GROUNDWATER PROTECTION PROGRAM

Groundwater Monitoring Program Overview

Groundwater monitoring at the West Valley Demonstration Project (WVDP or Project) complies with all applicable state and federal regulations and meets the requirements of United States (U.S.) Department of Energy (DOE) Order 450.1. Data obtained from the program enables site managers to determine baseline groundwater conditions, facilitates early detection of existing and potential groundwater contamination sources, provides surveillance of these sources, and provides information for decision-making.

The "WVDP Groundwater Protection Management Program Plan" documents the Project's approach to the protection of groundwater from on-site activities. The WVDP's groundwater monitoring program is outlined in the "Groundwater Monitoring Plan," which discusses groundwater characterization, current groundwater sampling agenda, and compliance with long-term monitoring requirements as identified in the Resource Conservation and Recovery Act (RCRA) facility investigation (RFI) and DOE Orders.

Site groundwater is not used for drinking or operational purposes, nor is effluent discharged directly to groundwater. No public water supplies are drawn from groundwater downgradient of the site or from downstream Cattaraugus Creek. Upgradient of the site, groundwater is used for drinking water by local residents.

Surface Water Hydrology

The 167-acre (68-hectare [ha]) Project site is located within the Western New York Nuclear Service Center (WNYNSC), which comprises approximately 3,338 acres (1,351 ha) and is located near the northern border of Cattaraugus County. The WNYNSC lies within the Cattaraugus Creek watershed, which empties into Lake Erie about 27 miles (43 kilometers) southwest of Buffalo. Buttermilk Creek, a tributary of Cattaraugus Creek, drains most of the WNYNSC and all of the WVDP.

The WVDP lies within the watershed of Frank's Creek, a tributary of Buttermilk Creek, which flows along the eastern and southern boundaries of the WVDP. Quarry Creek, a tributary of Frank's Creek, flows along the northern boundary of the WVDP (Fig. A-1). Erdman Brook, another tributary of Frank's Creek, bisects the WVDP into a north and south plateau. The main plant, waste tanks, and lagoons are located on the north plateau. The drum cell, the U.S. Nuclear Regulatory Commission (NRC)-Licensed Disposal Area

(NDA), and the New York State-Licensed Disposal Area (SDA) are located on the south plateau.

Geology

The WNYNSC is situated upon a layered sequence of glacial-age sediments that fill a steep-sided bedrock valley that is composed of interbedded shales and siltstones (Rickard, 1975).

The glacial sediments overlying the bedrock consist of a sequence of three glacial tills of Lavery, Kent, and possibly Olean age. The tills are separated by stratified fluvio-lacustrine deposits (silty or silty/sandy lakebed sediments). On the Project's north plateau, the Lavery till is capped by coarse-grained alluvial-fluvial deposits (sandy/silty/gravelly streambed sediments).

Hydrogeology

The sediments above the Kent till – the Kent recessional sequence, the Lavery till, the intra-Lavery till-sand, and the alluvial sand and gravel – are generally regarded as containing all of the potential routes for contaminant migration from the Project via groundwater. (Figs. 4-1 and 4-2 show the relative locations of these sediments on the north and south plateaus.) The Lavery till, the Kent recessional sequence, and the Kent till are common to both the north and south plateaus. The bottommost layer, the Kent till, is less permeable than the other geological units and does not provide a pathway for contaminant movement from the WVDP; therefore, it is not discussed here.

Kent Recessional Sequence. The Kent recessional sequence consists of a fine-grained lacustrine unit of interbedded clay and silty clay layers locally overlain by coarse-grained sands and gravels. These deposits underlie the Lavery till beneath most of the site, pinching out along the southwestern margin of the site where the walls of the east-ward-sloping bedrock valley intersect the sequence.

Groundwater flow in the Kent recessional sequence is predominantly to the northeast, discharging to Buttermilk Creek. Mean hydraulic conductivity is 2E-01 feet (ft)/day (8E-05 centimeters [cm]/second [sec]) or 2.6 inches/day, based on recent testing. Recharge comes from the overlying Lavery till and inflow from the bedrock to the southwest.

Lavery Till. The Lavery till is predominantly an olive-gray, silty clay glacial till with scattered lenses of silt and sand. It underlies both the north and south plateaus and ranges up to 130 ft (40 meters [m]) in thickness beneath the active areas of the site, slightly increasing northeastward toward Buttermilk Creek and the center of the bedrock valley.

Groundwater flow in the unweathered Lavery till is predominantly vertically downward at a relatively slow rate. Mean hydraulic conductivity is 1E-04 ft/day (3.5E-08 cm/sec) or 0.001 inches/day, based on recent testing.

On the south plateau, the upper zone of the Lavery till is exposed at the ground surface and is weathered and fractured to a depth of 3 to 16 ft (0.9 to 4.9 m). This layer, referred to as the weathered Lavery till, is unique to the south plateau. The weathered Lavery till has been oxidized to a brown color and contains numerous desiccation cracks and root tubes.

Groundwater flow in the weathered till has both horizontal and vertical components. This enables groundwater to move laterally across the south plateau before moving downward into the unweathered Lavery till or discharging to nearby incised stream channels. Mean hydraulic conductivity is 5E-02 ft/day (2E-05 cm/sec) or 0.6 inches/day, based on recent testing. The highest

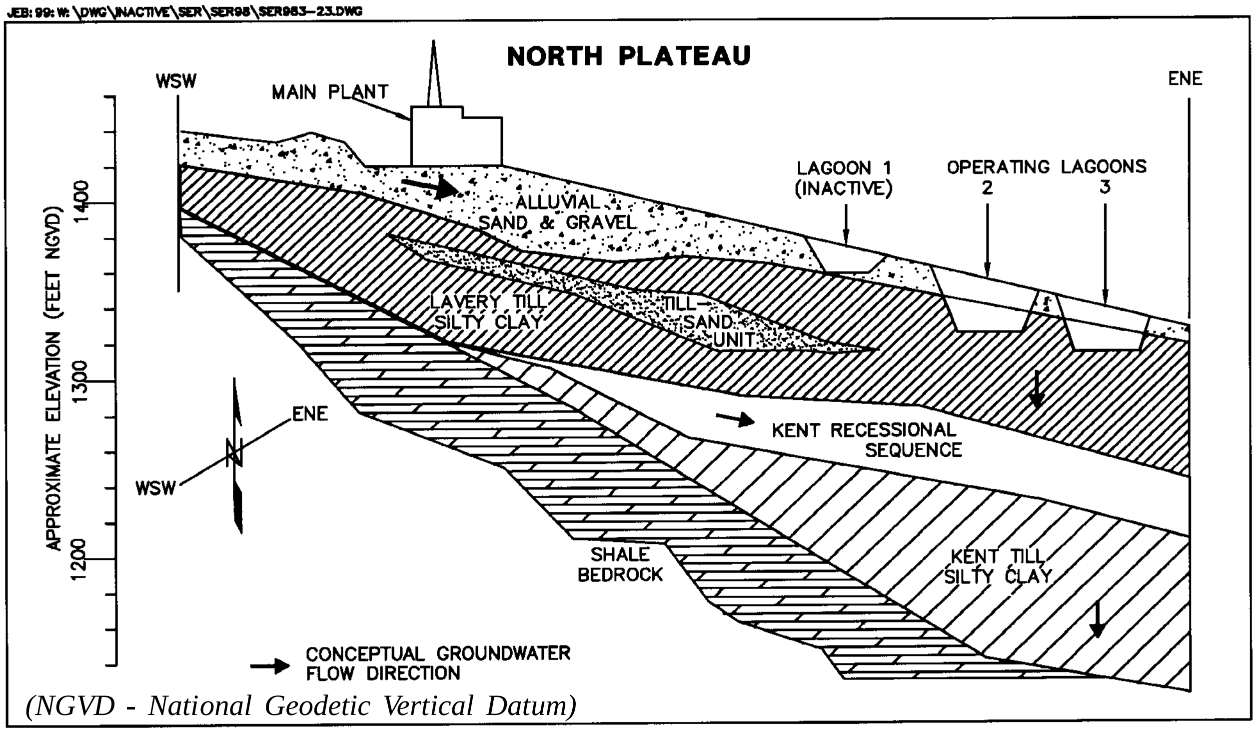

Figure 4-1. Geologic Cross Section Through the North Plateau (Vertical Exaggeration Approx. 2:1)

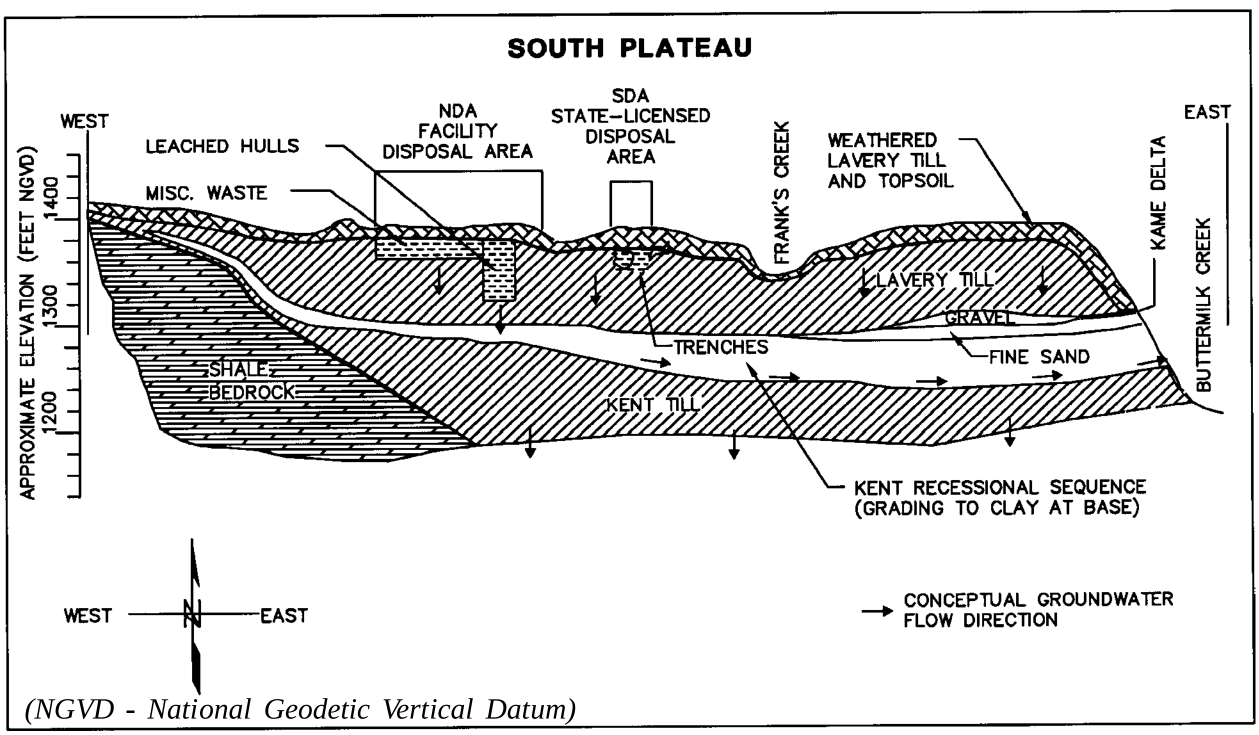

Figure 4-2. Geologic Cross Section Through the South Plateau (Vertical Exaggeration Approx. 2.5:1)

conductivities are associated with dense fracture zones found within the upper 7 ft (2 m) of the unit.

On the north plateau, the weathered till layer is much thinner or nonexistent and the unweathered Lavery till is directly overlain by the sand and gravel unit.

Sand and Gravel and Till-Sand Units. The sand and gravel unit and the Lavery till-sand are unique to the north plateau. The sand and gravel unit is a silty sand and gravel layer composed of younger Holocene alluvial deposits that overlie older Pleistocene-age glaciofluvial deposits. Together these two layers range up to 41 ft (12.5 m) in thickness near the center of the plateau and pinch out along the northern, eastern, and southern edges of the plateau, where they have been truncated by downward erosion of stream channels or depositional processes.

Groundwater in this unit generally flows northeastward across the plateau toward Frank's Creek. Groundwater near the northwestern and southeastern margins of the sand and gravel layer also flows radially outward toward Quarry Creek and Erdman Brook, respectively. There is minimal groundwater flow downward into the underlying Lavery till. Mean hydraulic conductivity is 16.4 ft/day (6E-03 cm/sec) or 200 inches/day, based on hydraulic conductivity field testing performed during the last five years.

Within the unweathered Lavery till on the north plateau is another unit, the Lavery till-sand. This thin, sandy unit of limited areal extent and variable thickness is found primarily beneath the southeastern portion of the north plateau. Groundwater flows through this unit in an east-southeast direction toward Erdman Brook, and surface seepage locations from the unit into Erdman Brook have not been observed. Mean hydraulic conductivity is 3.8 ft/day (1E-03 cm/sec) or 46 inches/day, based on hydraulic conductivity field testing performed during the last five years.

Hydrologic conditions of the site are more fully described in "Environmental Information Document, Volume III: Hydrology, Part 4" (West Valley Nuclear Services Co. [WVNSCO], March 1996) and in the "RCRA Facility Investigation Report Vol. 1: Introduction and General Site Overview" (WVNSCO and Dames & Moore, July 1997).

Routine Groundwater Monitoring Program

Groundwater is routinely monitored in the five hydrogeologic units previously described: the sand and gravel, the weathered Lavery till, the unweathered Lavery till, the Lavery till-sand, and the Kent recessional sequence. In 2005, a total of 69 on-site groundwater monitoring locations were sampled. These locations included 63 monitoring wells and well points, five groundwater seepage points, and one sump/manhole. Tables 4-1 and 4-2 provide a 2005 groundwater monitoring overview by geographic area and by monitoring purpose.

Monitoring Well Network. The majority of the routine groundwater monitoring wells were originally installed to monitor one (or more) solid waste management unit (SWMU) on the WVDP premises. (See "RCRA §3008(h) Administrative Order on Consent" [the Consent Order] in the "Environmental Compliance Summary.") Because many SWMUs are contiguous or so close together as to make their separate monitoring impractical, most SWMUs have been grouped into large units called super SWMUs (SSWMUs). The term "super SWMU" is unique to the WVDP and is not an official regulatory term. Table 4-3 describes the SSWMUs and their constituent SWMUs on site. Figures A-9 and A-10 in Appendix A show the locations of 11 of the WVDP SSWMUs.

Table 4-1
Groundwater Monitoring Overview by Geographic Area: Monitoring Year 2005

NUMBER OF…	Total WVDP	North Plateau	South Plateau	Off-site Residential
Monitoring Points Sampled - Analytical[a]	70	54	15	1
Monitoring Points - Water Elevations Only	55	39	16	0
Monitoring Events	5	4	4	1
Analyses	1,247	1,080	159	8
Results	10,767	9,546	1,203	18
Percent of Nondetectable Results	86%	87%	85%	56%
Water Elevation Measurements	464	340	124	0

[a] *Total number includes 69 on-site monitoring points and 1 off-site monitoring point.*

Table 4-2
Groundwater Monitoring Overview by Monitoring Purpose: Monitoring Year 2005

NUMBER OF…	Regulatory/ Waste Management	Environmental Surveillance
Monitoring Points Sampled - Analytical[a]	34	36
Monitoring Points - Water Elevations Only	0	55
Monitoring Events	4	5
Analyses	619	619
Results	5,490	5,277
Percent of Nondetectable Results	86%	87%
Water Elevation Measurements	128	336
Ranges of Results For Positive Detections For Organic Compounds (µg/L)		
1,1-Dichloroethane	7.0–11	NA
1,2-Dichloroethylene (total)	22–30	NA
Tributyl phosphate	2.0–360[b]	NA
Maximum Concentrations For Radiological Parameters (µCi/mL)		
Gross Beta	2.04E-04	1.16E-04
Strontium-90	8.79E-05	5.23E-05
Tritium	5.32E-06	5.01E-05

NA - Not applicable

[a] *Total number includes 69 on-site points and 1 off-site point.*

[b] *This value was the hightest of four analytical results reported at well WNW8605 during the third quarter of 2005; the value calculated and reported for well WNW8605 in Table E-9 is an average of all four results.*

Table 4-3
WVDP RCRA SSWMUs and Constituent SWMUs

SSWMU	CONSTITUENT SWMUs
SSWMU #1 – Low-Level Waste Treatment Facilities (LLWTF)	Former Lagoon 1 LLWTF Lagoons LLWTF Building Interceptors Neutralization Pit
SSWMU #2 – Miscellaneous Small Units	Sludge Ponds Solvent Dike Equalization Mixing Basin Paper Incinerator
SSWMU #3 – Liquid Waste Treatment System (LWTS)	LWTS Cement Solidification System Main Process Building (specific areas)
SSWMU #4 – High-Level Waste (HLW) Storage and Processing Area	Vitrification Facility Vitrification Test Tanks HLW Tanks Supernatant Treatment System
SSWMU #5 – Maintenance Shop Leach Field	Maintenance Shop Leach Field
SSWMU #6 – Low-Level Waste Storage Area	Lag Storage Additions 1, 2, 3, 4 Hardstands (old and new) Lag Storage
SSWMU #7 – Chemical Process Cell (CPC) Waste Storage Area	CPC Waste Storage Area
SSWMU #8 – Construction and Demolition Debris Landfill	Former Construction and Demolition Debris Landfill
SSWMU #9 – NRC-Licensed Disposal Area (NDA)	NDA Container Storage Area Trench Interceptor Project
SSWMU #10 – Integrated Radwaste Treatment System (IRTS) Drum Cell	IRTS Drum Cell
OTHER SSWMUs	
SSWMU #11 – New York State-Licensed Disposal Area (SDA)	The SDA is a closed radioactive waste landfill that is contiguous with the Project premises and is owned and managed by the New York State Energy Research and Development Authority (NYSERDA). For more information, see the NYSERDA website at www.nyserda.org.

Table E-1 lists the wells in the network, sorted by the geologic unit monitored, and the analytes measured in 2005. Note that monitoring of certain wells, marked by an asterisk, are specified in RFI reports prepared in accordance with the Consent Order for the WVDP.

Groundwater Elevation Monitoring. In addition to analytical samples, potentiometric (water level) measurements are collected from wells listed in Table E-1 in conjunction with the quarterly analytical sampling schedule (Appendix E). Groundwater elevation data are used to produce groundwater contour maps, which delineate flow directions and gradients. Long-term trend graphs are used to illustrate changes to the groundwater system, such as seasonal fluctuations. In 2005, water levels were routinely measured at 44 locations in addition to those that were sampled. (See Figures A-8 through A-10 in Appendix A.)

Surface water elevation measurements are also collected at 11 locations on the north plateau where the water table in the sand and gravel unit intersects the ground surface in the form of standing water. These measurements are correlated with groundwater elevation measurements taken at nearby monitoring wells, and are used to help define groundwater flow direction and gradients in the sand and gravel unit in areas where monitoring well coverage is sparse or nonexistent.

Analytical Trigger Level Evaluation. A computerized data-screening program uses “trigger levels” – preset conservative values for chemical and radiological concentrations and groundwater elevation measurements – to identify and promptly respond to anomalies in monitoring results. These levels, reviewed annually, are based on regulatory limits, detection limits, or statistically derived values.

Groundwater Monitoring Program Highlights 1982 Through 2005. Program content is dictated by regulatory requirements in conjunction with current operating practices and historical knowledge of previous site activities.

• Groundwater monitoring at the WVDP began in 1982 and continued to expand through 1992 with the addition of new wells, groundwater seep locations, a french drain outfall, and the NDA interceptor trench sump.

• In 1993, monitoring results indicated elevated gross beta activity in groundwater from the sand and gravel unit on the north plateau. Subsequent investigation of this area delineated a plume of contamination with a southwest to northeast orientation. (See “Special Groundwater Activities” and Figure 4-3 in this chapter for more detail.)

• An RFI expanded characterization program was conducted during 1993 and 1994 to fully assess potential releases of hazardous wastes or constituents from on-site SSWMUs. This investigation, which consisted of two rounds of sampling for a wide range of radiological and chemical parameters, provided valuable information regarding groundwater conditions near each SSWMU. Evaluation of these results influenced monitoring program modifications.

• Long-term monitoring needs were the focus of a 1995 groundwater monitoring program evaluation. After a comprehensive assessment, the number of sampling locations was reduced from 91 to 65 and analytical parameters were tailored to each sampling location for a more focused, efficient, and cost-effective program.

• In 1996, several groundwater seep monitoring locations on the northeast edge of the north plateau were added to the monitoring program and the french drain outfall was deleted for groundwater purposes. Five seep locations continue to be monitored.

• Four new groundwater monitoring wells were installed during August 2003 to provide upgradient and downgradient monitoring coverage for the remote-handled waste facility.

• Reductions in analytes or sampling frequencies were implemented at 14 monitoring locations in early 2005.

Results of Routine Groundwater Monitoring

Tables in Appendix E contain results of sampling for radiological and nonradiological analytes grouped by hydrogeologic unit. The wells in each table are arranged by hydraulic position relative to other wells within the same hydrogeologic unit. Wells identified as "UP" refer to either background wells or wells that are upgradient of other wells in the same hydrogeologic unit. Wells identified as "DOWN" are downgradient of other wells in that unit. In each table, wells are presented from upgradient to furthest downgradient. Hydraulic position provides the basis for presenting groundwater monitoring data in the tables and figures in this report. Table E-12 lists the practical quantitation limits (PQLs) for monitored organic compounds and metals. The PQL is the lowest level of an analyte that can be measured within specified limits of precision during routine laboratory operations (New York State Department of Environmental Conservation, 1991).

Sand and Gravel Unit on the North Plateau

Long-Term Trends of Gross Beta and Tritium at Selected Groundwater Monitoring Locations. Figures 4-4 through 4-7 show the trends of gross beta and tritium concentrations at selected monitoring locations in the sand and gravel unit. Using a logarithmic scale allows locations with widely differing concentrations to be plotted against average background concentrations on each graph.

Gross Beta. In 2005, 12 wells (104, 105, 111, 116, 408, 501, 502, 801, 8603, 8604, 8605, and 8609) showed gross beta concentrations that exceeded the DOE derived concentration guide (DCG) for strontium-90 (1.0E-06 microcuries/milliliter [µCi/mL]). Ten of the preceeding wells are within the groundwater plume of gross beta activity in the sand and gravel unit on the north plateau (Fig. 4-3). This area continues to be monitored closely. The source of the plume's activity can be traced to the soils beneath the southwest corner of the former process building. Lagoon 1, formerly part of the low-level waste treatment facility, has been identified as a source of the gross beta activity at the remaining wells, 8605 and 111.

• Figure 4-4 shows gross beta concentrations in wells 104, 408, 501, 502, and 8609 (that are somewhat centrally located on the north plateau and are closer to the plume's suspected source beneath the main plant). As in previous years, samples from well 408 continued to show the highest gross beta concentrations of all the wells within the north plateau gross beta plume. Except for short-term seasonal variations, gross beta results for wells 408, 501, and 502 progressively decreased from 2002 through 2005. Well 104 also showed slight decreases since 2003. Well 8609 exhibited a slight increase relative to 2004.

• Figure 4-5 shows gross beta concentrations in wells 105, 116, 801, 8603, and 8604 (that are located further downgradient from the plume's suspected source and are closer to the leading edges). Wells 105, 116, and 801 showed slight increases relative to 2004 values. Results in wells 8603 and 8604 were similar or slightly less than 2004 results. Well 105 shows the largest overall increase over the last ten years, although the rate of increase has decreased significantly.

• Figure 4-6 is a graph of gross beta concentrations at sand and gravel unit monitoring locations 111 and 8605, located near the eastern edge of the north plateau adjacent to former lagoon 1. Gross beta concentrations at wells 111 and 8605 were slightly lower in 2005 than in 2004.

Tritium. Figure 4-7 shows the tritium concentrations in wells 111, 8603, 8604, 8605, and 8609. Tritium concentrations in wells 111, 8605, and 8609 show slight decreases from 2004 to 2005. Slight increases were noted in wells 8603 and 8604 during 2005. However, all wells exhibit an overall decrease from 1996 through 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. Tritium at many of these locations is currently close to or within the background range.

North Plateau Seeps. Analytical results of sampling for radiological parameters from the sand and gravel unit seepage monitoring locations were compared with results from GSEEP, a seep monitored since 1991 that has not been affected by the gross beta plume. (Seep monitoring locations are noted on Figs. A-8 and A-9 in Appendix A. See Table E-2 for sampling results.)

Gross Beta. Radiological monitoring results continue to indicate that the gross beta groundwater plume has not migrated to these seepage areas. With the exception of SP11, gross beta concentrations from all seep monitoring locations were less than or similar to GSEEP concentrations during 2005. Gross beta concentrations at SP11 show a slightly increasing trend since early 1999 and somewhat steeper increases during 2001 through 2005. Contamination observed at SP11 is believed to be attributable to re-infiltration of contaminated water that has surfaced from the strontium-90 groundwater plume upgradient of this location. Although somewhat greater than values typically obtained at GSEEP, it is still well below the strontium-90 DCG (Table K-1).

Gross Alpha. Gross alpha concentrations at all seep sampling locations were very low – generally below the associated uncertainty or less than the detection limit.

Tritium. Tritium concentrations at the seeps remained similar to or less than concentrations at GSEEP. Tritium concentrations in the north plateau seeps, including GSEEP, are slightly higher than levels reported in background wells of the sand and gravel unit. Concentrations are similar to those seen in sand and gravel unit wells monitoring the lagoon areas of the north plateau, but are still far lower than the DCG for tritium.

Results for Volatile and Semivolatile Organic Compounds (VOCs and SVOCs). VOCs and SVOCs were sampled at specific locations (wells 8612, 8609, 803, 8605, 111, and seep sampling location SP12 [Fig. A-9 in Appendix A]) that have shown historical results above the PQLs. (See Tables E-8 and E-9 for sampling results and Table E-12 for a list of sampled analytes.) With the exception of the analytes discussed below, results are consistently nondetectable.

Total 1,2-Dichloroethylene (1,2-DCE-t). Positive detections of 1,2-DCE-t were first noticed at well 8612 in 1995. Concentrations of 1,2-DCE-t increased from 1995 through 2002, but show an overall decrease from 2002 through 2005 (Fig. 4-8).

j:\gis\aser.apr fig 4-3 gross beta plume, r5 (12/29/05) - fjc

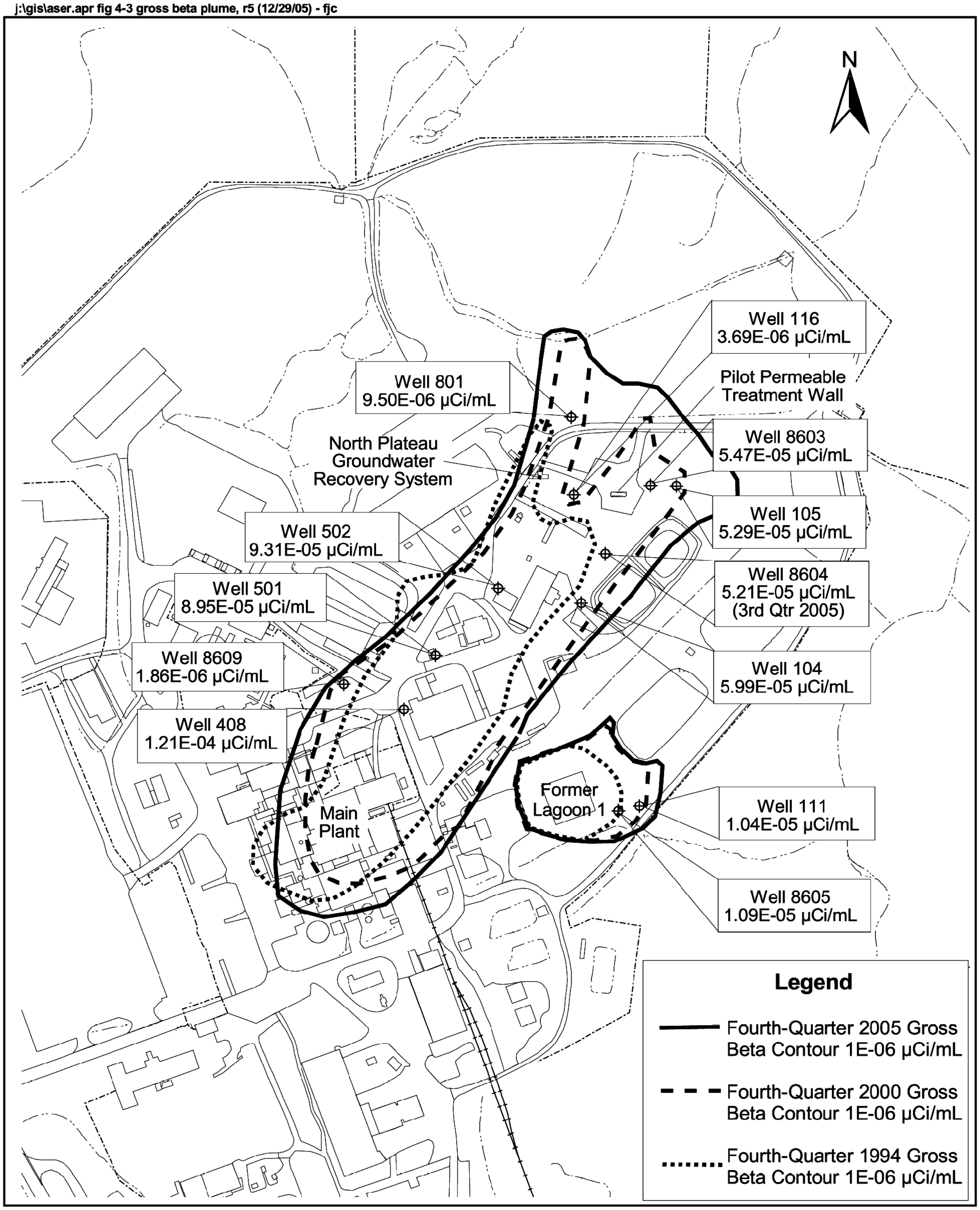

Figure 4-3. North Plateau Gross Beta Plume Area: Fourth-Quarter 2005 Results

1,1-Dichloroethane (1,1-DCA). Concentrations of 1,1-DCA at well 8612 decreased during 1995–1998, with a lower rate of decrease during 1999–2005 (Fig. 4-8). The compound was not detected at wells 8609, 803, or groundwater seep SP12 during 2005.

Dichlorodifluoromethane (DCDFMeth). DCDFMeth was detected at well 8612 during 2005 at relatively low concentrations near or below the PQL, but was not detected in wells 803, 8609, or seep monitoring location SP12.

1,1,1-Trichloroethane (1,1,1-TCA). The compound 1,1,1-TCA was detected in well 8612 during 2005 at estimated levels below the PQL, but was not detected in well 803, 8609, or in seep monitoring location SP12 (Fig. 4-8).

The VOCs 1,1-DCA, DCDFMeth, and 1,1,1-TCA are often found in combination with 1,2-DCE-t. In well 8612, each compound first exhibited an increasing trend that, after several years, was followed by a long-term decreasing trend. It is expected that 1,2-DCE-t will exhibit similar behavior, as indicated by its generally decreasing trend in recent years.

Tributyl Phosphate (TBP). Concentrations of TBP were detected in 2005 groundwater samples from well 8605, near former lagoon 1, at concentrations somewhat lower than those in 2004. TBP also was previously detected in well 111, located near well 8605, but at levels much lower than those at well 8605. TBP was detected at well 111 during 2005 at concentrations slightly below the PQL (Figure 4-9).

Ongoing detection of TBP in this localized area may be related to previously detected, positive concentrations of iodine-129 and uranium-232 in wells 111 and 8605, as noted in previous Annual Site Environmental Reports. The presence of these contaminants may reflect residual contamination from liquid waste management activities in the former lagoon 1 area during earlier nuclear fuel reprocessing.

Additional monitoring locations are sampled for VOCs and/or SVOCs because they are downgradient of locations that have shown positive results or to comply with the Consent Order. Results for these additional locations are consistently nondetectable.

Special Groundwater Activities

Gross Beta Plume on the North Plateau. Elevated gross beta activity has been detected in groundwater from the surficial sand and gravel unit in areas northeast of the building where Nuclear Fuel Services, Inc. reprocessed nuclear fuel (Fig. 4-3). In December 1993, elevated gross beta concentrations were detected in surface water at former sampling location WNDMPNE, located near the edge of the north plateau. This detection initiated a subsurface groundwater and soil investigation in 1994 using a Geoprobe® mobile sampling system to identify the location and extent of the gross beta plume beneath and downgradient of the former process building.

The highest gross beta concentrations in groundwater and soil were found near the southwest corner of the process building. Strontium-90 and its daughter product, yttrium-90, were identified as the major isotopic components of this elevated gross beta activity (WVNSCO, 1995). The gross beta activity in the area of former lagoon 1 is sourced by the lagoon's contents when it was closed. (See the discussion of tributyl phosphate in the previous section).

More attention was given in 1998 to the core area of the plume, determined to be beneath and immediately downgradient of the former process building. The 1998 study noted that, while the overall distribution of strontium-90 in groundwater within the plume was similar to 1994, concentrations detected in 1998 samples were generally lower than in 1994 samples, due to radioactive decay and continuing migration and dispersion of the plume (WVNSCO, June 1999).

North Plateau Groundwater Recovery System. In 1995, the north plateau groundwater recovery system (NPGRS) was installed to minimize the advance of the gross beta plume. The NPGRS is located near the leading edge of the western lobe of the plume where groundwater flows preferentially toward the edge of the plateau, seeps into a ditch, and flows as surface water toward monitoring location WNSWAMP. (See “Northeast Swamp Drainage Monitoring” in this chapter.) The NPGRS consists of three wells that extract contaminated groundwater, which is then treated by ion exchange to remove strontium-90. Pumping was halted at one of the three wells beginning in 2003 due to poor strontium-90 removal efficiency. Treated water is transferred to the lagoon system and is ultimately discharged to Erdman Brook.

The NPGRS operated throughout 2005, processing about 4.1 million gallons (gal) (16 million liters [L]). The system has recovered and processed approximately 43 million gal (163 million L) since November 1995.

Permeable Treatment Wall. A pilot-scale permeable treatment wall (PTW) was constructed in 1999 in the eastern lobe of the north plateau plume to test this passive, in-situ remediation technology. The PTW is a trench that is backfilled with clinoptilolite, a medium selected for its ability to adsorb strontium-90 ions from groundwater. The PTW extends vertically downward through the sand and gravel unit to the top of the underlying Lavery till and is approximately 30 ft long by 10 ft wide (9 m long by 3 m wide).

Additional test borings and monitoring well installations were completed in the vicinity of the PTW during the fall of 2001 to obtain improved definition of hydrogeologic conditions. The evaluation concluded that complex hydrogeologic conditions and disturbances from the installation are influencing groundwater flow into and around the pilot PTW. Monitoring and evaluation of water levels and radiological concentrations upgradient, within, and downgradient of the PTW continued during 2005.

Northeast Swamp Drainage Monitoring. Routine surface water sampling during 2005 continued to monitor radioactivity levels in surface water at location WNSWAMP (Appendix C-4). Gross beta and strontium-90 concentrations continued to fluctuate due to seasonal effects. Annualized average strontium-90 concentrations were relatively consistent during the first quarter of 2005, followed by steady increases through the third quarter, and slight decreases during the fourth quarter. The annualized average exceeded the DOE DCG during all of CY 2005 (Fig. 4-10). The main source of the elevated strontium-90 is seepage of groundwater affected by the north plateau plume into a ditch upstream of WNSWAMP. (See Figures 4-3 and A-2.) An estimated 36 million gallons of water flowed through this monitoring point during 2005.

The annualized average concentration of strontium-90 in surface water at sampling location WNSWAMP (on the WVDP premises) remained elevated with respect to background. Even so, monitoring downstream at the first point of public access (WFFELBR) continued to show gross beta concentrations that were only slightly higher than those at background location WFBIGBR. (See also “Northeast Swamp and North Swamp Drainage” in Chapter 2.)

South Plateau Weathered Lavery Till Monitoring at the NDA. A trench system was previously constructed along the northeast and northwest sides of the NDA to collect groundwater that may be contaminated with a mixture of n-dodecane and TBP. (See also "Environmental Program Information, Nuclear Regulatory Commission [NRC]-Licensed Disposal Area [NDA] Interceptor Trench and Pretreatment System" in Chapter 1.) Monitoring results in 2005 indicated no n-dodecane or TBP in groundwater near the NDA. 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.

WNNDATR and Well 909. Gross beta and tritium concentrations in samples from location WNNDATR, a sump at the lowest point of the interceptor trench, and from well 909 (Fig. A-8 in Appendix A), downgradient of WNNDATR, continued to be elevated with respect to background monitoring locations on the south plateau. Concentrations were still well below the DCGs.

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 ten 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.

Additional Monitoring and Investigations

Results of Radioisotopic Sampling. Groundwater samples for radioisotopic analyses are collected regularly from selected monitoring points in the sand and gravel unit and the weathered Lavery till (Table E-11). With the exception of strontium-90 concentrations from monitoring wells in the north plateau plume area and downgradient of the NDA, concentrations of radioisotopic analytes remained similar to previous historical results that typically are less than the detection limit and/or less than the uncertainty. Strontium-90 remained the major contributor to elevated gross beta activity in the north plateau plume and at the NDA, as indicated by the similarity between strontium-90 trends and gross beta trends in wells showing elevated gross beta results.

Historical monitoring results and previous special investigations have identified slightly elevated levels of carbon-14, technetium-99, and iodine-129 at a small number of monitoring locations. After accounting for strontium-90, these other radionuclides contribute very small percentages to total gross beta concentrations. Carbon-14 and technetium-99 have been detected in the sand and gravel unit at wells within the gross beta plume and downgradient of former lagoon 1. Iodine-129 has also been detected in the weathered Lavery till downgradient of the NDA. None of the carbon-14, technetium-99, or iodine-129 concentrations have been above DCGs. In general, frequent gross beta monitoring provides sufficient trend surveillance to identify any potential changes in radiological concentrations.

North Plateau Groundwater Quality Early Warning Monitoring. Early-warning monitoring of water recovered by the NPGRS is performed because this water is ultimately discharged off-site via the New York State Pollutant Discharge

Elimination System (SPDES) permitted outfall 001. Quarterly monitoring results from well 502, located directly upgradient of the NPGRS, can be used to identify metals concentrations in groundwater that may affect compliance with the SPDES permitted effluent limits. Results of sampling for metals at well 502 can be found in Table E-10.

Investigation of Chromium and Nickel in the Sand and Gravel Unit and Evaluation of Corrosion in Groundwater Monitoring Wells. A 1997 and 1998 study of the effect of modifying sampling equipment and methodology on concentrations of chromium and nickel in groundwater samples from the sand and gravel unit noted that such modifications produced decreases in these concentrations. This supported the hypothesis (which is documented in the technical literature) that elevated concentrations were not representative of actual groundwater conditions, but were caused by release of metals from subsurface corrosion of stainless steel well materials (WVNSCO and Dames & Moore, June 1998).

To ensure continued monitoring well integrity and collection of high-quality samples representative of actual groundwater conditions, wells are periodically inspected for corrosion. Approximately three-fourths of the stainless-steel wells monitoring the sand and gravel unit were internally inspected for corrosion during 2001. Wells containing corrosion were cleaned and then reinspected to verify that corrosion had been removed. Wells previously containing corrosion were inspected during late 2004 and 2005. Cleaning and reinspection are planned for 2006.

Fuel Receiving and Storage (FRS) Pool Water Infiltration. During mid-2005, water was found trickling into the empty former FRS pool during a quarterly inspection. The water is directed by a slope in the floor to the deeper stainless-steel-lined cask unloading pool (CUP), where it has accumulated to a depth of approximately four to six inches. Analytical data for the FRS CUP water indicate that groundwater is the source of the water. The strongest evidence is the similarity of strontium-90 concentrations in groundwater and those of FRS CUP water and the hydraulic setting. The elevated cesium-137 concentration in the water is not characteristic of groundwater in the vicinity of the FRS. Note that cesium-137 was not detected in Geoprobe® water samples collected just south of the FRS in 1998 and has not been detected in downgradient wells located in the main flow path of the north plateau strontium-90 plume. Therefore, the source of cesium-137 in the FRS CUP water may be residuals associated with the FRS walls. Since the water does not pose operational or safety concerns, it was left in the CUP under routine monitoring. There has been no measureable water level change since level measurement capability was established.

Off-Site Groundwater Monitoring. Groundwater is used as a potable water supply at off-site private residences near the WVDP. Nine off-site residential supply wells, located within 4.3 miles (7 km) of the facility, and one background well, located 18 mi (29 km) south of the site, are routinely sampled. Additional information is provided in "Overview of Drinking Water Monitoring" in Chapter 2.

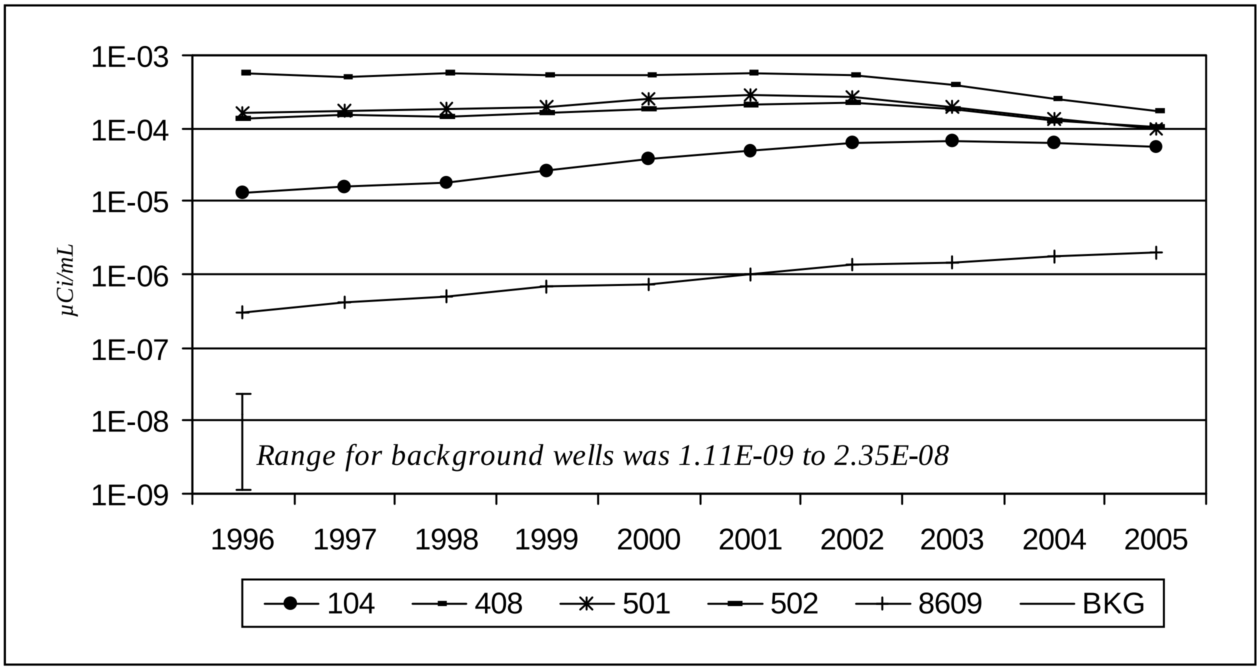

Figure 4-4. Average Annual Gross Beta Concentrations at Locations Closer to the Source of the North Plateau Plume

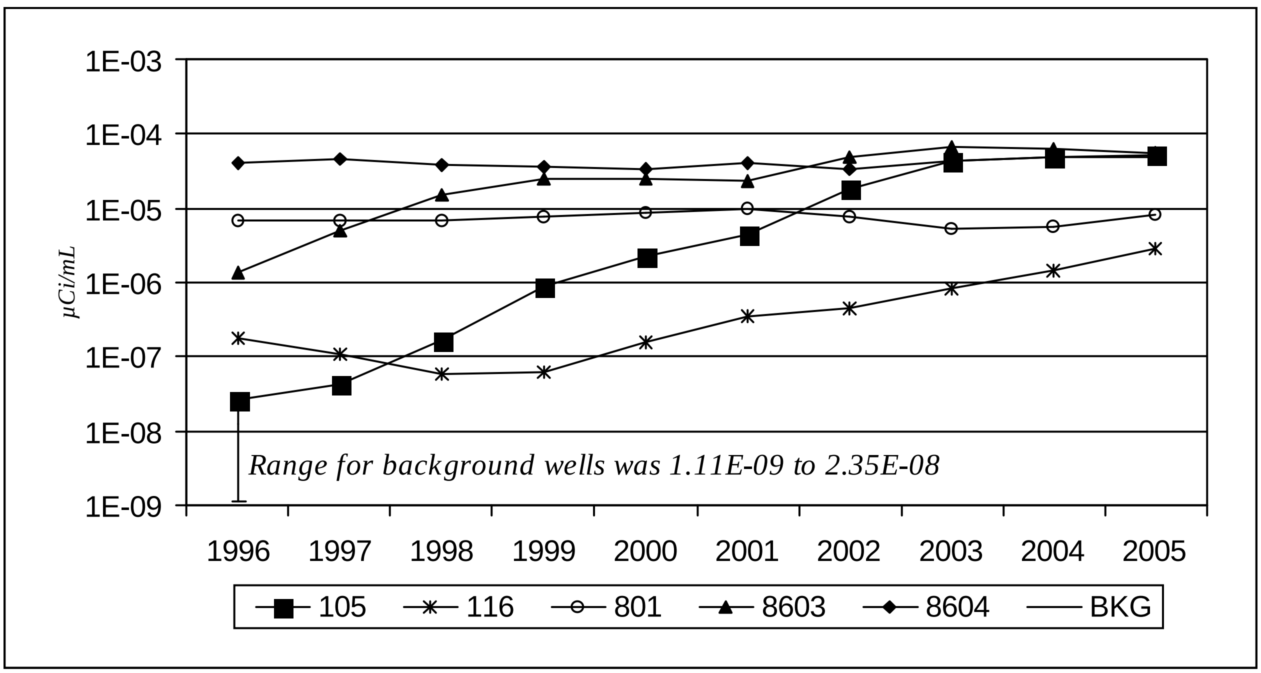

Figure 4-5. Average Annual Gross Beta Concentrations at Locations Closer to the Leading Edges of the North Plateau Plume

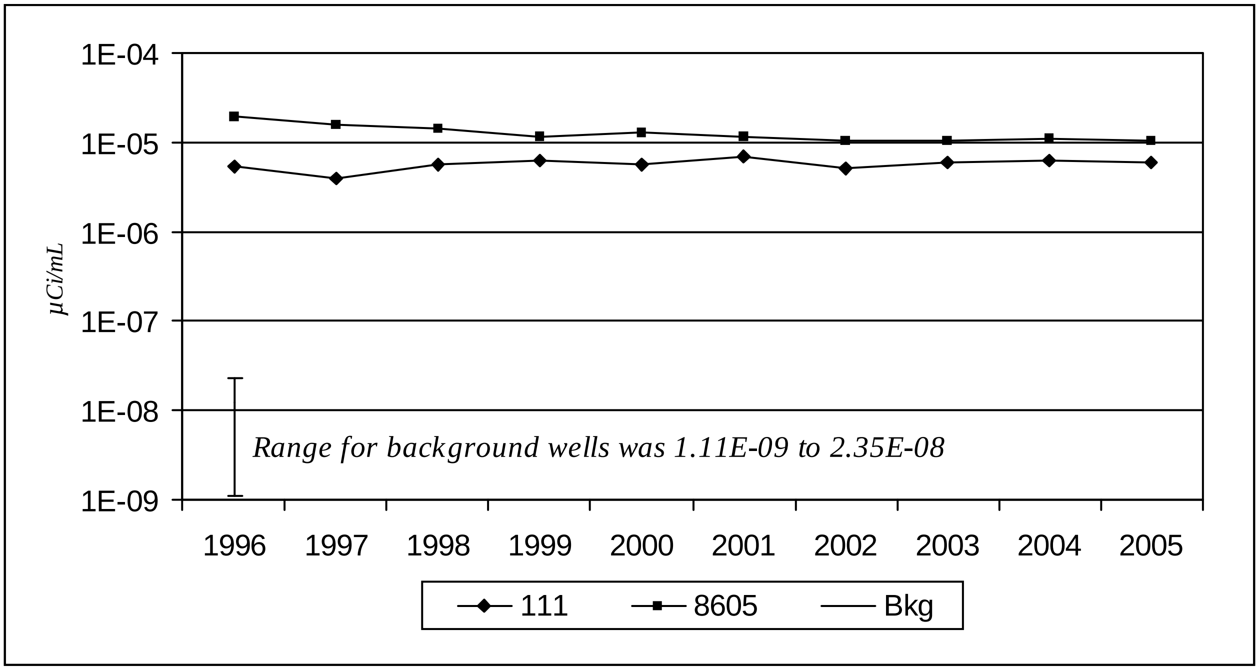

Figure 4-6. Average Annual Gross Beta Concentrations at Locations Near Former Lagoon 1

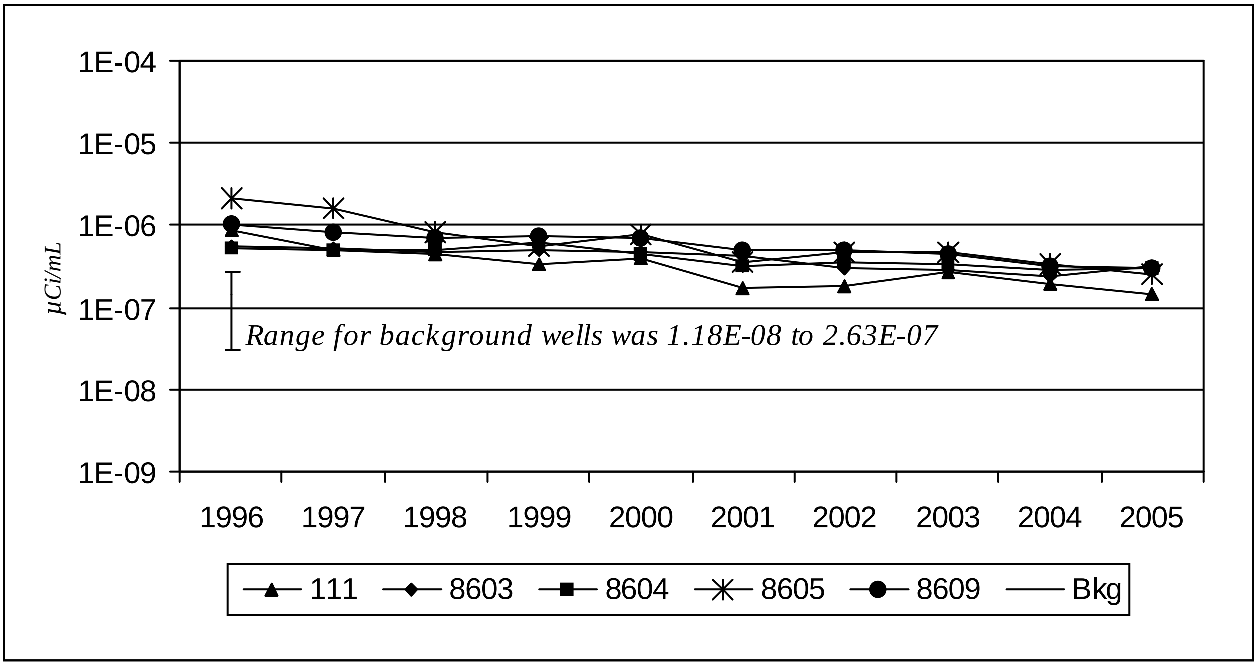

Figure 4-7. Average Annual Tritium Concentrations at Selected Locations in the Sand and Gravel Unit

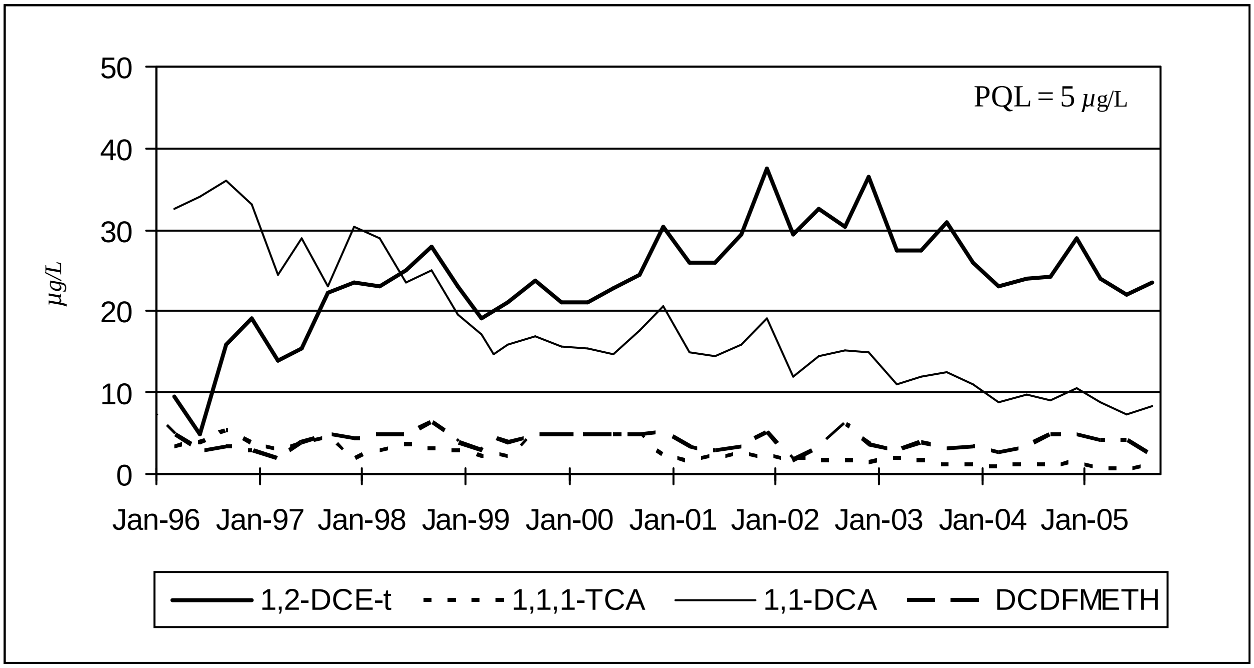

Figure 4-8. Concentrations of 1,2-DCE-t, 1,1,1-TCA, 1,1-DCA, and DCDFMeth at Well 8612 in the Sand and Gravel Unit

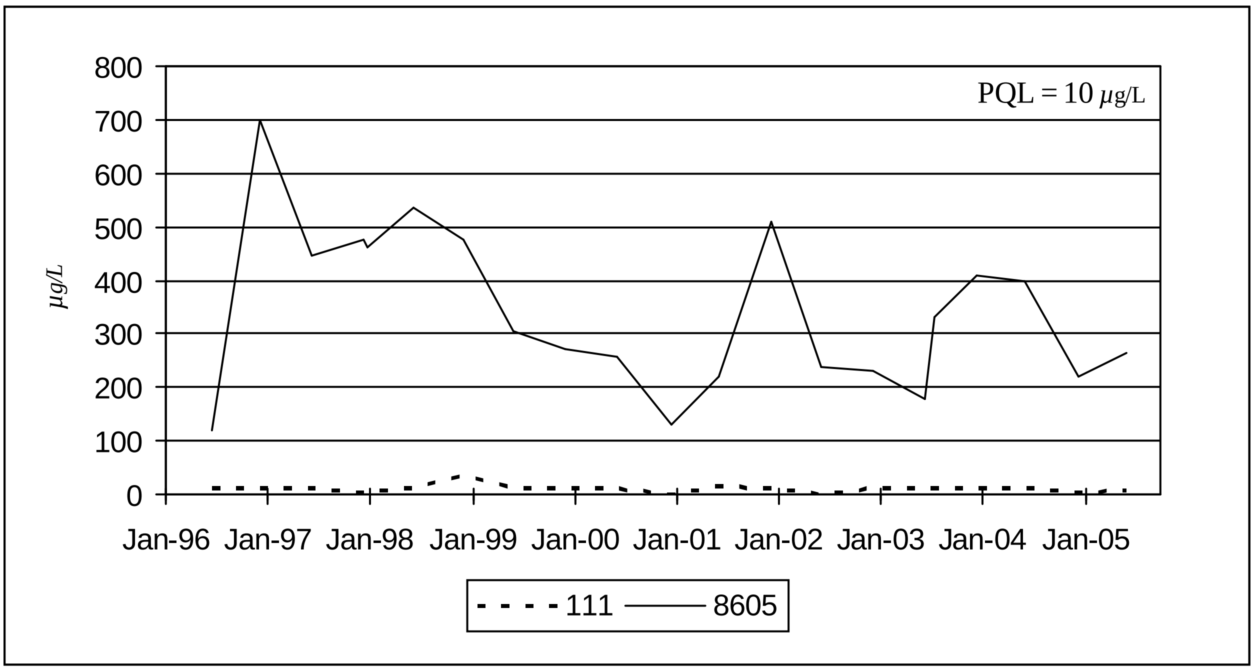

Figure 4-9. Concentrations of Tributyl Phosphate at Selected Locations in the Sand and Gravel Unit

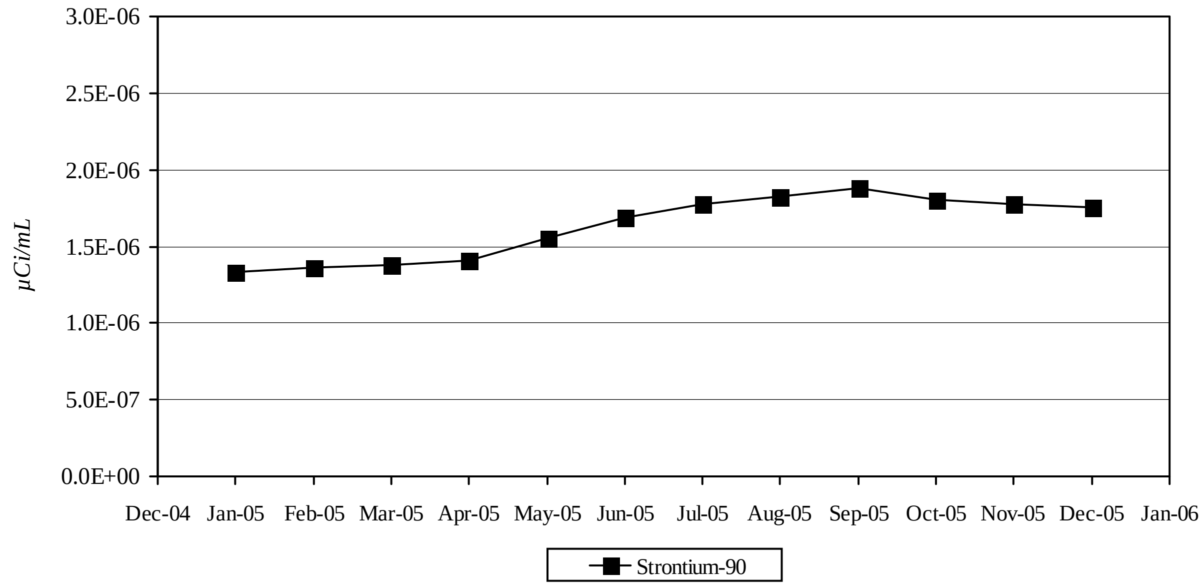

Figure 4-10. Annualized Average Strontium-90 Concentrations at WNSWAMP