter, and lead. The most stringent of the state and Federal ambient standards for each of these pollutants are given in **Table 3–11**. The area encompassing WNYNSC and the surrounding area in Cattaraugus County is classified as an attainment area for all six criteria pollutants except for the northern portion of WNYNSC which is in Erie County which is classified as nonattaining for the ozone 8-hour standard (40 CFR 81.333). Monitoring data for 2006 for the nearest State air pollutant monitors are shown in Table 3–11. These monitors are the closest to the WNYNSC but collect data from the more populated areas of Buffalo and Niagara Falls, rather than the less populated rural area around WNYNSC. The only large sources at WNYNSC are two steam boilers. Emissions of criteria pollutants in Cattaraugus County are less than in Erie County, which includes Buffalo and Niagara Falls (EPA 2006a). Therefore, actual background concentrations at WNYNSC would be expected to be lower.

The ambient air quality standards, other than those for ozone, particulate matter, lead, and those based on annual averages, are not to be exceeded more than once per year. The 24-hour PM_{10} standard is attained when the standard is not exceeded more than once per year over a 3-year average. The annual $PM_{2.5}$ standard is attained when the 3-year average of the weighted annual mean concentrations does not exceed the standard. The 24-hour $PM_{2.5}$ standard is attained when the 3-year average of the 98th percentile of the 24-hour concentrations does not exceed the standard. The 8-hour ozone standard is met when the average of the annual fourth-highest daily maximum 8-hour average concentration is less than or equal to the standard (40 CFR Part 50).

No Prevention of Significant Deterioration Class I areas exist within 100 kilometers (60 miles) of the WNYNSC.

Criteria pollutants and various toxic pollutants are released from WNYNSC primarily from combustion sources such as boilers, standby diesel generators, motor vehicles, and construction and materials handling equipment.

3.7.2.2 Radiological Releases

Airborne emissions of radionuclides released at the WVDP Site during 2006 are shown in **Table 3–11**. Most of the sources of these releases would be shut down and prepared for demolition by completion of the Interim End State.

Table 3–11 Ambient Air Quality Measurements for Buffalo, New York

Pollutant	*2006 Monitoring Data* [a]	*Standard* [b]	*Averaging Period*
Carbon monoxide [c] (micrograms per cubic meter)	7,000 3,500	40,000/ 10,000	1 Hour 8 Hours
Sulfur dioxide [c] (micrograms per cubic meter)	94 34 7.9	1,300/ 365/ 80	3 Hours 24 Hours Annual
Nitrogen dioxide [c] (micrograms per cubic meter)	30	100	Annual
Ozone [d] (micrograms per cubic meter)	163 [d]	157	8 Hours
Particulate matter with aerodynamic diameter less than or equal to 2.5 microns ($PM_{2.5}$) [c] (micrograms per cubic meter)	34 [f] 11	35 15	24 Hours Annual
Lead (micrograms per cubic meter)	NA [g]	1.5	Calendar Quarter
Particulate matter with aerodynamic diameter less than or equal to 10 microns (PM_{10}) (micrograms per cubic meter) [e]	28 13	150/ 45	24 Hours Annual

[a] Maximum reported value for the year.
[b] National Ambient Air Quality Standards, 40 CFR Part 50; State Ambient Air Quality Standards, 6 NYCRR 257.
[c] Buffalo, New York – 185 Dingens Street (State/Local Air Monitoring Station).
[d] Erie County, Amherst, Audubon Golf Course (National/State Local Air Monitoring Station). Monitored value represents the 3-year average of the 4th highest values for 2004 through 2006.
[e] Niagara Falls, New York – Frontier Avenue at 55th Street - 2005 data.
[f] 3-year average of 98th percentile values.
[g] No monitor exists in this part of the state. Data reported for 2004 included a value of 0.01 at a monitor in Niagara Falls.
Note: New York State also has a 3-hour ambient standard for nonmethane hydrocarbons and annual, 30-, 60-, and 90-day, and 24-hour standards for total suspended particulates. The total suspended particulate standards have been superseded by the Federal PM_{10} and $PM_{2.5}$ standards, although not yet officially adopted by the state. The state also has ambient standards for beryllium, fluorides, hydrogen sulfide, and settleable particulates.
Sources: EPA 2007c, NYSDEC 2007.

Table 3–12 Airborne Radioactive Effluent Released from Monitored Release Points in 2006

Isotope	*Release (curies)*
Gross Alpha	4.88×10^{-7}
Gross Beta	9.69×10^{-6}
Hydrogen-3	1.24×10^{-3}
Cobalt-60	5.38×10^{-8}
Strontium-90	3.06×10^{-6}
Iodine-129	2.51×10^{-5}
Cesium-137	3.72×10^{-6}
Europium-154	1.13×10^{-7}
Uranium-232	5.31×10^{-8}
Uranium-233/234	2.31×10^{-8}
Uranium-235/236	8.11×10^{-9}
Uranium-238	2.13×10^{-8}
Plutonium-238	6.54×10^{-8}
Plutonium-239/240	1.06×10^{-7}
Americium-241	2.15×10^{-7}

Source: WVNS and URS 2007.

The EPA, under the Clean Air Act and its implementing regulations, regulates airborne emissions of radionuclides. DOE facilities are subject to 40 CFR Part 61, Subpart H. Subpart H contains the national emission standards for emissions of radionuclides other than radon from DOE facilities. The applicable standard for radionuclides is a maximum of 10 millirem (0.1 millisievert) effective dose equivalent (EDE) to any member of the public in 1 year.

DOE holds permits for radiological air emissions under the National Emissions Standards for Hazardous Air Pollutants. The following emissions sources are monitored on a continuous basis for radionuclides: the Main Plant Process Building ventilation stack; the former vitrification heating; ventilation and air conditioning system; the 01-14 building ventilation stack; the supernatant treatment system ventilation stack; and the Remote-Handled Waste Facility (WVNS and URS 2007). These air emission sources will have been shut down and prepared for demolition by completion of the Interim End State except for the permanent ventilation system which provides ventilation to the Supernatant Treatment System and waste storage tanks 8D-1, 8D-2, 8D-3, and 8D-4. Permitted portable outdoor ventilation enclosures are used to provide the ventilation necessary for the safety of personnel working with radioactive materials in areas outside permanently ventilated facilities or in areas where permanent ventilation must be augmented. One ambient air sampler continued operating in 2006 to monitor air near the onsite lag storage area. The combined emissions from the monitored sources resulted in doses that were calculated to be less than 1 percent of the 10 millirem per year EPA standard for total radionuclides (WVNS and URS 2007).

3.7.3 Noise

Existing noise sources at WNYNSC include heating, ventilation, and air conditioning systems; material handling equipment (fork lifts and loaders); construction equipment; trucks; and automobiles. Noise levels produced by activities at the WNYNSC are expected to be compatible with adjoining land uses. Noise levels near the WNYNSC but outside the WNYNSC are generated predominantly by traffic movements and, to a much lesser degree, residential-, agricultural-, commercial-, and industrial-related activities. No data currently exist on the routine background ambient noise levels produced by activities at WNYNSC or noise levels near the WNYNSC. The land uses in the area would indicate that the noise levels in the area would be low, and range from that typical of rural residential areas (L_{dn} [Day-Night Average Sound Level] 35 to 50 dBA [decibels A-weighted] [EPA 1974]) to industrial locations. Noise measurements made in preparation of the *U.S. Route 219 Final Environmental Impact Statement* (USDOT and NYSDOT 2003a) indicate one-hour equivalent sound levels ($L_{eq}(1)$) during off peak traffic hours of 52 and 54 dBA, along Schwartz Road and County Route 12, respectively. This data was collected in 1996 at least 15 meters (50 feet) from the road. These levels may be representative of roads near the WNYNSC. Nearby noise sensitive areas include residences located near to the WNYNSC boundary such as those along Route 240 to the northeast; along Buttermilk Road to the east; along Fox Valley Road to the southwest; along Rock Spring Road to the south and northwest; along Dutch Hill Road to the southwest and west; and along Boberg Road to the west-northwest (URS 2002a).

3.8 Ecological Resources

Ecological resources include terrestrial resources, wetlands, aquatic resources, and threatened and endangered species. Each resource area is addressed separately below.

3.8.1 Terrestrial Resources

The WNYNSC lies within the Eastern Deciduous Forest Floristic Province, near the transition between the beech-maple forest and hemlock-white pine-northern hardwood forest regions. Typical plant associations of both forest regions exist at the site along with some elements of the boreal forest (WVNS 1996). Currently, the site is nearly equally divided between forestland and abandoned farmland that has not been farmed, grazed, or logged since the 1960s. The relatively undisturbed nature of large portions of the area has allowed for natural succession, thus permitting native vegetation to become reestablished (DOE 2003e). The abandoned farmland has reverted to successional old field, shrubland, and young forest plant communities (WVNS and URS 2004b).

The WNYNSC provides habitat especially attractive to white-tailed deer (*Odocoileus virginianus*) and other various resident and migratory birds, reptiles, and small mammals. Although an overall sitewide wildlife management plan does not exist, NYSERDA sponsors a program to control the deer population by giving hunters limited access to WNYNSC (excluding the Project Premises) during the deer hunting season, a decision that is made on an annual basis (WVNS and URS 2005). Specific controls are also in place for handling nuisance wildlife (i.e., woodchuck [*Marmota monax*]) before site safety is compromised. While methods of control vary, humane treatment of the animals during control activities is a priority and is performed by trained personnel. Wildlife that is caught or found dead is surveyed for radiological contamination before final disposition (WVNS 2005).

Amphibians and Reptiles—Over 35 species of amphibians and reptiles may occur on or near the WNYNSC; however, only 10 amphibians and 1 reptile species actually have been observed. The species observed frequent aquatic and wetland habitats. Although no reptiles other than snapping turtles (*Chelydra serpentina*) have been recorded on the site, several snake species including rat snakes (*Elaphe* spp.), garter snakes (*Thamnophis* spp.), and king snakes (*Lampropeltis* spp.) are likely to be present (WVNS 1996).

Birds—Approximately 175 species of birds have been recorded on or near the WNYNSC. Diversity of bird populations and species varies seasonally due to migration. Permanent residents account for 10 percent of the regional bird list and include the American crow (*Corvus brachyrhynchos*), black-capped chickadee (*Poecile atricapillus*), blue jay (*Cyanocitta cristata*), dark-eyed junco (*Junco hyemalis*), downy woodpecker (*Picoides pubescens*), European starling (*Sturnus vulgaris*), great horned owl (*Bubo virginianus*), northern cardinal (*Cardinalis cardinalis*), red-tailed hawk (*Buteo jamaicensis*), rock dove (*Columba livia*), ruffed grouse (*Bonasa umbellus*), and wild turkey (*Meleagris gallopavo*). Nonpermanent bird species make up the majority of the recorded populations, with 67 percent classified as summer residents, 19 percent as migrants, and 4 percent as visitors, which visit but do not breed in the area (WVNS 1996).

Mammals—More than 50 mammal species potentially inhabit the WNYNSC, with at least 22 having been observed. Large mammals known to inhabit the site include the white-tailed deer, which is representative of the general region (WVNS 1996). As noted above, NYSERDA has initiated a program to control the deer population on the site.

Other mammals observed at the WNYNSC include several species of bats, beaver (*Castor canadensis*), Eastern chipmunk (*Tamias striatus*), Eastern cottontail (*Sylvilagus floridanus*), Eastern gray squirrel (*Sciurus carolinensis*), meadow jumping mouse (Z*apus hudsonicus*), muskrat (*Ondatra zibethicus*), opossum (*Didelphis virginiana*), raccoon (*Procyon lotor*), red fox (*Vulpes vulpes*), red squirrel (*Tamiasciurus hudsonicus*), and woodchuck (*Marmota monax*) (WVNS 1996).

3.8.2 Wetlands

Wetlands perform numerous environmental functions that benefit the ecosystems as well as society, such as removing excess nutrients from the water that flows through them. The benefit derived from nutrient removal is improved or maintained water quality. This in turn promotes clean drinking water, safe recreation, and secure fish and wildlife habitat. Further, wetlands absorb, store, and slowly release rain and snowmelt water, which minimizes flooding, stabilizes water flow, retards runoff erosion, and controls sedimentation. Wetlands filter natural and manufactured pollutants by acting as natural biological and chemical oxidation basins. Water leaving a wetland is frequently cleaner than water entering. Wetlands can also be helpful in recharging groundwater and serve as groundwater discharge sites, thereby maintaining the quality and quantity of surface water supplies. Wetlands are one of the most productive and valuable habitats for feeding, nesting, breeding, spawning, resting, and providing cover for fish and wildlife (NYSDEC 2005c).

The most recent wetland delineation was conducted in July and August of 2003, and verified in November 2005, on approximately 152 hectares (375 acres) of the WNYNSC, including the Project Premises and adjacent parcels to the south and east of the Project Premises (WVNS and URS 2004b, Wierzbicki 2006). Wetland plant communities identified within the limits of the assessment area include wet meadow, emergent marsh, scrub shrub, and forested wetland. The investigation identified 68 areas comprising approximately 14.78 hectares (36.52 acres) as jurisdictional wetlands, with each area ranging from 0.004 to 2.95 hectares (0.01 to 7.3 acres) as shown in **Figure 3–25** and **3–26**.

A field investigation conducted on November 2, 2005, by the U.S. Army Corps of Engineers in conjunction with review of relevant reports and maps, confirmed the 2003 wetlands delineation results that there are wetlands totaling 14.78 hectares (36.52 acres). Twelve wetlands, totaling 0.98 hectares (2.43 acres), were observed to exhibit no surface water connection to a water of the United States, and are considered isolated, intrastate, and nonnavigable wetlands. It was concluded that 13.8 hectares (34.09 acres) of wetlands are waters of the United States subject to regulation under Section 404 of the Clean Water Act. These waters were determined to be part of an ecological continuum constituting a surface water tributary system of Buttermilk Greek, Cattaraugus Creek, and Lake Erie. The U.S. Army Corps of Engineers approved DOE's wetland determination application on January 26, 2006, which will remain valid for a period of 5 years unless new information warrants revision prior to the expiration date (Senus 2006).

In addition to being considered jurisdictional by the U.S. Army Corps of Engineers, certain wetlands are also regulated by New York as freshwater wetlands. Article 24 of New York State's Freshwater Wetlands Act regulates draining, filling, construction, pollution or any activity that substantially impairs any of the functions and values provided by wetlands that are 5 hectares (12.4 acres) or larger. The state also regulates work within a 30.5-meter (100-foot) buffer zone around designated freshwater wetlands. Although there are no wetlands currently mapped by the NYSDEC, six wetlands (W10, W11, W14, W15, W18, and W54) encompassing 7.0 hectares (17.3 acres) and delineated in the 2003 field investigation appear to be hydrologically connected (see Figure 3–25). The majority of these wetlands are located just south of the south Project Premises fence (WVNS and URS 2004b). On December 28, 2005, NYSDEC-Region 9 concurred with the wetland delineation conducted in 2003. The Agency concluded that the six wetland areas are hydrologically connected, exceed 5 hectares (12.4 acres) and therefore in aggregate constitute an Article 24 state jurisdictional wetland (Ermer 2005). These wetland areas are dominated by wet meadow plant communities but also include emergent marsh, scrub shrub (shrub swamp), and forested wetland (deciduous swamp) plant communities (WVNS and URS 2004b). According to the New York State Freshwater Wetlands classification system the presence of emergent marsh, scrub shrub, and forested vegetation require that the complex be considered a Class IV wetland (of the four classes, Class I has the highest value) (WVNS and URS 2004b). The classification system recognizes that different wetland types have different values and applies different standards for permit issuance.

Several onsite surface water monitoring locations are maintained for sampling both radiological and nonradiological constituents; two of these are associated with site wetlands (see Figure 3–18). The northeast swamp (WNSWAMP) is sampled to monitor surface water drainage and emergent groundwater from the northeastern portion of the site's North Plateau. The north swamp (WNSW74A) monitoring point is sampled to monitor drainage including emergent groundwater to Quarry Creek from the northern portion of the North Plateau. Sampling results are discussed in Section 3.6.1.

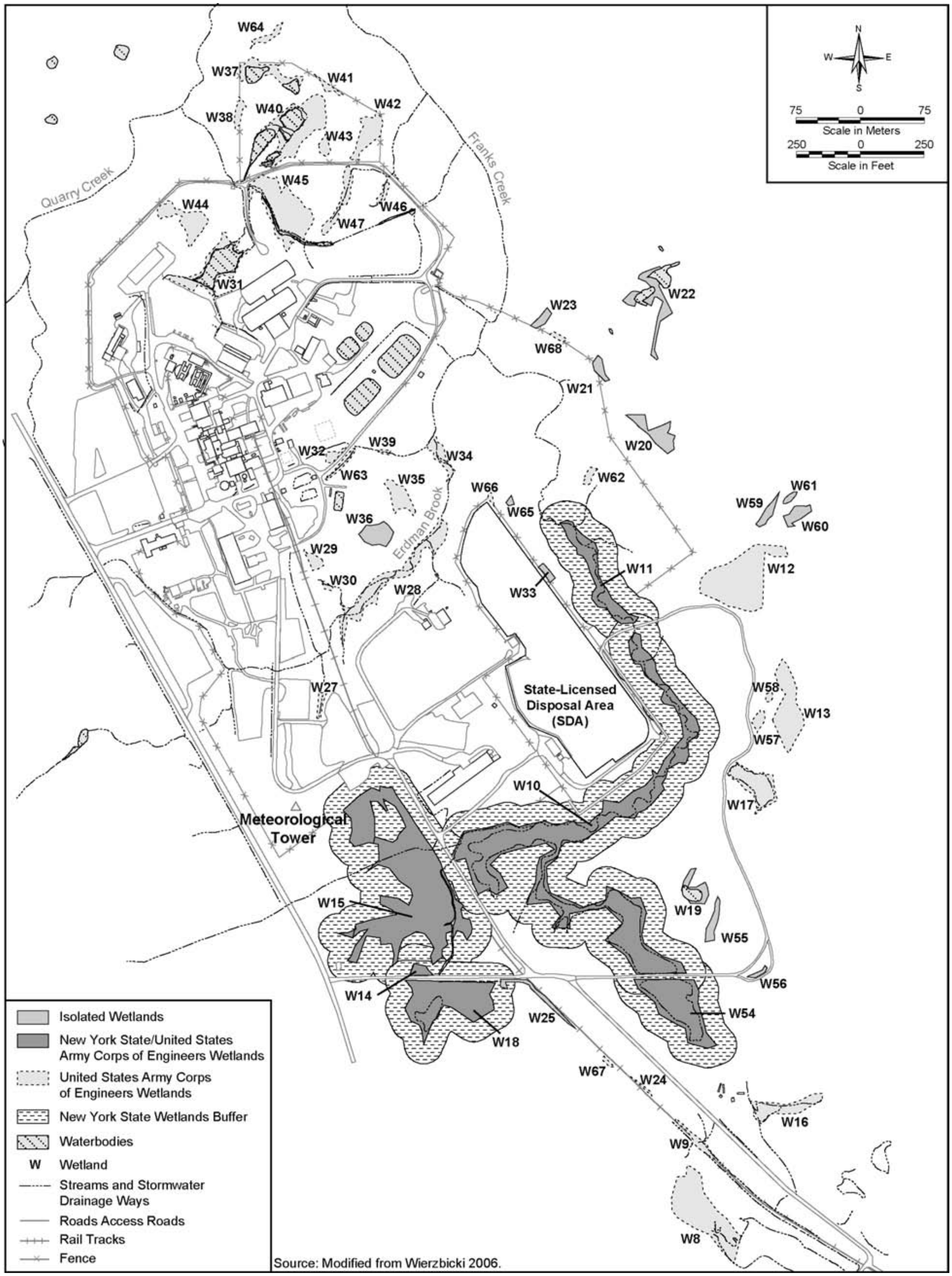


Figure 3–25 Wetlands in the Vicinity of the West Valley Demonstration Project Premises

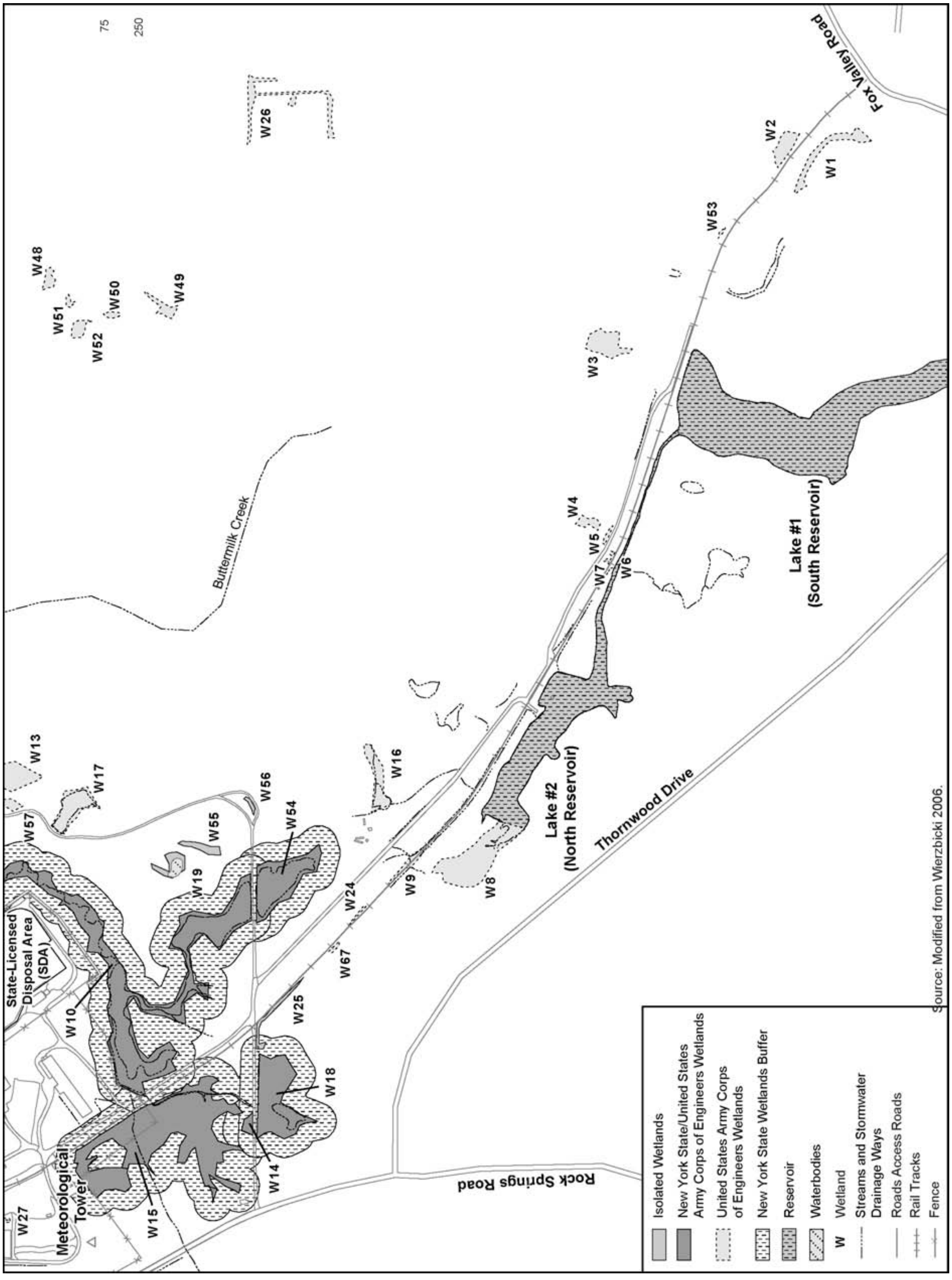


Figure 3–26 Wetlands in the Southern Vicinity of the West Valley Demonstration Project Premises

3.8.3 Aquatic Resources

Aquatic habitat within the Project Premises consists of stream channels, including Franks Creek, Erdman Brook, and Quarry Creek; four active waste treatment facility lagoons; two utility wastewater sludge ponds; one effluent mixing basin (equalization pond); and various maintained stormwater drainages. Two large reservoirs, located in the southern part of the site, overflow to Buttermilk Creek, which then flows northwest to Cattaraugus Creek (WVNS and URS 2005). At least 20 fish species have been observed in the creeks on the WNYNSC, including the Eastern blacknose dace (*Rhinichthys atrarulus*), bluntnose minnow (*Pimephales notatus*), creek chub (*Semotilus atromaculatus*), northern hogsucker (*Hypentelium nigricans*), shiner (*Notropis* spp.), stonecat (*Noturus flavus*), white sucker (*Catostomus commersonii*), and brown trout (*Salmo trutta*). Unique to Cattaraugus Creek, probably due to the presence of the deep pool (near the Route 240 bridge), were largemouth bass (*Micropterus salmoides*) and sunfish (*Lepomis* spp.), as well as horny head chub (*Nocomis biguttatus*). Rainbow darter (*Etheostoma caeruleum*) were found only in Buttermilk Creek, and fantail darter (*Etheostoma flabellare*) were observed only in Quarry Creek. There is less fish diversity in the ponds and reservoirs, in which sunfish are the most common species, than in the creeks. Blacknose dace, largemouth bass, shiners and sunfish have been seen in the north reservoir; only sunfish have been seen in the south reservoir. Bluegill (*Lepomis macrochirus*) live in the farmer's pond located off Route 240 to the east and brown bullhead (*Ameiurus nebulosus*) and white crappie (*Pomoxis annularis*) were observed in the beaver pond near Boberg Road to the west of the site (WVNS 1996).

3.8.4 Threatened and Endangered Species

Consultations with the U.S. Fish and Wildlife Service and New York Natural Heritage Program, as well as previous studies, have identified a number of special status species that could occur on the site (see **Table 3–13)**. Critical habitat for the species identified in the table does not occur on the site.

Although the state endangered rose pink (*Sabatia angularis*) was reported on the site in 1992, a field botanical investigation conducted in 2000 failed to relocate it (DOE 2003e). The bald eagle (*Haliaeetus leucocephalus*), which has been delisted in the lower 48 states by the U.S. Fish and Wildlife Service (72 FR 37346), is listed in New York as threatened and may be an occasional transient to the site. Delisting the bald eagle as a threatened species under the Endangered Species Act does not affect the protection provided under the Bald and Golden Eagle Protection Act, the Migratory Bird Treaty Act, or New York-State laws (Doran 2008). The clay-colored sparrow (*Spizella pallida*) has not been recorded on the site but has been found within the vicinity (Seoane 2008). A northern harrier was observed on the site during a spring 1991 biological survey; however, there is little suitable habitat on the site for this species as it prefers open wet meadows for hunting (WVNS 1992b).

The clubshell and rayed bean, although reported in Cattaraugus County, were not found in Buttermilk or Cattaraugus Creeks when those streams were surveyed in 1991 (Doran 2008, WVNS 1992b). Additionally, they were not reported by the New York Natural Heritage Program when that organization was consulted concerning state-listed species potentially present in the vicinity of the site (Seoane 2008).

Although not protected by Federal or state regulations, the cobblestone and Appalachian tiger beetles are ranked as critically imperiled and imperiled, respectively, by the New York Natural Heritage Program. The former species has been found on a cobble bar along Cattaraugus Creek downstream from the confluence of Buttermilk and Cattaraugus Creeks while the latter has been found in the vicinity of the confluence of these two streams (Seoane 2008).

Table 3–13 Threatened, Endangered, and Other Special Status Species Occurring in the Vicinity of the Western New York Nuclear Service Center

Common Name	*Scientific Name*	*Federal Status*	*State Status*	*Natural Heritage New York State Rank*
Plants				
Rose pink	*Sabatia angularis*		Endangered	
Birds				
Bald Eagle	*Haliaeetus leucocephalus*	Delisted [a]	Threatened	
Clay-colored Sparrow	*Spizella pallida*			Imperiled
Northern harrier	*Circus cyaneus*		Threatened	
Freshwater Mussels				
Clubshell	*Pleurobema clava*	Endangered	Endangered	
Rayed bean	*Villosa fabalis*	Candidate	Endangered	
Beetles				
Appalachian tiger beetle	*Cicindela ancocisconensis*			Imperiled
Cobblestone tiger beetle	*Cicindela marginipennis*			Critically imperiled

[a] Effective August 8, 2007, the bald eagle was removed from the list of threatened wildlife in the lower 48 states (72 FR 37346).

Federal:

Delisted – Removed from the list of threatened and endangered species.
Candidate – Current information indicates the probable appropriateness of listing as endangered or threatened.
Endangered – In danger of extinction throughout all or a significant portion of its range.
Threatened – Likely to become endangered within the foreseeable future throughout all or a significant portion of its range.

State:

Endangered – Any native species in imminent danger of extirpation or extinction in New York State.
Threatened – Any native species likely to become an endangered species within the foreseeable future in New York State.

New York State Natural Heritage State Rank:

Critically imperiled – Typically 5 or fewer occurrences, very few remaining individuals, acres, or miles of stream, or some factor of its biology making is especially vulnerable in New York State.
Imperiled – Typically 6 to 20 occurrences, few remaining individuals, acres, or miles of stream, or factors demonstrably making it very vulnerable in New York Sate.

Sources: DOE 2003e; Doran 2008; NYSDEC 2008c, 2008d; Seoane 2008; WVNS 1992b.

3.9 Cultural Resources

The most recent cultural resources study of the WNYNSC took place between June and December 1990 and involved two stages: (1) literature search and sensitivity assessment; and (2) field investigation (Pierce 1991). The study area consisted of approximately 146 hectares (360 acres) that may be affected by future plans and/or WNYNSC closure. The study area was subdivided into 29 study units (A through Y, and AA through EE) based on a number of factors including ease of access, vegetation, and topographic features. The study area included narrow linear parcels paralleling tributaries to Buttermilk Creek as far as its confluence with Cattaraugus Creek, parcels adjacent to the Project Premises, and a parcel encompassing the Bulk Storage Warehouse area in WMA 11 as shown in **Figure 3–27**.

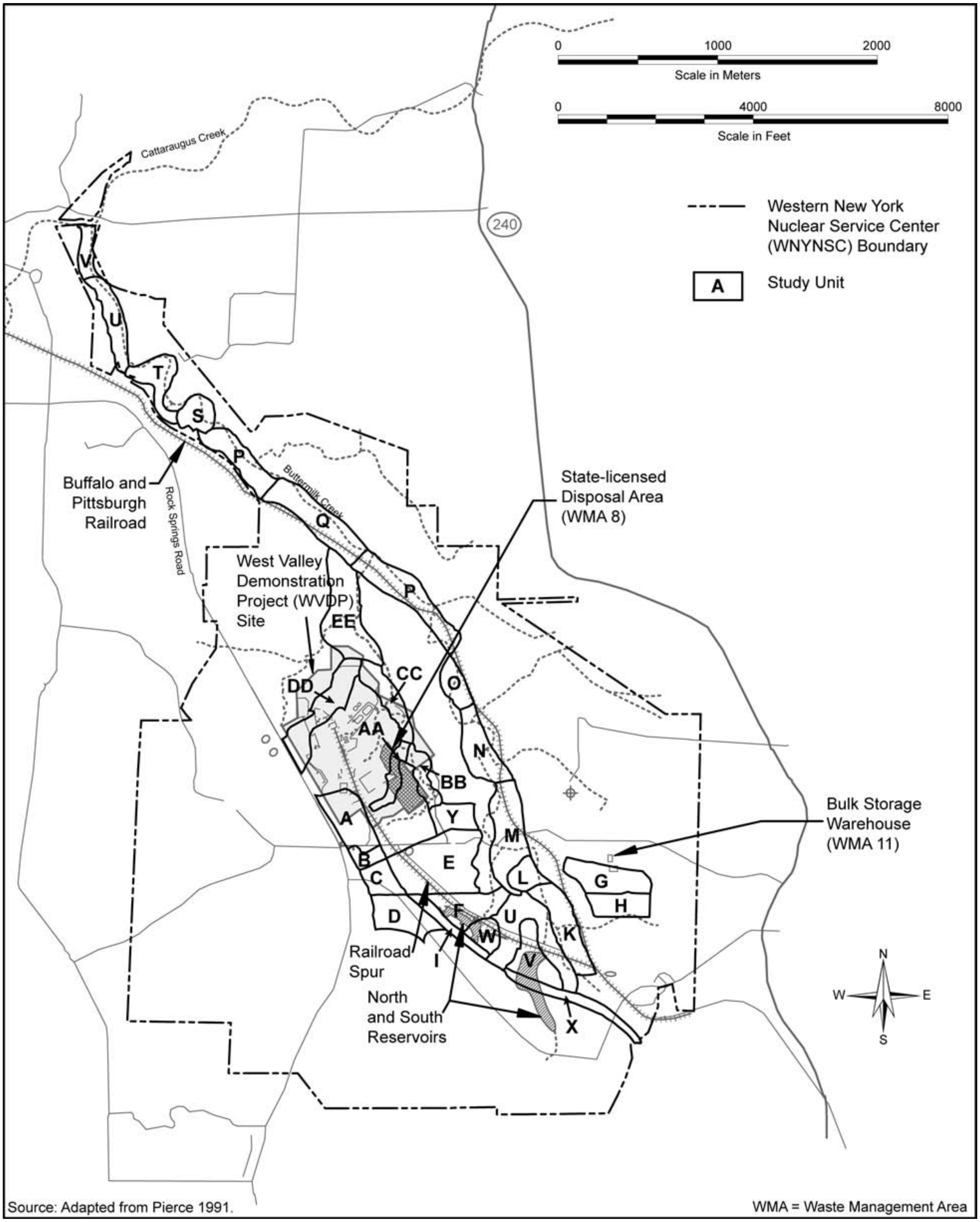


Figure 3–27 Cultural Resources Study Units

A variety of field methods, singly and in combination, were employed throughout the study area: intensive walkover reconnaissance, exposed creek bank and terrace inspection, and shovel testing. In addition to occasional isolated historic cultural material recovered during surface inspections and/or shovel testing, the investigation yielded one prehistoric and eight historic archeological sites, and two historic standing structures. The variety of cultural resources identified in the study area reinforced the belief that a microcosm of local and regional lifeways and settlement patterns might be found there. Western New York has a long and varied culture history ranging from the prehistoric past through Euroamerican settlement to the nuclear age (Pierce 1991). Based on the background research and preliminary walkover inspection, the cultural resource sensitivity within the study area was considered to be moderate to high for locating unrecorded prehistoric and/or historic resources. However, these sensitivities were moderated by the extremely high degree of natural erosion and manmade impacts that have occurred within the study area.

The study concluded that unrecorded archaeological sites are probably present within the WNYNSC. However, they were not located in the study area and are more likely to be found on the higher terrace or upland and headwater locations (Pierce 1991). Further, the New York State Historic Preservation Office has determined that facilities on the Project Premises are not eligible for inclusion in the National Register of Historic Places (Kuhn 1995), and no properties on the WNYNSC have been determined eligible for the National Register of Historic Places (DOE 2005a, DOE 2006d, Kuhn 1995).

3.9.1 Prehistoric Resources

A scraping tool was found in Study Unit E west of the access road leading into the borrow pit (Study Unit Y). The site is situated in a former agricultural field and orchard on a slight ridge overlooking an intermittent drainage leading to Erdman Brook. Fourteen additional shovel test pits were excavated in the vicinity, and no other cultural material was recovered, nor were any cultural features (e.g., hearths, pits) observed. The artifact is considered to be a "stray find" because it was isolated and not in association with other prehistoric cultural material or features (Pierce 1991).

3.9.2 Historic Resources

Of the eight historic sites and two historic structures found during the study, three additional investigations prior to any further disturbance would likely be required as indicated in the following description of the resources (Pierce 1991).

Goodemote/Spittler Farmstead Site (Study Unit A)—Isolated historic artifacts were recovered that were primarily farm related including several rusting metal objects (i.e., nails, pitchfork fragments, and iron plate), and two ceramic whiteware shards. Historical maps indicate there were two farmsteads in the vicinity, but the recovered artifacts were thought to be from the Goodemote/Spittler Farmstead. The barns, residences, and outbuildings of both farmsteads were demolished in the early 1960s during the development and construction of the reprocessing plant. The artifacts recovered from this site do not, in themselves, possess characteristics that would make them eligible for the National Register of Historic Places because they are typical items utilized in the daily routine of a farm and are considered to be isolated from the primary center of the farmstead, which was completely destroyed. No additional cultural resource investigations are believed necessary for this area (WVNS 1994b).

Frank Farmstead Site (Study Unit D)—This site originally contained a residence, barn, outbuilding, and semi-circular drive. Subsurface testing at this site recovered a concentration of ceramics (datable to the second quarter of the nineteenth century) and construction materials (e.g., bricks, nails, glass, and roofing material). Some mixing and burning of materials was apparent, which was consistent with the information on the demolition procedures used following condemnation of the farmstead in the 1960s. The Frank Farmstead site could provide information on the early settlers to the area, as the Frank family was the first to settle in the town of Ashford in the early 1800s. The Frank Farmstead site appears to maintain integrity in the configuration of the structures that were once there. A comparison of the artifacts from this site with those of other early German settlements in western New York may provide information on the similarity or uniqueness of the Ashford population. The site may also provide information on the cultural behavior of one family through time, as the farmstead was occupied by the Franks until its demolition.

Fleckenstein Farmstead Site (Study Unit L)—Historical maps and interviews conducted indicated a farmstead might be found and the walkover investigation verified a farmstead complex consisting of the remains of three foundations and ornamental shrubbery. Two of the foundations are comprised of fieldstone and concrete, one of which is probably a residence, while the remains of the barn are made of cobbles and rocks. Very few artifacts were recovered from the shovel testing and, with the exception of two ceramic fragments, no datable cultural deposits were recovered. Based on these findings, no additional cultural resources investigations are recommended because the material found does not meet the eligibility criteria for the National Register of Historic Places.

Hoyt's Siding Site (Study Unit O)—This site consists of the remains of a railroad stop constructed sometime between 1869 and 1920. Artifacts recovered include railroad debris, a rectangular concrete slab, and railroad tracks. No shovel test pits were excavated at this site (WVNS 1994b). At the direction of the State Historic Preservation Office, additional Stage 1B cultural resource investigations (shovel testing) could be undertaken to recover datable cultural resource deposits and to allow a determination as to whether the site would be eligible for inclusion in the National Register of Historic Places (WVNS 1994b).

Capron Farmstead Site (Study Unit S)—This site was found on the earliest map available for the study, with a date of 1869. Preliminary walkover reconnaissance identified a house foundation, a bridge, a U.S. Geological Survey gauging station, a concrete foundation, and a barn or mill foundation. The bridge was built sometime after 1949, when it replaced an earlier structure that was constructed in 1932. Shovel testing at this site produced ceramics, metal fragments, milk cans, bricks, and fragments of mechanical items. None of the materials dated to the earlier occupation; however, the area near the possible residence was not tested (WVNS 1994b). At the direction of the State Historic Preservation Office, additional Stage 1B cultural resource investigations (shovel testing) could be undertaken to recover datable cultural resource deposits and to allow a determination as to whether the site would be eligible for inclusion in the National Register of Historic Places (WVNS 1994b).

Late Twentieth Century Hunting Camp (Study Unit U)—The remains of an apparent hunting camp were located adjacent to Buttermilk Creek. A building was thought to be located in the camp and it appears to have been square with a gable roof and an associated unidentified concrete structure. No artifacts were recovered and because of the recent age of the materials, no excavations were conducted. Due to the contemporary date of this site and the fact that it is not unique to the area, it is not considered to be significant and does not possess characteristics that would make it eligible for the National Register of Historic Places.

Rider/Harvey/Whiteman Silo/Barn Site (Study Unit AA)—This site consists of the remains of a concrete and fieldstone silo pad with a barn foundation. Historic maps and resident interviews indicated that the silo/barn remnants probably belonged to the former Rider/Harvey/Whiteman Farmstead, which was demolished during the construction of the reprocessing plant and railroad. Because of severe disturbances, this site is not considered to be significant.

Erdman/Gentner Trash Midden (Study Unit DD)—This site represents a late 1950s to early 1960s residential and agricultural trash deposit. It contained an unusually high number of metal pails, which reinforces information that the Erdman/Gentner farm was functioning as a dairy farm. Other artifacts include other metal objects (e.g., lawn chairs, nails, and bedsprings), bottles, glass fragments, and ceramics. The material found is not inconsistent with material found elsewhere on recent farm sites; the midden contained recent datable artifacts (e.g., 1950s ceramics, bottle, etc.), as well as material related to daily subsistence and maintenance activities conducted on farms (e.g., dairying, maple sugaring, etc.). None of the midden material nor its context make it eligible for the National Register of Historic Places.

Buttermilk Hill Schoolhouse (Study Unit C)—The District 14 Schoolhouse was a one-and-a-half-story frame structure located at the northeast corner of Rock Springs and Buttermilk Hill Roads and appeared on historic maps of the area somewhere between 1869 and 1920. No cultural material was recovered during shovel testing and because the structure lacks architectural uniqueness, and integrity, this resource was not considered to be eligible for the National Register of Historic Places (Pierce 1991). The schoolhouse was demolished in 2007.

Twentieth Century Hunting Camp (Study Unit D)—Located at the north edge of the north reservoir, this hunting camp was formerly accessible by an unimproved dirt and grass road. The 6 by 7.6 meter (20 by 25 foot), one-story, frame structure is constructed of plywood with packing crate walls. Half-logs had been applied to its exterior, probably to give it the appearance of a log cabin. The cabin has a gable roof on one half with a salt-box type roof on the other. Its wooden floor, now deteriorated, was once set on concrete piers formed in bushel baskets. The structure appeared to have been divided into two rooms, a living area with a fieldstone and concrete fireplace, and a kitchen area containing a deteriorating gas stove and refrigerator. Because of its recent age and lack of association with historic periods or events, this resource does not possess characteristics that would make it eligible for the National Register of Historic Places.

3.9.3 Traditional Cultural Resources

Although American Indian archaeological materials are limited at the WNYNSC, other traditional use areas may be present. The WNYNSC is approximately 24 kilometers (15 miles) upstream from the Cattaraugus Indian Reservation, land reserved for the Seneca Nation of Indians. Communications with the Seneca Nation are ongoing to address potential impacts to their cultural sites and resources as a result of implementing the selected alternative. Specifically, the Seneca Nation of Indians request that planning and decisions regarding the site take into consideration, in detail, their way of life, the herbs they gather and consume, and the degree of their subsistence on aquatic life within Cattaraugus Creek (Snyder 1993). See Section 5.6 regarding communications with the Seneca Nation of Indians.

3.10 Socioeconomics

This section briefly describes the socioeconomic conditions of a two-county ROI, an area in western New York State comprised of Cattaraugus and Erie Counties that are most directly affected by ongoing activities at the WNYNSC. Approximately 95 percent of the employees currently reside in these counties (Malone 2003). This socioeconomic characterization focuses on the regional economic characteristics, population and demographic characteristics, housing and public services, utilities, and transportation.

3.10.1 Regional Economic Characteristics

The WNYNSC is one of the largest employers in Cattaraugus County and as of August 2006 employed 384 people directly, including contractors, security, DOE and NYSERDA personnel (WVES 2008). Employment at the WNYNSC also creates additional employment in the ROI. The WNYNSC contributes to the economic condition of the region through the wages it pays and the goods and services it purchases. It is estimated that the WNYNSC generates indirect employment of approximately 412 jobs. Therefore the total employment that can be attributed WNYNSC activities in the ROI is approximately 796 jobs.

In fiscal year 2008, it is estimated that WNYNSC paid approximately $27 million for base annual salaries (WVES 2008). The WNYNSC also purchased about $11 million in goods and services from firms in the local area in fiscal year 2006 (WVES 2008). As of March 2008, the average salary for the largest employer at WNYNSC was $70,168 (WVES 2008), which was higher than the average salary for all industrial sectors for both Cattaraugus and Erie Counties (BLS 2008a).

Annual payments of approximately $500,000 are made from WNYNSC to local municipalities in the ROI in lieu of property taxes. The West Valley Central School District is the largest recipient of the payments at about $280,000. The town of Ashford receives $160,000, and Cattaraugus County receives $60,000. These payments are provided to compensate local governments for any loss in revenue that could have been earned if the site was not publicly owned (WVES 2008).

Based on 2007 annual information, the distribution of employment by industry sector shows that the largest number of workers in the ROI are government employees (17.5 percent in the ROI), followed by professional and business services (12.8 percent), health care and social assistance (12.7 percent), and retail trade (11.1 percent) (NYSDOL 2008a). In 2007, as a percentage of the civilian labor force, the unemployment rates for Cattaraugus and Erie Counties were 5.1 percent and 4.6 percent, respectively, which were in line with the New York State average of 4.5 percent (NYSDOL 2008b). In 2006, approximately 3.2 percent of the Cattaraugus and Erie County workforce who did not work from home commuted an hour or more to work (DOC 2006). This may be indicative of the approximate percentage of people leaving these counties to work elsewhere.

3.10.2 Population and Demographic Characteristics

Figures 3–28 and **3–29** show the population distribution within 80 kilometers (50 miles) and 480 kilometers (300 miles) of the site, respectively (DOC 2008a, ESRI 2008, Statistics Canada 2008). Census estimates from the 2006 American Community Survey indicate relatively stable overall population levels in the two counties surrounding the WNYNSC. The total population in these counties decreased by 1.8 percent between the 1990 census and the 2000 census. From 2000 through 2006, the census estimates the population in these two counties decreased by another 3.0 percent. **Table 3–14** shows the demographic profile of the ROI population. Persons self-designated as minority individuals comprise about 19 percent of the total population. This minority population is composed largely of Black or African American residents.

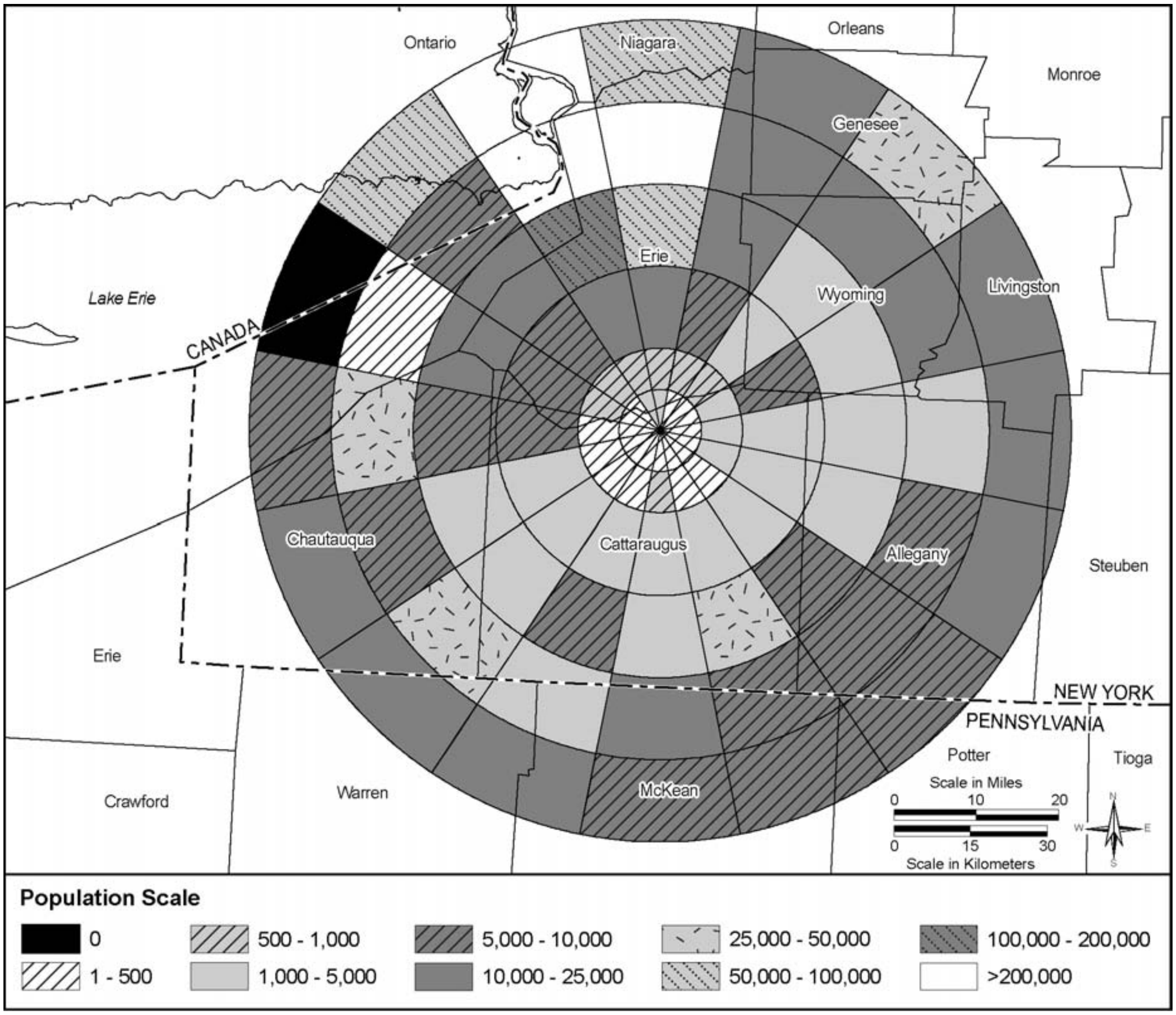


Figure 3–28 Population Distribution within 80 Kilometers (50 miles) of the Site

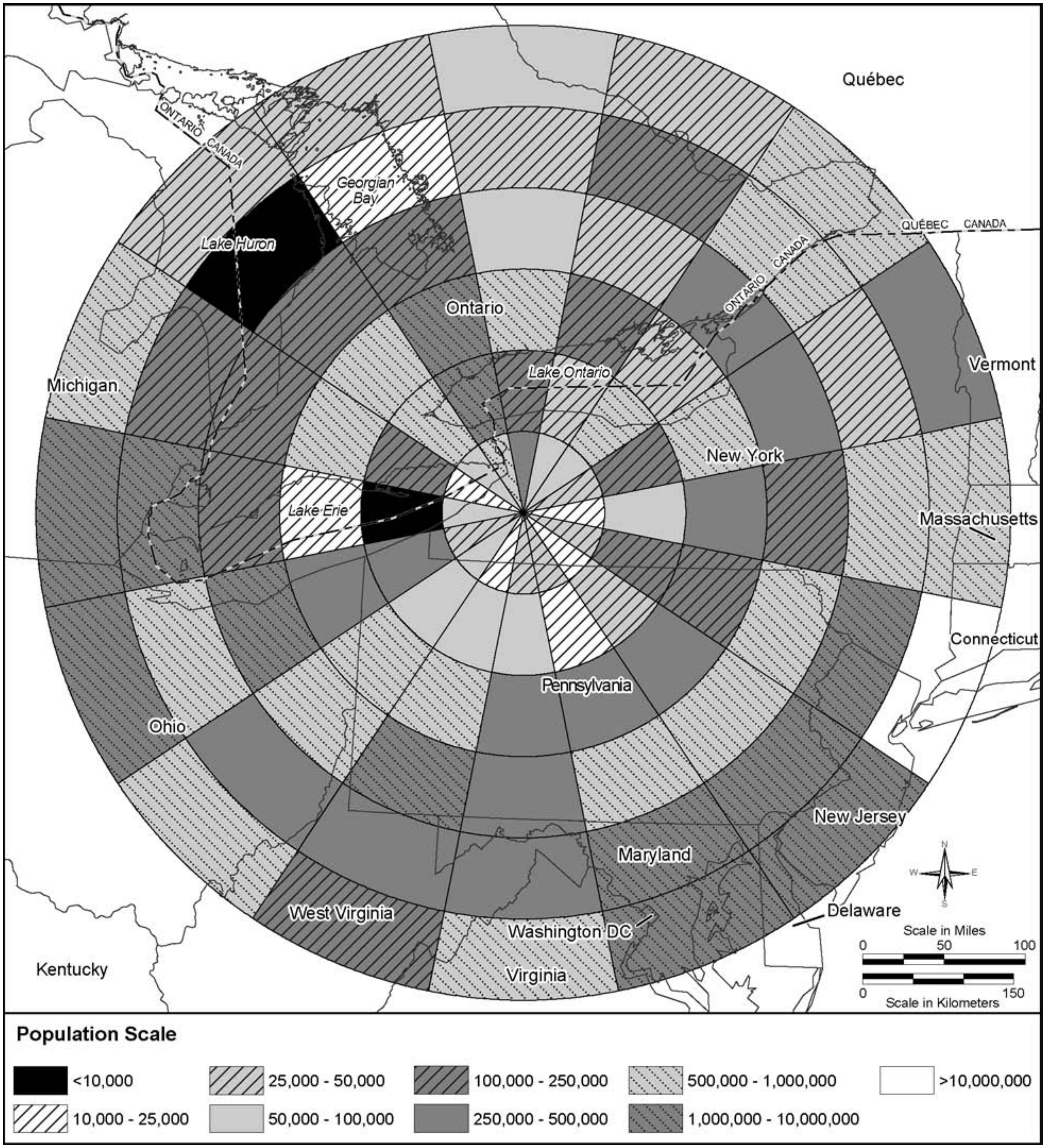


Figure 3–29 Population Distribution within 480 Kilometers (300 miles) of the Site

Table 3–14 Demographic Profile of the Population in 2000 in the Western New York Nuclear Service Center Region of Influence

	Cattaraugus County		***Erie County***		***Region of Influence***	
Population						
2006 population	81,534		921,390		1,002,924	
2000 population	83,955		950,265		1,034,220	
Percent change from 2000 to mid-2006	-2.9		-3.0		-3.0	
Race (2006)	***Total***	***Percent***	***Total***	***Percent***	***Total***	***Percent***
White, not of Hispanic Origin	75,989	93.2	734,642	79.7%	810,631	80.8
Black or African American [a]	1,163	1.4	123,273	13.4%	124,436	12.4
American Indian and Alaska Native [a]	2,207	2.7	4,861	0.5%	7,068	0.7
Asian [a]	613	0.8	18,689	2.0%	19,302	1.9
Native Hawaiian and Other Pacific Islander [a]	0	0.0	65	0.0%	65	0.0
Some other race [a]	77	0.1	12,296	1.3%	12,373	1.2
Two or more races [a]	681	0.8	13,310	1.4%	13,991	1.4
White Hispanic	804	1.0	14,254	1.5%	15,058	1.5
Total minority	5,545	6.8	186,748	20.3%	192,293	19.2
Total Hispanic [b]	929	1.1	33,271	3.6%	34,200	3.4

[a] Includes persons who self designated themselves as Hispanic or Latino.
[b] Includes all persons who self designated themselves as Hispanic or Latino regardless of race.
Sources: DOC 2000, 2006.

Income information for the two-county ROI is included in **Table 3–15**. The median household incomes in Cattaraugus and Erie Counties are below the median household income level for New York State. Cattaraugus County is below the state level by approximately $12,300, and Erie County is below the state level by about $8,900. Erie County's median household income, $42,494, is 8 percent higher than Cattaraugus County's household income. According to census estimates, 14.5 percent of the population in Erie County was below the official poverty level in 2005, while 14.7 percent of the population in Cattaraugus County was below the poverty level, as compared to 14.2 percent of the state (DOC 2006).

Table 3–15 Income Information for the Western New York Nuclear Service Center Region of Influence

	Cattaraugus County	***Erie County***	***New York***
Median household income 2006 ($)	39,066	42,494	51,384
Percent of persons below the poverty line (2005)	14.7	14.5	14.2

Source: DOC 2006.

3.10.3 Housing and Public Services

3.10.3.1 Housing

Erie County housing inventory accounted for 91.3 percent of housing units in the ROI in 2006 (DOC 2006). More than half of the homes in the ROI in 2006 were attached or unattached single-family units (60 percent). In 2006, the estimated vacancy rate was 7.4 percent for units for sale or rent, excluding seasonally vacant units (DOC 2006).

3.10.3.2 Public Services

This section describes public services available in the area surrounding the WNYNSC, including public safety, public health, and education.

Public Safety

The New York State Police and the Cattaraugus County Sheriff Department have overlapping jurisdictions for the West Valley area. Any assistance needed may be obtained from the State or County Police Departments (DOE 2003e). The State Police substation in Ellicottville has jurisdiction over the WNYNSC. Another State Police substation located in Machias, about 12.8 kilometers (8 miles) away would provide backup assistance (Mogg 2003). There is a Cattaraugus County Sheriff substation at the WNYNSC, with three to four officers that would respond to emergencies at the WNYNSC (WVES 2008). Backup support is available from Cattaraugus County's entire Sheriff Department which is comprised of 104 full- and part-time sworn officers (DCJS 2008). The nearest station in Cattaraugus County is in Ellicottville. In 2006 there were 2,043 sworn full or part-time police officers in the two county ROI. The ratio of sworn officers to every one-thousand people in the ROI was 2.0. Sworn officers to population ratios for Cattaraugus and Erie Counties were 2.5 and 2.0, respectively. The New York State ratio of sworn officers to every thousand people was 3.1. These ratios do not include State Troopers since they patrol larger regional jurisdictions throughout the state (DCJS 2008).

The West Valley Volunteer Hose Company provides fire protection services to the WNYNSC and the Town of Ashford. The West Valley Volunteer Hose Company, which is part of the West Valley Fire District I, has 70 active volunteers (Gentner 2008) and provides emergency response to the WNYNSC through a Letter of Agreement. The WNYNSC also has a Letter of Agreement with West Valley Fire District I for emergency services (Chilsom 2003). Responders are trained and briefed annually by the Radiation and Safety Department at the WNYNSC and NYSERDA on hazards at the site. Responders have limited training and capability to assist in chemical or radioactive occurrences. The West Valley Volunteer Fire Department has an agreement with the bordering towns' fire departments for mutual assistance in situations needing emergency backup. These neighboring volunteer fire departments are the William C. Edmunds Fire Company (East Otto), Ellicottville Volunteer Fire Department, Machias Volunteer Fire Department, Chaffee-Sardinia Memorial Fire Department, Delevan Volunteer Fire Department, East Concord Volunteer Fire Department, and Springville Volunteer Fire Department (DOE 2003e).

Public Health

The Cattaraugus County Health Department provides health and emergency services for the entire county, with the closest locations to the WNYNSC being in the towns of Machias and Little Valley. Other resources providing health care services include Promedicus Health Group; Evergreen Women's Health; LLP; Main Urology Associates; Concord Medical Group; and several private physician practices located in Springville. The Bertrand Chaffee Hospital in Springville in Erie County is the closest hospital to the WNYNSC, located approximately 6 kilometers (4 miles) north on Route 39 in Springville. This facility has 49 beds and will likely remain the primary health services supplier in the area. A written protocol for emergency medical needs at the WNYNSC provides the basis for support in the event of emergency from Bertrand Chaffee Hospital (DOE 2003e) and the Erie County Medical Center. Cattaraugus County has 2 hospitals: Olean General Hospital in Olean with 186 beds and TLC Health Network in Gowanda with 34 certified beds. Erie County has 10 hospitals with a total of 2,635 beds (NYSDOH 2008a). The New York State Physician Profile listed 1,070 physicians in Erie County and 68 in Cattaraugus County (NYS Physician Profile 2008).

Education

There are 13 school districts in Cattaraugus County and 29 in Erie County (NYSED 2008). These districts provide preschool through high school education. In the 2005 to 2006 school year, there were 14,888 students enrolled in public schools in Cattaraugus County and 129,618 in Erie County. Erie County has a student teacher ratio of about 12.5 students per teacher, while Cattaraugus County has a ratio of 11.2 students per teacher (NYSED 2008).

3.11 Human Health and Safety

Public and occupational health and safety issues include the determination of potential adverse effects on human health that could result from acute and chronic exposure to ionizing radiation.

3.11.1 Radiation Exposure and Risk

3.11.1.1 Environmental Monitoring Program Overview

Exposure of human beings to radioactivity would be primarily through air, water, and food. At the WNYNSC, all three pathways are monitored, but air and surface water pathways are the two primary near-term means by which radioactive material can move off site.

The onsite and offsite monitoring programs at the WNYNSC include measuring the concentrations 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 produces a comprehensive picture of onsite and offsite levels of radioactivity from all sources.

More detailed measurements are also made for specific radionuclides. Strontium-90 and cesium-137 are measured because they have been previously detected in WNYNSC waste materials. Radiation from other important radionuclides such as tritium or iodine-129 is not sufficiently energetic to be detected by gross measurement techniques, so it is analyzed separately using more sensitive methods. Heavy elements such as uranium, plutonium, and americium require special analysis to be measured because they exist in such small concentrations in the WNYNSC environs.

3.11.1.2 Radiation Exposure

Major sources and levels of background radiation exposure to individuals in the vicinity of the site are shown in **Table 3–16**. Annual background radiation doses to individuals are expected to remain constant over time. Background radiation doses are unrelated to site operations.

Normal operational releases of radionuclides to the environment from site operations provide another source of radiation exposure to individuals. Types and quantities of radionuclides released from operations in 2006 are listed in the *Annual Site Environmental Report, Calendar Year 2006* (WVNS and URS 2007). Estimated doses from these releases are summarized below.

Airborne Emissions

The EPA, under the Clean Air Act and its implementing regulations, regulates airborne emissions of radionuclides. DOE facilities are subject to 40 CFR Part 61, Subpart H. Subpart H contains the national emission standards for emissions of radionuclides other than radon from DOE facilities. The applicable standard for radionuclides is a maximum of 10 millirem (0.1 millisievert) EDE to any member of the public in 1 year.

Table 3–16 Sources of Background Radiation Exposure to Individuals in the United States Unrelated to Western New York Nuclear Service Center Operations

Source	*Effective Dose Equivalent (millirem per year)*
Natural Background Radiation	
External cosmic, ground level [a]	28
External terrestrial [b]	28
Internal terrestrial and global cosmogenic	39
Radon (in homes)	200
Other Background Radiation	
Diagnostic x-rays and nuclear medicine	53
Other, including weapons test fallout	2
Consumer and industrial products	10
Total	360

[a] Cosmic radiation doses are lower in the lower elevations and higher in the mountains.
[b] Variation in the external terrestrial dose is a function of the variability in the amount of naturally occurring uranium, thorium, and potassium in the soil and in building materials.
Sources: NCRP 1987, WVNS and URS 2007.

Maximum Dose to an Offsite Individual—Based on the nonradon airborne radioactivity released from all sources at the site during 2006, it was estimated that a person living in the vicinity of the site could have received a total EDE of 0.0011 millirem from airborne releases. This maximally exposed offsite individual would be located 1.9 kilometers (1.2 miles) north-northwest of the site and was assumed to eat only locally produced foods. This maximum dose to an offsite individual is a small fraction (0.01 percent) of the EPA air limit of 10 millirem.

Collective Dose to the Population—Based upon the latest U.S. census population data collected in 2000, about 1.5 million people were estimated to reside within 80 kilometers (50 miles) of the site. This population received an estimated dose of 0.0062 person-rem total EDE from radioactive airborne effluents released during 2006.

Waterborne Releases

Waterborne releases from the site involve routine batch releases from Lagoon 3, effluent from the sewage treatment facility, and drainage from the North Plateau. Doses to an offsite individual and population are estimated on the basis of radioactivity measurements supplied by the environmental monitoring program.

Maximum Dose to an Offsite Individual—Based on the radioactivity in liquid effluents discharged from the site during 2006, an offsite individual could receive a maximum EDE of 0.048 millirem, based on liquid effluent releases and drainage from the north plateau. This exposure would be less than the 4 millirem regulatory limit as defined by the Primary Drinking Water Standards.

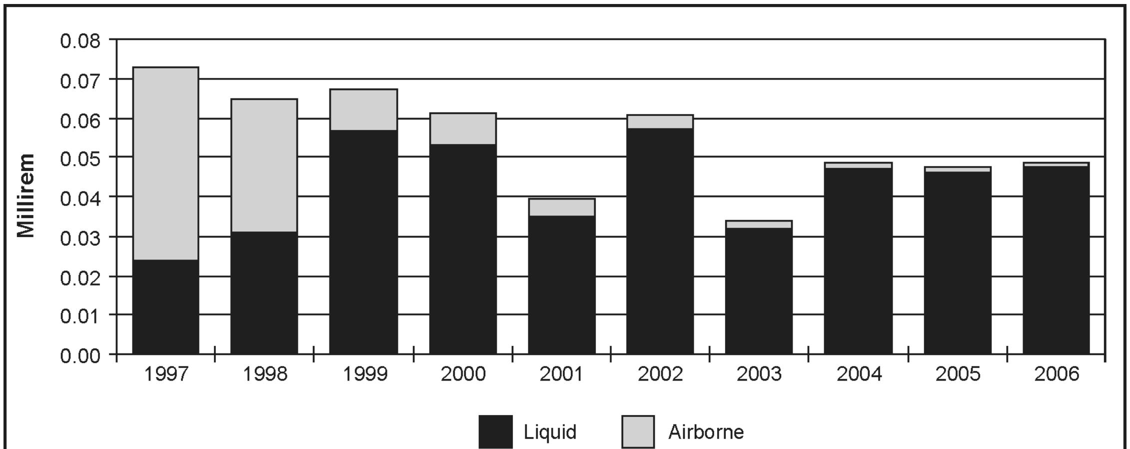
Collective Dose to the Population—As a result of radioactivity released in liquid effluents during 2006, the population living within 80 kilometers (50 miles) of the site would have received a collective EDE of 0.21 person-rem.

Dose from All Pathways

The potential dose to the public from both airborne and liquid effluents released from the site during 2006 is the sum of the individual dose contributions. The calculated maximum EDE from all pathways to a nearby resident was 0.049 millirem. This is a small fraction (0.049 percent) of the 100-millirem annual limit in DOE Order 5400.5.

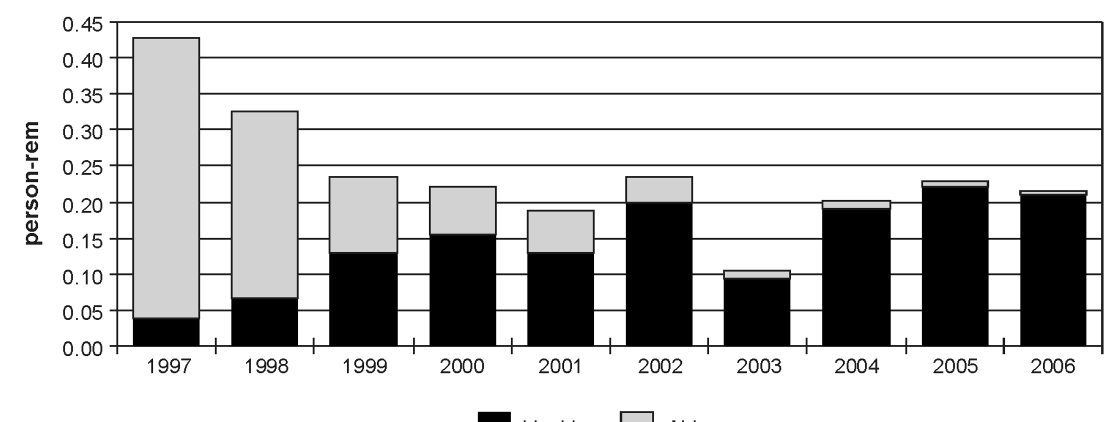
The total collective EDE to the population within 80 kilometers (50 miles) of the site was 0.22 person-rem, with an average EDE of 0.00014 millirem per individual. The estimated population dose from airborne radon, calculated annually, was approximately 0.34 person-rem.

Figures 3–30 and **3–31** show the calculated annual dose to the hypothetical maximally exposed individual and the collective dose to the population respectively over the last 10 years. The overall radioactivity represented by these data confirms the continued inconsequential addition to the natural background radiation dose that the individuals and population around the WNYNSC receive from site activities.



Source: WVNS and URS 2007.

Figure 3–30 Effective Dose Equivalent from Liquid and Airborne Effluents to a Maximally Exposed Individual Residing Near the Western New York Nuclear Service Center



Source: WVNS and URS 2007.

Figure 3–31 Collective Effective Dose Equivalent from Liquid and Airborne Effluents to the Population Residing within 80 Kilometers (50 miles) of the Western New York Nuclear Service Center

3.11.2 Health Effect Studies

Both the State of New York Health Department and the U.S. National Cancer Institute maintain statistical records of cancer incidence and mortality rates. Cancer incidence and mortality rates for the counties surrounding the site are compared to those for New York State for the time period of 2000 to 2004 in **Table 3–17** (NYSDOH 2008b). When compared to New York State, excluding New York City since it is not representative of the rural demographics of the counties on and around the site, Cattaraugus County and its collocated counties have comparable cancer incidence rates to the State. The Cattaraugus County death rate from cancer is lower than 23 of the 62 counties in the State and its cancer incidence rate is lower than 41 of the 62 state counties for the time period of 2000 to 2004. Furthermore, comparison of Cattaraugus County cancer incidence and mortality rates to that of adjacent counties does not show that it has a higher rate (it is lower than some and higher than others). There is no statistically significant trend that indicates that the cancer incidence of the population around the site is different than other counties or the State of New York.

Table 3–17 Comparison of 2000 to 2004 Cancer Rates for Counties around the West Valley Demonstration Project and New York State

Cancer Incidence per 100,000 people	*Cattaraugus County*	*Allegany County*	*Chautauqua County*	*Erie County*	*Wyoming County*	*New York State (excluding New York City)*
Incidence - male	581.4	587.6	627.1	590.6	621.5	571.1 (594.1)
Incidence - female	451.5	445.4	406.2	437.6	444.7	427.4 (451.5)
Annual deaths - male and female	204.9	221.7	205.0	210.3	207.0	189.7

Source: NYSDOH 2008b.

The National Cancer Institute analyses (NCI 2008) show that the Cattaraugus County cancer death rate is similar to that for United States through 2004, with a stable trend (i.e., not increasing or decreasing) for all cancers from 2000 to 2004. From 1976 through 1998, the Cattaraugus County invasive malignant tumor incidence rate among both males and females was lower than that of New York State (excluding New York City) and comparable during the period from 2000 to 2004. It is important to note that cancer incidence rate is related, among other factors, to the availability and use of medical services in each county.

All cancer incidence and death rate statistical data from the State of New York (NYSDOH 2008b) and the National Cancer Institute (NCI 2008) from 1976 to 2004 substantiate that the region around the site does not exhibit any unusual or excessive cancers in the public population, but rather is typical of the area, New York State, and the United States. There is no identifiable increase in cancer risk in the area around the WNYNSC.

3.11.3 Chemical Exposure and Risk

Hazardous chemicals can cause cancer- and noncancer-related health impacts. Effective administrative and design controls that decrease hazardous chemical releases to the environment and help achieve compliance with permit requirements (e.g., air emission and the National Pollutant Discharge Elimination System permit requirements) minimize health impacts on the public. The effectiveness of these controls is verified through the use of monitoring information and inspection of mitigation measures. Health impacts on the public may result from inhaling air containing hazardous chemicals released to the atmosphere. Risks to public health from other possible pathways, such as ingestion of contaminated drinking water or direct exposure, are lower than those from the inhalation pathway.

Exposure pathways to workers during normal operations may include inhaling contaminants in the workplace atmosphere and direct contact with hazardous materials. The potential for health impacts varies among facilities and workers, and available information is insufficient for a meaningful estimate of impacts. However, DOE policy requires that conditions in the workplace be as free as possible from recognized hazards that cause, or are likely to cause, illness or physical harm. In general, workers are protected from workplace hazards through adherence to Occupational Safety and Health Administration and EPA standards that limit workplace atmospheric and drinking water concentrations of potentially hazardous chemicals. Worker exposure to hazardous chemicals in the workplace is minimized by techniques such as appropriate training, use of protective equipment, monitoring of the workplace environment, limits on duration of exposure, and engineered and administrative controls. Monitoring and controlling hazardous chemical usage in operational processes help ensure that workplace standards are not exceeded and worker risk is minimized.

The site complies with the Emergency Planning and Community Right-to-Know Act for reporting chemical inventories and toxic release inventories. The site also complies with all Toxic Substances Control Act requirements pertaining to asbestos and PCB regulations. For 2006, the site reported the following chemicals in quantities above the Emergency Planning and Community Right-to-Know Act 312 Threshold Planning Quantities: hydrogen peroxide solution (35 percent), portland cement, ion exchange media, liquid nitrogen, diesel fuel #2, sodium hydroxide, oils of various grades, gasoline, and sulfuric acid. This information is annually submitted to state and local emergency response organizations and fire departments specifying the quantity, location, and hazards associated with chemicals stored at the site (WVNS and URS 2007).

Underground and aboveground storage tanks are used for storage of certain hazardous chemicals. RCRA regulations cover the use and management of underground tanks for storage of petroleum and hazardous substances and establish minimum design requirements to protect groundwater resources from releases. New York State also regulates underground storage tanks through two programs: petroleum bulk storage (6 NYCRR Parts 612-614) and chemical bulk storage (6 NYCRR Parts 595-599). State 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 (WVNS and URS 2007).

A single 2,080-liter (550-gallon), double-walled, steel underground storage tank, upgraded in 1998 to bring it into compliance with the most recent EPA requirements (40 CFR 280.21), is used to store diesel fuel for the supernatant treatment system/permanent ventilation system standby power unit. This tank is equipped with aboveground piping, an upgraded interstitial leak detection system, and a high-level warning device, and therefore meets the state requirements of 6 NYCRR Parts 612–614. This is the only underground petroleum storage tank currently in use at the site. There are no underground chemical bulk storage tanks at the site (WVNS and URS 2007).

New York State regulates aboveground petroleum and chemical bulk storage tanks under 6 NYCRR Parts 612–614 and Parts 595–599, respectively. These regulations require secondary containment, external gauges to indicate the content levels, monthly visual inspections of petroleum tanks, and documented daily, annual, and five-year inspections of chemical tanks. Petroleum tank fill ports also must be color coded, and chemical tanks must be labeled to indicate the product stored. Petroleum bulk storage is also addressed through the Spill Prevention, Control, and Countermeasures plan prepared in accordance with 40 CFR Part 112. Tank registration at the end of 2006 included nine aboveground petroleum tanks (five containing diesel fuel, three containing #2 fuel oil, and one containing unleaded gasoline) (WVNS and URS 2007).

The site regularly applies a NYSDEC-registered biocide to control algae and waterborne pathogens in the site cooling water tower system. Control of the organisms is necessary to minimize the potential for cooling system damage due to fouling from algae buildup and minimize the potential for worker exposure to waterborne pathogens such as *Legionella* (WVNS and URS 2007).

3.11.4 Occupational Health and Safety

Table 3–18 presents the calculated WNYNSC injury rates and associated data for the years 1999 through 2005, and the 7-year average. The table shows that the 7-year average is below the average associated with related industries, as published by the Bureau of Labor Statistics. In addition, the industry rates at WNYNSC have significantly decreased between 1999 and 2005. Worker safety at WNYNSC has improved with the implementation of DOE's Voluntary Protection Program which promotes safety and health excellence through cooperative efforts among labor, management, and government at the DOE contractor sites.

Table 3–18 Injury Rates at West Valley Nuclear Services Company

Calendar Year	*Lost Workday Injury Rate* [a]	*Recordable Injury Incidence Rate* [a]
1999	1.14	1.99
2000	0.89	1.77
2001	1.60	3.09
2002	1.3	2.4
2003	0.2	0.5
2004	0.0	0.3
2005	0.0	0.2
7-Year Average	0.73	1.46
National Average for Waste Management and Remediation Services Industry [b]	3.9	6.5
National Average for Industrial Inorganic Chemicals Manufacturing Industry [b]	1.4	2.7
National Average for Heavy and Civil Engineering Construction Industry [b]	3.0	5.3

[a] Rates are per 100 full-time workers.
[b] 2006 rates from the Bureau of Labor Statistics, Industry Injury and Illness Data (BLS 2008b).
Sources: DOE 2002f, BLS 2008b.

With respect to radiological occupational exposure at the WNYNSC, DOE reports a collective total EDE of 16.5 person-rem for 2000, 22.2 person-rem for 2001, 30.5 person-rem for 2002, 41.7 person-rem for 2003, 39.7 person-rem for 2004, 14.5 for 2005 and 16.1 for 2006 (DOE 2003a, 2004a, 2006a). This equates to an average dose to workers with a measurable total EDE of 67 millirem in 2000, 95 millirem in 2001, 128 millirem in 2002, 201 millirem in 2003, 165 millirem in 2004, 69 millirem in 2005, and 85 millirem in 2006 (DOE 2007). Although collective occupational doses increased during the period of cleanup operations in the 2002 to 2004 timeframe, there were no instances of a worker at West Valley receiving a dose in excess of the total EDE regulatory limit (5 rem) (DOE 2003a, 2004a, 2006a).

Incidents involving worker radiation exposure occur from time to time. One of the more serious worker radiation exposure incidents occurred in January 2005, when a waste container liner holding debris from cleanup of the vitrification cell was moved into the adjoining crane maintenance room without a required detailed radiation survey. A worker placing packaged radioactive waste into the liner and a technician performing radiological surveys of this waste received unplanned radiation exposure from an unidentified hot spot on the liner, which measured 50 rem per hour 2 inches from the surface. While exposures to the worker and technician exceeded the contractor's daily limit of 100 millirem, their cumulative exposure totals for the year were small fractions of the 5 rem annual regulatory limit for radiation workers (Mellor 2005, WVNSCO 2005).

The site historic worker injury rates and radiological occupational exposure are significantly lower than other related industries and regulatory guidelines. This comparison is indicative of the practices, procedures, and controls used for occupational health and safety.

3.11.5 Accident History

The following summary addresses site accidents that are known to have resulted in environmental impacts and others that might have, based on available operating records and evidence in the form of measured contamination in environmental media. Note that the term *accidents* is used here in a broad sense to also include releases of radioactivity and hazardous materials that are known to have impacted the environment as a consequence of: (1) unintentional releases, (2) planned releases, (3) facility design, (4) site practice, (5) site hydrogeology, and (6) combinations of these factors.

Insofar as practical, accidents are divided into those that occurred during the period when NFS was responsible for the site and the WVDP period. Accidents involving radioactivity are first discussed, followed by those involving hazardous materials. This subsection concludes with a discussion of the integrity of underground tanks and lines.

3.11.5.1 Nuclear Fuel Services Period – 1966 through 1981

Accidents Involving Radioactivity

Chapter 2 briefly describes the environmental consequences of two significant radiological accidents that occurred at the West Valley Site, the radioactive nitric acid spill that was the dominant contributor to the North Plateau groundwater plume and the 1968 uncontrolled releases that resulted in the extended area of surface soil contamination known today as the Cesium Prong. Both took place during reprocessing operations.

The spill identified as the major source of the North Plateau groundwater plume involved an estimated 760 liters (200 gallons) of recovered nitric acid that leaked from Line 7P-240-1-C in the off-gas operating aisle, ran down the walls of the off-gas cell and the adjacent southwest stairwell below, and leaked under the Main Plant Process Building through a floor expansion joint (WVNSCO 1995). Strontium-90 and its decay product, yttrium-90, are the principle radionuclides of health concern in this plume. In addition, leakage from Lagoon 1, principally water containing tritium also contribute to the gross beta activity in the plume. The potential dose effects of tritium are, however, small in comparison with the potential effects from strontium-90. More details on the sources and extent of the plume and the estimated inventory of the activity involved are shown in Appendix C, Section C.2.13. This release impacted WMAs 1, 2, 3, 4, and 5.

The uncontrolled, airborne releases in 1968 occurred when a high-efficiency particulate air filter in the main ventilation system failed and part of the filter media was drawn into the blower, cut into pieces, and discharged out the main stack (Urbon 1968). The consequences of this accident were underestimated by NFS, who stated initially that “radioactivity [within the plant exclusion fence] was retrieved during clean-up operations” (Urbon 1968). The scope of this release became more apparent in a series of aerial radiological surveys begun in the late 1960s that culminated in 1984 (EG&G/EM 1991). The offsite effects were later more fully defined in an investigation sponsored by NYSERDA (Luckett 1995).

Other accidents involving radioactivity that occurred during reprocessing operations included:

- In February 1967, a spill occurred during a waste transfer from the General Purpose Evaporator (7C-5) to waste tank 8D-2. Approximately 2,100 liters (555 gallons) of high-activity liquid from Line 7P-170-2-C in the Acid Recovery Pump Room entered the room sump and drained to the old interceptor in WMA 2. Radioactivity from this spill contaminated the interceptor to the point where 30 centimeters (12 inches) of concrete were poured on the interceptor bottom to reduce resulting high radiation levels (Winchow 1967). This release may have also impacted environmental media beneath this portion of the Main Plant Process Building.

- A February 1967 spill of an unknown volume of radioactive liquid from wastewater Line 7P-160-2-C occurred immediately south of Tank 7D-13 outside the southern end of the Plant Office Building in WMA 1 (NYSERDA 2006a).

- In 1967, contaminated groundwater "flowing underground from the general plant area" was discovered during construction of the new interceptors, indicating the presence of contaminated groundwater and subsurface soil in WMAs 1 and 2 before the January 1978 release from Line 7P-240-1-C in the off-gas operating aisle (Taylor 1967).

- In 1967, three fires occurred in the Main Plant Process Building General Purpose Cell in which spent fuel cladding (zirconium hulls) ignited, two of which activated the cell fire suppression system (Lewis 1968). Airborne radioactivity from these fires apparently did not impact environmental media.

- In 1967 and 1968, other small fires occurred from time to time in the Chemical Process Cell when high-temperature reactions involving uranium or zirconium hulls burned holes in dissolver baskets (Lewis 1968, Urbon 1968). Airborne radioactivity from these fires apparently did not impact environmental media.

- On March 8, 1968, failure of a dissolver off-gas system filter in the Main Plant Process Building resulted in a radioactivity release through the Main Plant Process Building stack, causing releases to reach the monthly allowance 2 days later, which included 0.28 curies of particulate activity (North 1968). This release may have produced minor impacts downwind.

- On March 20, 1968, failure of a vessel off-gas system filter in the Main Plant Process Building resulted in a radioactivity release thorough the Main Plant Process Building stack causing the March 1968 releases to exceed the monthly allowance by 15 percent (North 1968). This release may have produced minor impacts downwind.

- Several leaks during the 1968 to 1977 period were associated with condensate line 8P-46-6-A5 from Tank 8D-2 in the section between the Equipment Shelter and the west wall of the Acid Recovery Pump Room. This six-inch carbon steel line, a portion of which was rerouted in 1967, was maintained under vacuum and an unexpected 62,000-liter (16,400-gallon) liquid volume increase in Tank 8D-2 was attributed to groundwater leaking into this line being drawn into the tank. Leaks from this line may have impacted subsurface soil and groundwater in WMAs 1 and 3, but the impacts likely would have been small since the line was maintained under vacuum (Duckworth 1977, NYSERDA 2006a).

- A 1970 to 1971 investigation of unexpected tritium and gross beta contamination in Erdman Brook led to the discovery of contamination in the sanitary sewer system that resulted in discharge of approximately 0.5 curie gross beta and 0.05 curie strontium-90 from the Old Sewage Treatment Plant into this stream through the treated sewage outfall (Duckworth 1972). This release impacted water and sediment in Erdman Brook and downstream.

- In August of 1974, a failed sanitary sewer line located near underground Tank 7D-13 was discovered to be contaminated by groundwater in the area; leakage into the sewer line was believed to be responsible for elevated gross beta and strontium-90 concentrations observed in the sewage outfall during the 1970 to 1972 period that impacted water and sediment in Erdman Brook and downstream (WVNSCO 1995).

- Numerous spills of radioactive liquid and/or radioactive debris occurred inside various areas of the Main Plant Process Building – including pieces of spent fuel and spent fuel cladding – that did not appear to affect the environment.

- Numerous releases of airborne radioactivity occurred inside Main Plant Process Building areas, some of which led to installation of a new ventilation system in 1970 (Michalczak 2003). Minor environmental impacts from increased stack emissions may have resulted.

- Migration of tritium from Lagoon 1 that impacted subsurface soils and groundwater in WMA 2 that eventually led to closure of this unlined lagoon in 1984 (WVNSCO 1994).

- Releases of radioactive liquid effluents contributed to sediment contamination in Franks Creek, Buttermilk Creek, and Cattaraugus Creek, the scope of which became evident in 1968 (Barasch and Beers 1971) and by later aerial radiation level measurements.

Note that spills of radioactive materials inside the Main Plant Process Building process cells were an anticipated consequence of plant operations and these cells were designed to contain them. Consequently, such spills generally did not impact outside areas.

Low-level radioactive contamination in surface soil in the Cesium Prong area has likely been naturally spread by precipitation into ditches and channels that saw surface water runoff from this area. This phenomenon may have enlarged the area impacted by the deposition of airborne radioactivity from the Main Plant Process Building stack, although detailed data that show this effect are not available.

From 1966 to 1971, Lagoons 1, 2, and 3 were used sequentially. These Lagoons discharged to Erdman Brook. The O2 Building and Lagoons 4 and 5 were built in 1971 to actively treat wastewater before discharge to Erdman Brook. Liners were installed in Lagoons 4 and 5 in 1974 after Lagoons 1, 2, and 3 were suspected of leaking wastewater to the underlying sand and gravel.

Another phenomenon related to site hydrology is the seepage of groundwater to the surface and in drainage ditches in swampy areas of WMA 4. Gradual migration of radioactivity in the North Plateau groundwater plume eventually led to radioactivity in this plume reaching the surface in the seep locations, resulting in contaminated surface soil and drainage ditch sediment in these areas.

Releases Involving Hazardous Materials

Some of the radioactivity releases described above contained hazardous contaminants. Additional hazardous materials releases involved the solvent dike, which received runoff from the Solvent Storage Terrace located on the Main Plant Process Building from 1966 to 1987. Radioactive tributyl phosphate and n-dodecane spilled from solvent tanks in the Solvent Storage Terrace were conveyed through a floor drain and related underground piping to the dike. The solvent dike was removed from service in 1987 by removing and packaging the berm and radiologically contaminated soil and sediment, along with the drain line.

3.11.5.2 West Valley Demonstration Project Period – 1982 to Present

The site documents accidents involving radioactivity and hazardous materials using a tiered system based on accident seriousness. All are investigated and actions taken to prevent recurrence and similar problems. The potential environmental consequences are also evaluated and considered in connection with the site environmental monitoring program, which addresses compliance with regulatory standards for environmental releases (WVNS and URS 2005).

Accidents Involving Radioactivity

Accidents with actual or potential environmental consequences related to radioactive contamination include:

- A radioactive release to the ground, apparently associated with outdoor storage of contaminated equipment and waste was discovered in 1983 at the old hardstand located at the west end of Lag Storage Additions 3 and 4 in WMA 5. This hardstand consisted of an outdoor lay-down area with an asphalt surface approximately 45 meters by 45 meters (150 feet by 150 feet), surrounded by unpaved ground and woods. Gamma radiation levels as high as 1,500 millirem per hour were measured 5 centimeters (two inches) above the ground surface. In 1983, aboveground portions of contaminated trees were removed. In 1984, approximately 1,302 cubic meters (46,000 cubic feet) of contaminated soil, asphalt, tree stumps, roots, and other vegetation were removed from this area and placed in the decommissioned Lagoon 1 in WMA 2. Note that this release apparently occurred entirely during the NFS period. A 1995 estimate of the activity in the old hardstand debris placed in Lagoon 1 totaled approximately 18 curies, including the short-lived progeny of strontium-90 (yttrium-90) and cesium-137 (barium 137m) (Keel 1984, WVNSCO 1994, 1995, 1997a).

- In 1985, a spill of approximately 1,900 liters (500 gallons) of radioactive condensate from Tank 8D-1 from a leaking valve filled a valve pit west of Tank 8D-2, ran onto the ground into a buried culvert, and entered a drainage ditch in WMA 2, necessitating removal of contaminated soil in the Waste Tank Farm area (WVNSCO 1985). This release primarily impacted surface soil in WMA 3.

- In 1986, a spill of low-level contamination occurred at the pipe chase on the roof of the Utility Room in WMA 1; it did not result in any environmental impact (WVNSCO 1986a).

- In 1986, a small amount of contaminated sludge was spilled on the concrete sidewalk outside of the O2 Building in WMA 2 that was readily decontaminated (WVNSCO 1986b).

- In 1987, 19 to 38 liters (5 to 10 gallons) of slightly radioactive condensate from a portable ventilation unit filter spilled on the ground near Tank 8D-2 in WMA 3; this release did not produce any measurable contamination in the soil (WVNSCO 1987a).

- In 1987, a small amount of contaminated liquid spilled from a 208-liter (55-gallon) drum containing spent resin at the Lag Storage Addition hardstand in WMA 5, resulting in removal of a small amount of contaminated soil (WVNSCO 1987b).

- In 1997, a small spot of relatively high-activity, previously-unidentified soil contamination was found in WMA 2 north of Lagoon 5 during a radiological survey near environmental characterization activities (WVNSCO 1997c).

- In 1999, approximately 230 liters (60 gallons) of demineralized flush water overflowed a manhole at the Equalization Basin, resulting in no environmental impact (WVNSCO 1999b).

- In 2003, a breach in a riser was found from Line 15WW-569, that received laundry water. Approximately 3,400 liters (900 gallons) per day was released through the breach (DOE 2003f). The line was repaired.

- In 2004, two radiologically contaminated bees' nests were found when a walkway was removed between the Vitrification Test Facility and a nearby trailer in WMA 2. Experience indicated that the nests were likely built with mud from one of the lagoons (WVNSCO 2004). This incident is representative of cases where low-level radioactive contamination has been found to be spread by insects or small animals from time to time.

- In 2005, two small fires occurred inside the Vitrification Cell in the Vitrification Facility that did not result in release of radioactivity outside of the building (DOE 2005b).

Other documented radioactive spills that did not impact the environment occurred inside the Main Plant Process Building, 01-14 Building, Vitrification Facility, the former Radwaste Processing Building, the Drum Cell, the former Lag Storage Areas 3, and Low-Level Waste Treatment Facility Area buildings.

Accidents Involving Hazardous Materials

The number of documented WVDP accidents involving hazardous materials has been small compared to the number involving radioactivity. Representative hazardous materials spills include the following:

- In 2000, mercury from a previous spill was discovered in the Utility Room while workers were removing a cover plate to gain access to a floor drain piping cleanout plug (WVNSCO 2000a).

- In 2000, a small amount of nitric acid leaked on the floor of the Cold Chemical Room during repair of nitric acid valves (WVNSCO 2000b).

3.11.5.3 Underground Tank and Underground Line Integrity

No documented leaks from underground storage tanks have occurred. Several leaks from underground lines that carried radioactive liquid or gas are known to have occurred, as explained above.

High-Level Waste Tanks

The assumed integrity of underground storage Tanks 8D-1, 8D-2, 8D-3, and 8D-4 is based on the absence of documented leaks and other factors, such as:

- The presence of the reinforced concrete tank vaults, which provide secondary containment for these tanks and annular spaces that facilitate monitoring for possible tank leakage;

- The leak detection systems associated with Tanks 8D-1 and 8D-2, which employ instruments to monitor liquid levels in the pans under each tank and in the tank vaults, along with recorders and alarm systems;

- The analytical results of samples of in-leakage of surface water or groundwater into the vaults of Tanks 8D-1 and 8D-2, which have experienced such in-leakage;

- The results of monitoring of the sump level in the common vault for Tanks 8D-3 and 8D-4;

- The use of operating procedures to ensure actual parameters associated with liquid transfers correspond with expected conditions, to identify anomalies such as unexpected liquid losses;

- The absence of unexplained liquid losses;

- Analytical data from groundwater monitoring hydraulically downgradient from the tanks, which have not identified radioactive contamination from possible tank leakage; and

- Analytical data from the RCRA facility investigation of the tank farm area, which do not indicate a release of RCRA hazardous contaminants from the tanks (WVNSCO 1997b).

Other Underground Tanks

The assumed integrity of other underground tanks, including the concrete interceptors that are open to the atmosphere, is based on factors such as:

- The absence of documented leaks and unexplained liquid losses;

- The use of operating procedures to ensure actual parameters associated with liquid transfers correspond with expected conditions, to identify anomalies such as unexpected liquid losses;

- Analytical data from groundwater monitoring hydraulically downgradient from the tanks, which have not identified radioactive contamination from possible tank leakage; and

- Analytical data from the RCRA facility investigation of the Low-Level Waste Treatment Facility, which do not indicate a release of RCRA-hazardous contaminants from the tanks (WVNSCO 1997a).

Underground Lines that Carried High-Activity Liquid

The assumed integrity of underground lines that carried high-activity liquid is based on factors such as:

- Construction materials that provided durability and corrosion resistance. Stainless steel piping joined by field welds was used for lines that carried high-activity liquid or chemical solutions.

- The use of double-walled pipe or stainless steel conduits that provided secondary containment for high-activity lines. The waste transfer lines that carried PUREX and THOREX waste from the Main Plant Process Building to Tank 8D-2 and Tank 8D-4, respectively, are of double wall construction. The waste transfer lines that run from the high-level waste tanks to the Vitrification Facility in the High-Level Waste Trench are also double walled. The underground lines that run from the M-8 Riser of Tank 8D-2 to the Supernatant Treatment System Building are enclosed in a 50-centimeter (20-inch) stainless steel pipe.

Any major leaks would likely have been identified at the time they occurred, based on considerations such as:

- The use of operating procedures to ensure that actual parameters associated with liquid transfers correspond with expected conditions, to help identify anomalies such as unexpected liquid losses.

- The leak detection system in the annular space between the inner and outer walls of the waste transfer piping in the High-Level Waste Transfer Trench provided added assurance that these lines did not leak, and the concrete pipe trench provided assurance that any leaks from these lines would not have reached the surrounding soil.

Other Underground Lines

The assumed integrity of other underground lines is based on similar factors, such as:

- Equipment design;
- The use of operating procedures to ensure actual parameters associated with liquid transfers correspond with expected conditions, to identify anomalies such as unexpected liquid losses;
- The results of groundwater monitoring associated with the WVDP environmental monitoring program, especially samples from nearby wells hydraulically downgradient of the lines; and
- The results of subsurface soil sample analysis associated with RCRA facility investigations.

The environmental impacts of any undetected leaks would not likely be widespread because the constant downward slope provided to promote gravity flow would minimize the volume of any leaks that may have occurred.

Conclusions

Such design features, controls, and monitoring programs provide reasonable assurance that there have been no leaks from the high-level waste tanks or from underground lines that carried high-activity liquid, and that the probability of leaks from other tanks or underground lines that have produced widespread environmental impact is low.

Most incidents at the Project Premises are typical of industrial sites and do not involve any radioactivity or radiation exposure. The following five incident descriptions are illustrative of these types of events (DOE 2002e, 2003b, 2003c, 2003d, 2004c).

- On July 8, 2004, a worker repositioning a pipe dislodged an 11-kilogram (25-pound) piece of temporary grating that fell and grazed another worker’s head. Medical examination resulted in no treatment required for this worker.
- On February 1, 2003, a large mass of ice was discovered to have fallen from a roof scupper and damaged a roof located 30 feet (9.1 meters) below. A temperature rise caused the ice mass to break free from the roof. No workers were injured as a result of this event.
- On January 30, 2003, a quality assurance inspector discovered counterfeit bolts on one ratchet lever tie-down strap that was going to be used to secure a low-level radioactive waste container to a pallet for shipping. All other bolts were inspected and found to be satisfactory, and the suspect bolt was confiscated and replaced prior to any use of the strap. No injuries resulted from this incident.
- On May 30, 2002, a 54.5-kilogram (120-pound) crane load block (hoist hook) and its 9-kilogram (20-pound) wire rope fell to a lower floor just missing a worker standing near the point of impact. Crane hoist limitations, inadequate prejob briefing, and inadequate operator training were found to be the root cause of this event. No workers were injured in this incident.
- On May 31, 2000, electricians were in the process of moving electrical conduits and receptacles with an indication that the circuit breaker feeding the affected circuit was deenergized. However, before beginning their work, the electricians noticed that pilot lights on a battery pack that was connected to the same circuit were illuminated indicating that the circuit was still energized. The cause of this

situation was found to be multiple errors in the labeling of circuits and circuit breakers. No workers were injured in this incident.

3.12 Environmental Justice

Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, directs Federal agencies to identify and address, as appropriate, disproportionately high and adverse health or environmental effects of their programs, policies, and activities on minority and low-income populations. Minority persons are those who identify themselves in the 2000 census as Hispanic or Latino, Asian, Black or African American, American Indian or Alaska Native, Native Hawaiian or Other Pacific Islander, Some Other Race, or multiracial (with at least one race designated as a minority race under Council of Environmental Quality Guidelines). Persons whose income was below the Federal poverty threshold in 2000 are designated as low-income.

Demographic information obtained from the U.S. Census Bureau was used to identify low-income and minority populations within 80 kilometers (50 miles) of the site (DOC 2008b). The 80-kilometer (50-mile) radius encompasses all or part of 10 counties in New York (Allegany, Cattaraugus, Chautauqua, Erie, Genesee, Livingston, Niagara, Orleans, Stueben, and Wyoming), 3 counties in Pennsylvania (McKean, Potter, and Warren), and 8 census subdivisions in Ontario, Canada (Dunnville, Fort Erie, Niagara Falls, Pelham, Port Colborne, Thorold, Wainfleet, and Welland).

Census data were compiled at a variety of levels corresponding to geographic areas. In order of decreasing size, the areas used are states, counties, census tracts, and block groups. A “block group” is geographically the smallest area for which the Census Bureau tabulates sample data used to identify low-income populations. For this reason block groups were used to identify minority and low-income populations that reside in the United States in this analysis. Block groups consist of all the blocks in a census tract with the same beginning number.

Minority populations are identified in block groups where either the minority population percentage of the block group is significantly greater than the minority population percentage in the general population or if the minority population of the block group exceeds 50 percent. The term “significantly” is defined by NRC guidance as 20 percentage points (69 FR 52040). The minority population percentage of New York State in 2000 was 38 percent; therefore the lower threshold of 50 percent was used in this analysis to define the term “minority population.” In the 13 U.S. counties surrounding the site, 1,505 block groups were identified to be all or partially included in the 80-kilometer (50-mile) radius. Two hundred and twenty-eight of these block groups were identified to contain minority populations. **Figure 3–32** shows the minority population distribution within an 80-kilometer (50-mile) radius within the United States. In 2001, the percentage of Canadians identifying themselves as a minority in all of the 8 Canadian census subdivisions within the 50-mile radius of West Valley is far lower than the minority population percentage in all of Ontario (20 percent) and Canada (16.1 percent). The average minority population percentage in the potentially affected areas in Canada in 2001 was approximately 4.9 percent (Census Canada 2001a).

There are four American Indian Reservations within the potentially affected area. The closest (25 kilometers [15 miles]) to WNYNSC is the Cattaraugus Reservation of the Seneca Nation of Indians, which has a minority population of 90 percent. The Allegany Reservation, which is 35 kilometers (20 miles) from WNYNSC, consists of 23 percent minorities; the Tonawanda Reservation, which is 60 kilometers (40 miles) from WNYNSC, consists of 48 percent minorities; and the Oil Springs Reservation, which is 40 kilometers (25 miles) from WNYNSC, consists of 9 percent minorities. Several other census block groups with minority populations in excess of 50 percent exist in the Buffalo metropolitan area. The total minority population within the 80-kilometer (50-miles) radial distance from the WVDP Site accounts for approximately 14 percent of the population in the area, or about 240,000 people. The racial and ethnic composition of this population is predominantly African-American and Hispanic.

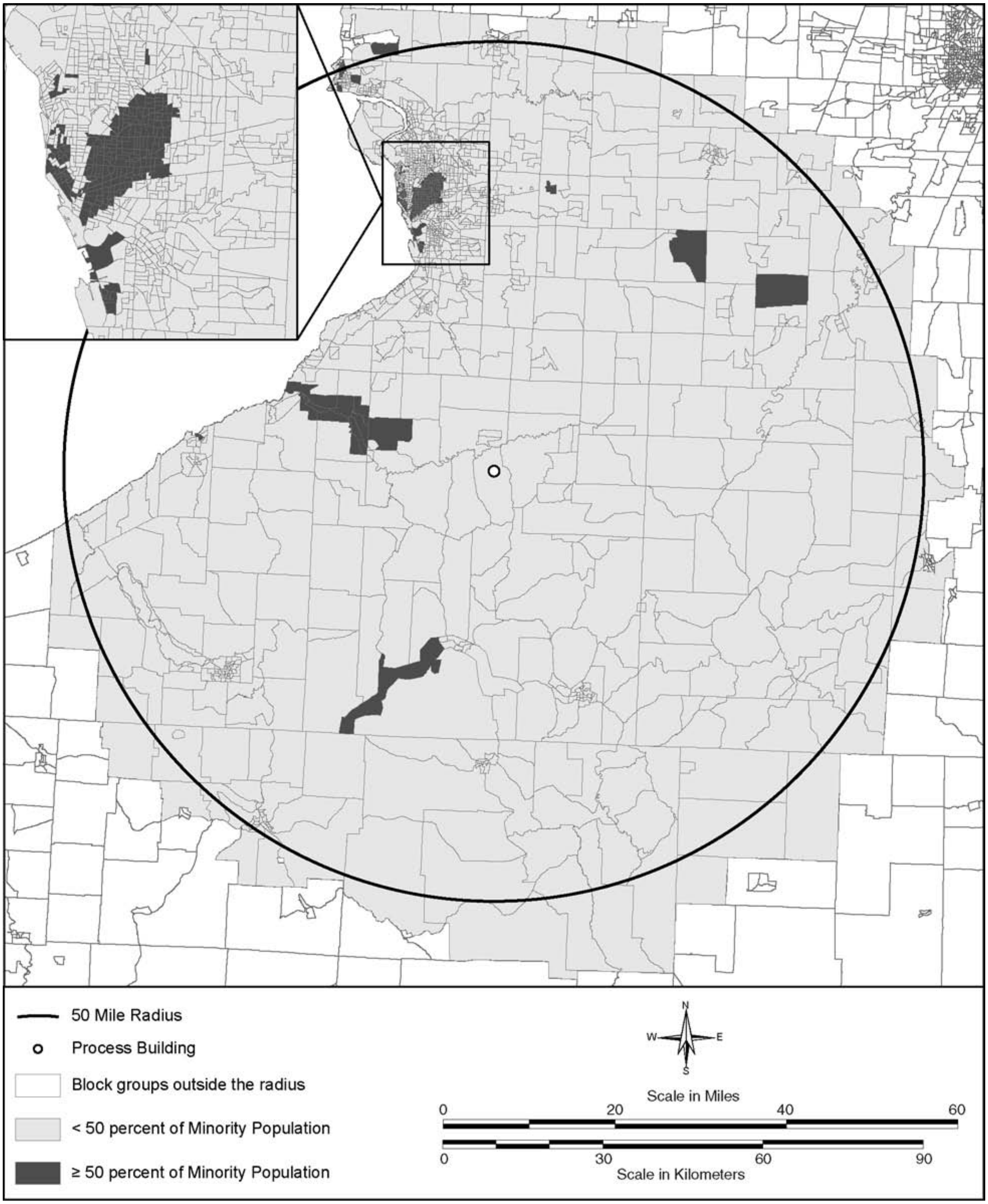


Figure 3–32 Minority Population Distribution within an 80-Kilometer (50-mile) Radius of the Site

Low-income populations in the United States are identified in block groups in the same manner as minority populations as discussed above. As shown in **Figure 3–33**, the percentage of people whose income in 1999 was below the poverty level in New York State was 14.6 percent; therefore a threshold of 34.6 percent was chosen as the criteria for identifying low-income populations. Of the 1,505 block groups in the potentially affected area, 165 were identified to contain low-income populations above the threshold. In 2001, the percentage of Canadians considered to be living in poverty in the 8 census subdivisions within the 50-mile radius of West Valley is consistent with the poverty rates for Ontario (14.2 percent) and Canada (16.2 percent) (Census Canada 2001a, 2001b; CCSD 2007). The average rate of poverty (incidence of low-income) in the potentially affected areas in Canada in 2001 was approximately 13.1 percent (Census Canada 2001b).

3.13 Waste Management and Pollution Prevention

3.13.1 Waste Management

The categories of waste that currently exist at WVDP include nonhazardous waste, hazardous waste, low-level radioactive waste, mixed low-level radioactive waste, transuranic waste, and high-level waste. These waste types are defined in Chapter 2, Section 2.1 in a text box. Further, under NRC requirements in 10 CFR 61.55, commercial low-level radioactive waste is divided into classes. Those classes are Class A, Class B, and Class C. **Table 3–19** shows the limits on concentrations of specific radioactive materials allowed in each class. Radioactive waste not meeting the criteria for these classes falls into a fourth class, known as Greater-Than-Class C.

- Class A waste is waste that is usually segregated from other waste classes at the disposal site. The physical form and characteristics of Class A waste must meet the minimum requirements set forth in 10 CFR 61.56(a). If Class A waste also meets the stability requirements set forth in 10 CFR 61.56(b), it is not necessary to segregate the waste for disposal. Low-level radioactive waste may also be categorized as low specific activity waste for the purposes of transportation analyses. Low specific activity wastes have low specific activity, are nonfissile, and meet certain regulatory exceptions and limits. Low specific activity wastes may be transported in large bulk containers.

- Class B waste is waste that must meet more rigorous requirements on waste form to ensure stability after disposal. The physical form and characteristics of Class B waste must meet both the minimum and stability requirements set forth in 10 CFR 61.56.

- Class C waste is waste that not only must meet more rigorous requirements on waste form to ensure stability but also requires additional measures at the disposal facility to protect against inadvertent intrusion. The physical form and characteristics of Class C waste must meet both the minimum and stability requirements set forth in 10 CFR 61.56.

- Greater-Than-Class C waste is waste that exceeds the low-level waste Class C criteria of 10 CFR 61.55 and are generally not acceptable for near-surface disposal. There may be some instances where Greater-Than-Class C waste would be acceptable for near-surface disposal and these instances will be evaluated on a case-by-case basis.

Vitrified high-level waste in stainless steel canisters is currently stored in the High-Level Waste Interim Storage Area. Low-level radioactive waste is stored in steel drums and boxes either outside on hardstands or inside storage structures. Hazardous and mixed low-level radioactive wastes are packaged, treated (neutralized) and disposed on site; packaged and treated on site, and disposed off site; or packaged on site, and treated and disposed off site. Mixed low-level radioactive waste not able to be treated is being stored on site pending a decision on disposition of these materials per the Federal Facility Compliance Act Consent Order and Site Treatment Plan (WVES 2007a).

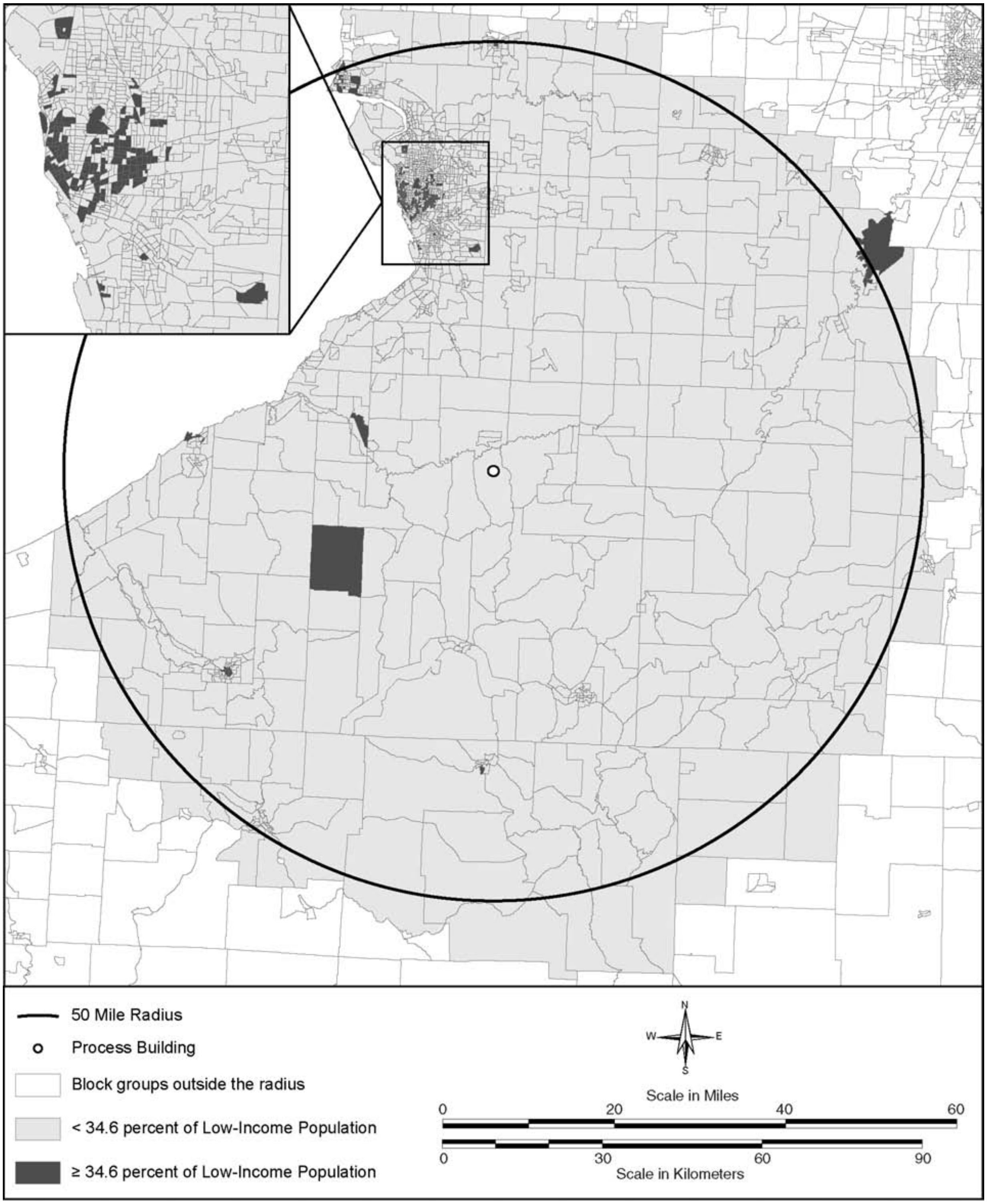


Figure 3–33 Low-Income Population Distribution within an 80-Kilometer (50-mile) Radius of the Site

Table 3–19 Nuclear Regulatory Commission Radioactive Waste Classification Criteria – Abbreviated

Radionuclide	*Class A*	*Class B*	*Class C*	*Greater-Than-Class C*
Tritium-3 (curies per cubic meter)	≤ 40	No limit	No limit	No limit
Carbon-14 (curies per cubic meter)	≤ 0.8	—	> 0.8 to 8	> 8
Cobalt-60 (curies per cubic meter)	≤ 700	No limit	No limit	No limit
Nickel-63 (curies per cubic meter)	≤ 3.5	> 3.5 to 70	> 70 to 700	> 700
Strontium-90 (curies per cubic meter)	≤ 0.04	> 0.04 to 150	> 150 to 7,000	> 7,000
Technetium-99 (curies per cubic meter)	≤ 0.3	—	> 0.3 to 3	> 3
Iodine-129 (curies per cubic meter)	≤ 0.008	—	> 0.008 to 0.08	> 0.08
Cesium-137 (curies per cubic meter)	≤ 1	> 1 to 44	> 44 to 4,600	> 4,600
Alpha emitting transuranic nuclides with half-life greater than 5 years (nanocuries per gram)	≤ 10	—	> 10 to 100	> 100
Plutonium-241 (nanocuries per gram)	≤ 350	—	> 350 to 3,500	> 3,500
Curium-242 (nanocuries per gram)	≤ 2,000	—	> 2,000 to 20,000	> 20,000

Source: 10 CFR 61.55.

The site has a radioactive waste management program that implements DOE Order 435.1. The *WVDP Waste Acceptance Manual* describes how radioactive waste is managed at the site. Hazardous wastes are managed in accordance with 6 New York Code of Rules and Regulations Parts 370 to 374 and 376. Mixed low-level radioactive waste is treated in accordance with applicable hazardous and radioactive waste requirements, and the WVDP Site Treatment Plan that contains proposed schedules for treating mixed low-level radioactive waste to meet the land disposal restrictions of the Resource Conservation and Recovery Act. Hazardous and mixed low-level radioactive waste activities are reported to NYSDEC annually in the *WVDP's Annual Hazardous Waste Report*, which specifies the quantities of waste generated, treated, and disposed of, and identifies the treatment, storage, and disposal facilities used (WVNS and URS 2005, 2007).

The wastes that are currently generated by DOE and contractor activities at WNYNSC will be phased out as these activities near completion. The *West Valley Demonstration Project Waste Management EIS* (*WVDP WMEIS*) (DOE 2003e) and *WVDP WMEIS Supplement Analysis* (DOE 2006b) were prepared to determine how DOE should disposition the operations and decontamination wastes that are in storage or will be generated over a 10-year period. DOE did not evaluate nonhazardous and hazardous waste management in the *WVDP WMEIS*. In addition, the wastes evaluated in the *WVDP WMEIS* do not include wastes generated by the alternatives evaluated in this West Valley Decommissioning EIS.

In the Record of Decision (ROD) for the *WVDP WMEIS* (70 FR 35073), DOE decided to partially implement Alternative A, the Preferred Alternative. Under Alternative A of the *WVDP WMEIS*, DOE is shipping low-level radioactive waste and mixed low-level radioactive waste off site for disposal in accordance with all applicable regulatory requirements, including permit requirements, waste acceptance criteria, and applicable DOE Orders. DOE is currently disposing of low-level radioactive waste and mixed low-level radioactive waste at commercial sites, the Nevada Test Site near Mercury, Nevada, or a combination of commercial and DOE sites, consistent with DOE's February 2000 decision regarding low-level radioactive waste and mixed low-level radioactive waste disposal (65 FR 10061). Waste handling and disposal activities at the commercial disposal site in Utah are regulated by the NRC and the State of Utah under a Radioactive Material License (UT2300249). Low-level radioactive waste and mixed low-level radioactive waste handling and disposal activities at Hanford and the Nevada Test Site are described in the *Final Waste Management Programmatic Environmental Impact Statement for Managing, Treatment, Storage, and Disposal of Radioactive and Hazardous Waste* (DOE 1997a), and the *Final EIS for the Nevada Test Site and Off-Site Locations in the State of Nevada* (DOE 1996b). Disposal of low-level radioactive waste and mixed low-level radioactive waste at Hanford is contingent upon DOE's meeting the terms of the Settlement Agreement with Washington Department of Ecology, in the case of Washington v. Bodman.

DOE has deferred a decision on the disposal of transuranic waste, pending a determination by DOE that the waste meets all statutory and regulatory requirements for disposal at the Waste Isolation Pilot Plant (WIPP). The impacts of disposal of transuranic waste at WIPP are described in the *Waste Isolation Pilot Plant Disposal Phase Final Supplemental Environmental Impact Statement* (DOE 1997b). DOE is preparing an EIS that will examine the disposal of "Greater-Than-Class C" (GTCC) low-level radioactive wastes and similar DOE waste streams for which disposal is not currently available (72 FR 40135). Because of the uncertainty in the defense determination, DOE plans to include WVDP transuranic waste in the scope of the *Disposal of Greater-Than-Class C Low-Level Radioactive Waste Environmental Impact Statement (Greater-Than-Class C EIS)*, which may later be determined to be defense related and eligible for disposal at WIPP.

Consistent with the *Waste Management Programmatic Environmental Impact Statement High-Level Waste* ROD (64 FR 46661), DOE will store canisters of vitrified high-level waste at the WVDP site until transfer for disposal in a geologic repository (assumed to be the Yucca Mountain Repository). The impacts of disposal of high-level radioactive waste at Yucca Mountain are described in the *Final Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada* (DOE 2002b), as modified by the *Supplemental Environmental Impact Statement* (DOE 2008b).

The *Environmental Assessment for the Decontamination, Demolition, and Removal of Certain Facilities at the West Valley Demonstration Project (WVDP DD&R EA)* (DOE 2006c) and FONSI (DOE 2006d) was issued and signed on September 14, 2006. The Environmental Assessment (EA) identified 36 facilities that are (or in the next 3 years will be) no longer required to safely monitor, maintain, or support future removal of vitrified high-level radioactive waste, or the closure of other onsite facilities. DOE issued a FONSI, based on the analysis contained in the EA, determining that the Proposed Action did not constitute a major Federal action significantly affecting the quality of the human environment (WVNS and URS 2007). DOE is currently in the process of decontamination, demolition, and removal of these facilities, and disposal of the resulting wastes.

Table 3–20 shows the waste volumes that need to be managed at the site. These are based on the volumes of waste that are currently in storage and projections of additional wastes that could be generated from ongoing operations and decontamination, demolition, and removal of unneeded facilities over a 10-year period. These volumes do not include wastes generated by the alternatives evaluated in this West Valley Decommissioning EIS.

The current legacy transuranic waste inventory volume is estimated at approximately 760 cubic meters (27,000 cubic feet) of contact handled waste and 1,100 cubic meters (38,000 cubic feet) of remote handled waste. In addition, another approximately 200 cubic meters (7,000 cubic feet) of contact handled transuranic waste and 85 cubic meters (3,000 cubic feet) of remote handled transuranic waste are projected to be generated during ongoing decontamination activities through the end of FY 2011 (Chamberlain 2008).

In accordance with past site practices, industrial waste is currently shipped to landfills in Model City, New York and Angelica, New York, for disposal. Hazardous waste is shipped to a landfill in Indianapolis, Indiana for disposal (DOE 2006c). Digested sludge from the site sanitary and industrial wastewater treatment facility is shipped to the Buffalo Sewer Authority for disposal (WVNS and URS 2007).

Table 3–20 10-Year Projected Waste Volumes (cubic meters) [a]

Waste Type	*WVDP Waste Minimization Plan* [b]	*WVDP WMEIS* [d]	*WVDP DD&R EA* [c]	*Total* [e]
Nonhazardous Waste	9,157	Not estimated	16,380	25,537
Hazardous Waste	4.9	Not estimated	1,994	1,999
Total Low-level Radioactive Waste	–	23,235	2,124	25,359
Class A Low-level Radioactive Waste	–	14,768	2,124	16,892
Class B Low-level Radioactive Waste	–	2,191	0	2,191
Class C Low-level Radioactive Waste	–	6,276	0	6,276
Mixed Low-level Radioactive Waste Class A	–	670	77	747
Total Transuranic Waste	–	1,388	0	1,388
Contact-handled Transuranic Waste	–	1,133	0	1,133
Remote-handled Transuranic Waste	–	255	0	255
High-level Radioactive Waste	–	275 canisters	0	275 canisters

WVDP WMEIS = West Valley Demonstration Project Waste Management EIS, WVDP DD&R EA = Environmental Assessment for the Decontamination, Demolition, and Removal of Certain Facilities at the West Valley Demonstration Project.

[a] Does not include wastes generated by the alternatives evaluated in this West Valley Decommissioning EIS.

[b] 10-year nonhazardous and hazardous waste volumes estimated using 2004 generation rates (WVNS 2004b). Converted conservatively assuming a density of 500 kilograms per cubic meter of waste.

[c] 4-year waste volumes from the *WVDP DD&R EA* (DOE 2006c).

[d] 10-year waste volumes from the *WVDP WMEIS* (DOE 2003e) and *WVDP WMEIS Supplement Analysis* (DOE 2006b).

[e] If the waste incidental to reprocessing process is not applied, approximately 310 cubic meters (11,000 cubic feet) of waste would be added to the inventory of high-level radioactive waste already stored on the site, and the amount of low-level radioactive waste and transuranic waste would be reduced by about 160 cubic meters (5,700 cubic feet) and 150 cubic meters (5,300 cubic feet), respectively.

Note: To convert cubic meters to cubic feet, multiply by 35.314.

Wastes subject to offsite disposal under the decisions made in the *WVDP WMEIS* ROD are being processed and stored in several WVDP buildings until shipped off site. Vitrified high-level radioactive waste is currently stored in the Main Plant Process Building. Low-level radioactive waste and transuranic wastes are stored in Lag Storage Areas 3, and 4 and the Chemical Process Cell Waste Storage Area. Volume reduction of oversized contaminated materials occurs in the Remote-Handled Waste Facility (DOE 2003e). As described in the *WVDP DD&R EA* (DOE 2006c), Lag Storage Area 3, and the Chemical Process Cell Waste Storage Area are scheduled for decontamination, demolition, and removal by 2010. In addition, under the Interim End State, the Main Plant Process Building and the Remote-Handled Waste Facility are scheduled to be gutted and decontaminated by 2011 (Bower 2007).

Lag Storage Areas 3 and 4: Lag Storage Area 3 and 4 are low-level radioactive waste, and mixed low-level radioactive waste RCRA interim status, storage facilities. They are twin structures located about 152 meters (500 feet) northeast of the Main Plant Process Building. Originally built in 1991 and upgraded in 1996 (Lag Storage Area 3) and 1999 (Lag Storage Area 4), these buildings provide enclosed storage space for waste containers. Lag Storage Areas 3 and 4 have operating capacities of 4,701 cubic meters (166,018 cubic feet) and 4,162 cubic meters (146,980 cubic feet), respectively (DOE 2003e). Wastes currently stored in these buildings are being removed and disposed under the ROD for the WVDP WMEIS (70 FR 35073). Lag Storage Area 3 is scheduled for decontamination, demolition, and removal by 2010 (DOE 2006c).

Located just inside and to the west of Lag Storage Area 4's south wall roll-up door is the Container Sorting and Packaging Facility. This engineered area was added in 1995 for contact sorting of previously packaged wastes. On the south side of Lag Storage Area 4, there is an enclosed shipping depot to enhance the WVDP's ability to ship wastes off site for disposal (DOE 2003e).

Chemical Process Cell Waste Storage Area: The Chemical Process Cell Waste Storage Area, about 274 meters (900 feet) northwest of the Process Building, was constructed in 1985 as a storage area primarily for radioactively contaminated equipment removed from the Chemical Process Cell. Painted carbon steel waste storage boxes of various sizes are stored within the Chemical Process Cell Waste Storage Area. These boxes, which contain contaminated vessels, equipment, and piping removed from the Chemical Process Cell, are stored in the center area of the enclosure. This center area is surrounded by hexagonal concrete shielding modules. These modules provide line-of-sight shielding around the waste boxes they encircle. Additional carbon steel waste boxes were placed on the east and west ends of the enclosure for additional shielding. This outer layer of waste boxes contains low dose low-level radioactive waste equipment and material removed from clean-up activities carried out in the Product Purification Cell and Extraction Cell 3 (DOE 2003e). Wastes currently stored in this building are being removed and disposed under the ROD for the *WVDP WMEIS* (70 FR 35073). The Chemical Process Cell Waste Storage Area is scheduled for decontamination, demolition, and removal by 2010 (DOE 2006c).

Main Plant Process Building: The Main Plant Process Building is comprised of a series of cells, aisles, and rooms constructed of reinforced concrete and concrete block. Several cells in rooms in the Main Plant Process Building were decontaminated to prepare them for reuse as interim storage space for high-level radioactive waste or as part of the Liquid Waste Treatment System. Among the areas decontaminated was the Chemical Process Cell. The Chemical Process Cell is currently used for storage of 275 canisters of high-level radioactive waste vitrified in a borosilicate glass matrix (DOE 2003e). The Main Plant Process Building is scheduled to be gutted and decontaminated by 2011 (Bower 2007).

Tank Farm: The Tank Farm includes four waste storage tanks (8D-1, 8D-2, 8D-3, and 8D-4). Built between 1963 and 1965, the waste storage tanks were originally designed to store liquid high-level radioactive waste generated during fuel reprocessing operations. The two larger tanks, 8D-1 and 8D-2, are reinforced carbon steel tanks. Each of these tanks has a storage capacity of about 2.8 million liters (750,000 gallons) and is housed within its own cylindrical concrete vault. Tank 8D-2 was used during reprocessing as the primary storage tank for high-level radioactive waste, with 8D-l as its designated spare. Both were modified by the WVDP to support high-level radioactive waste treatment and vitrification operations. The two smaller tanks are stainless steel tanks with a storage capacity of about 57,000 liters (15,000 gallons) each. A single concrete vault houses both of these tanks. Tank 8D-3, once designated as the spare for 8D-4, is currently used to store decontaminated process solutions before they are transferred to the Liquid Waste Treatment System for processing. Tank 8D-4, which was used to store liquid acidic THOREX waste generated during a single reprocessing campaign, is no longer used for vitrification. DOE manages these tanks in such a way as to minimize the risk of contamination leaching into the surrounding stream corridors (DOE 2003e).

Remote Handled Waste Facility: Wastes that have high surface radiation exposure rates or contamination levels require processing using remote-handling technologies to ensure worker safety. These remote-handled wastes are processed in the Remote-Handled Waste Facility (DOE 2003e).

The Remote-Handled Waste Facility is located in the northwest corner of the WVDP site, northwest of the STS Support Building and southwest of the Chemical Process Cell Waste Storage Area. Primary activities in the Remote-Handled Waste Facility include confinement of contamination while handling, assaying, segregating, cutting, and packaging remote-handled waste streams. Equipment in the Remote-Handled Waste Facility can cut relatively large components into pieces small enough to fit into standard types of waste containers (DOE 2003e).

The wastes to be processed in the Remote-Handled Waste Facility are in the form of tanks, pumps, piping, fabricated steel structures, light fixtures, conduits, jumpers, reinforced concrete sections, personal protective equipment, general rubble, and debris. Wastes from the Remote-Handled Waste Facility are packaged in

208-liter (55-gallon) drums and B-25 boxes (DOE 2003e). The Remote-Handled Waste Facility began operations in June 2004 (WVNS and URS 2005). The Remote-Handled Waste Facility is scheduled to be gutted and decontaminated by 2011 (Bower 2007).

3.13.2 Waste Minimization and Pollution Prevention

The site maintains a program of reducing and eliminating the amount of waste generated from site activities. Each year, waste reduction goals are set for all major waste categories and then tracked against these performance goals. The emphasis on good business practices, source reduction, and recycling minimizes the generation of low-level radioactive waste, mixed low-level radioactive waste, hazardous waste, industrial wastes, and sanitary wastes, such as paper, wood, and scrap metal. The following items were recycled during 2006 (WVNS and URS 2007):

- Office and mixed paper – 27.8 metric tons (30.6 tons),
- Corrugated cardboard – 19.6 metric tons (21.6 tons),
- Stainless steel – 27.8 metric tons (30.6 tons),
- Iron/steel – 190 metric tons metric tons (210 tons),
- Batteries – 8.1 metric tons (8.9 tons),
- Fluorescent light bulbs – 0.39 metric tons (0.43 tons), and
- Wood – 2.8 metric tons (3.1 tons).

A hazardous waste reduction plan that documents efforts to minimize the generation of hazardous waste is filed with NYSDEC every 2 years and updated annually (70 FR 35073).

The WVDP's Pollution Prevention Awareness Program is a significant part of the waste minimization program. The plan establishes the strategic framework for integrating waste minimization and pollution prevention into waste generation and reduction activities, procuring recycled products, reusing existing products, and conserving energy. A main goal of the program is to make all employees aware of the importance of pollution prevention (WVNS and URS 2007).

The WVDP is a charter member of EPA's National Environmental Performance Track program. The National Environmental Performance Track program encourages facilities with strong environmental records to go above and beyond their legal requirements by setting measurable goals to improve the quality of our nation's air, water, and land. The WVDP renewed its membership in the Performance Track program for Calendar Year 2007 through Calendar Year 2009 (WVES 2007a).