GROUNDWATER MONITORING

Geology of the West Valley Site

The West Valley Demonstration Project is located on the dissected and glaciated Allegheny Plateau at the northern border of Cattaraugus County in southwestern New York. The site is underlain by a thick sequence of Holocene (recent) and Pleistocene (ice age) sediments contained in a steep-sided bedrock valley. From youngest to oldest, these unconsolidated deposits consist of alluvial and glaciofluvial silty coarse-grained deposits, found almost exclusively in the northern part of the site, and a sequence of up to three fine-grained glacial tills of Lavery, Kent, and possible Olean age, which are separated by stratified fluvio-lacustrine deposits. These are underlain by bedrock composed of upper Devonian shales and interbedded siltstones of the Canadaway and Conneaut Groups, which dip southward at about 5 m/km (Rickard 1975).

The sediments above the second (Kent) till are generally regarded as containing all of the potential routes for the migration of contaminants from the WVDP site. (See **Hydrogeology of the West Valley Site** below for a description of these units. See also Figs. 3-1 and 3-2, which show relative locations of these sediments on the north and south plateaus.)

The most widespread glacial unit in the site area is the Kent till, deposited between 15,500 and 24,000 years ago toward the end of the Wisconsinan glaciation. At that time the ancestral Buttermilk Creek Valley was covered with ice. As the glacier receded, debris trapped in the ice was left behind in the vicinity of West Valley. Meltwater, confined to the valley by the debris dam at West Valley and the ice front, formed a glacial lake that persisted until the glacier receded far enough northward to uncover older drainage ways. As the ice continued to melt, more material was released and deposited to form the recessional sequence (lacustrine and kame delta deposits) that presently overlie the Kent till. Continued recession of the glacier ultimately led to drainage of the proglacial lake and exposure of its sediments to erosion (LaFleur 1979).

About 15,000 years ago the ice began its last advance (Albanese et al. 1984). Material from this advance covered the recessional deposits with as much as 40 meters (130 ft) of glacial till. This unit, the Lavery till, is the uppermost unit throughout much of the site. The retreat of the Lavery ice left behind another proglacial lake that ultimately drained, allowing modern Buttermilk Creek to flow northward to Cattaraugus Creek. The modern Buttermilk Creek has cut the present valley since

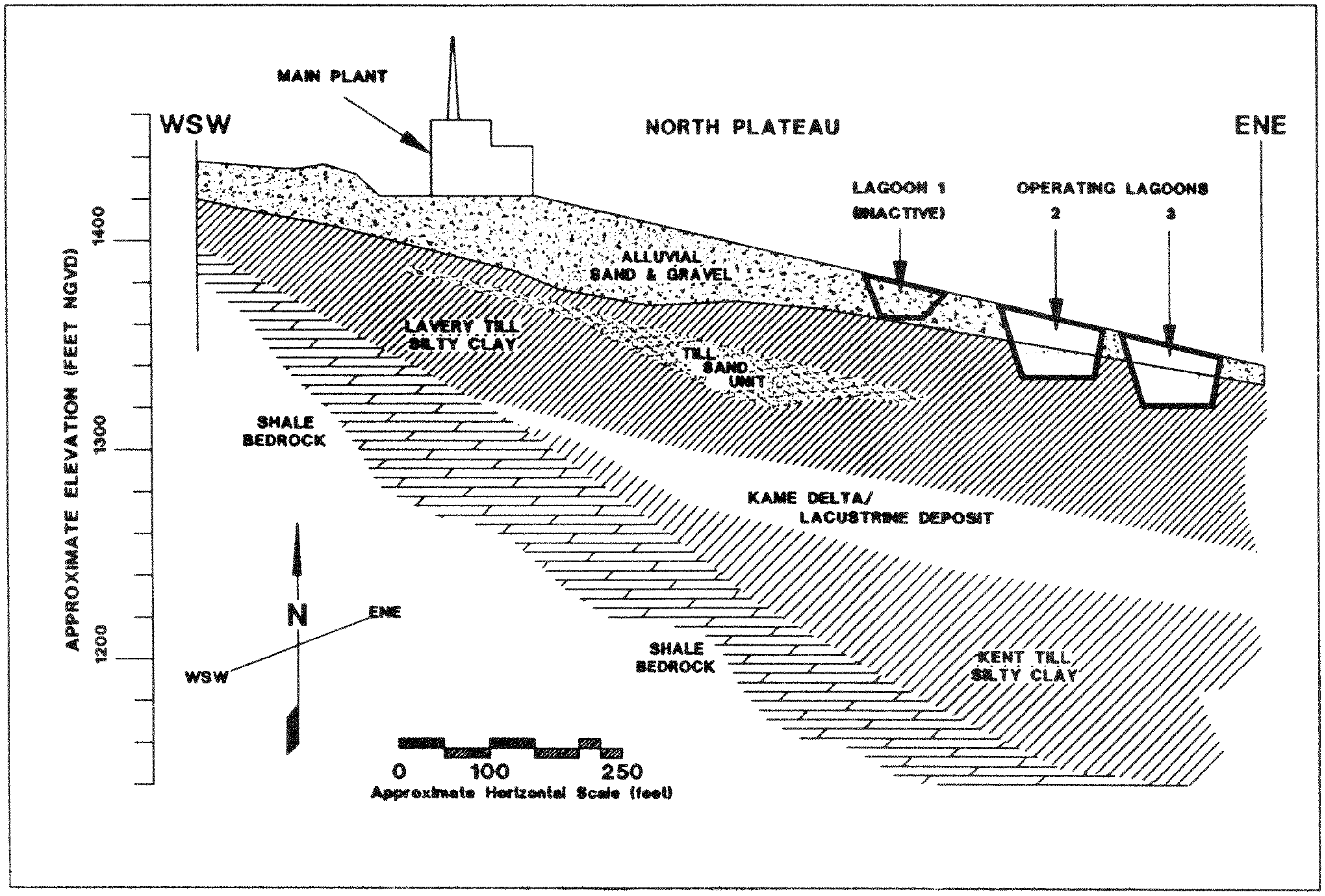


Figure 3-1. Geologic Cross Section through the North Plateau

the final retreat of the Wisconsinan glacier. Post-Lavery outwash and alluvial fans, including the fan that overlies the northern part of the WVDP, were deposited on the Lavery till between 15,000 and 14,200 years ago (LaFleur 1979).

Surface Water Hydrology

The Western New York Nuclear Service Center lies within the Cattaraugus Creek watershed, which empties into Lake Erie about 43 kilometers (27 mi) southwest of Buffalo. Buttermilk Creek, which is a tributary of Cattaraugus Creek, drains most of the WNYNSC and all of the WVDP facilities.

The WVDP site is contained within the Frank's Creek watershed; Frank's Creek is a tributary of Buttermilk Creek. The WVDP is bounded by Frank's Creek to the east and south, and Quarry Creek (a tributary of Frank's Creek) to the north. Another tributary of Frank's Creek, Erdman Brook, bisects the WVDP into a north and south plateau. (See Fig. 3-3.)

The main plant, waste tanks, and lagoons are located on the north plateau. The drum cell, the NRC-licensed disposal area (NDA), and the state-licensed disposal area (SDA) are on the south plateau.

Hydrogeology of the West Valley Site

Unweathered Lavery Till and Recessional Sequence on the North and South Plateaus

The Lavery till is predominantly an olive gray, silty clay glacial till with scattered pods or masses of silt and sand. The till ranges up to 30 meters (100 ft) in thickness beneath the active areas of the site, generally increasing towards Buttermilk Creek and the center of the bedrock valley. The Lavery till is the surficial unit on the south plateau and is the host formation for wastes buried in the SDA and NDA; on the north plateau the Lavery till is immediately overlain by the surficial sand and gravel layer. Groundwater flow in the unweathered till is predominantly vertically downward, towards the underlying recessional sequence. The hydraulic conductivity of the unweathered till ranges from 10^{-8} to 10^{-7} cm/sec (10^{-5} to 10^{-4} ft/day). Values of vertical and horizontal hydraulic conductivity obtained from laboratory analysis of undisturbed cores and field analyses of piezometer recovery data suggest that the unweathered till is essentially isotropic, i.e., it has equal flow properties in both vertical and horizontal directions.

The underlying recessional sequence, commonly called the lacustrine unit, consists of alternating deposits of lacustrine clayey silts and coarser kame delta and outwash type of sands and gravels. These deposits underlie the Lavery till beneath most of the site, pinching out along the southwestern corner where the bedrock valley intersects the sequence. Groundwater flow is predominantly to the northeast, towards Buttermilk Creek, at an estimated velocity of 13 cm/year (0.4 ft/yr). The hydraulic conductivity is approximately 10^{-6} cm/sec (10^{-3} ft/day). Recharge comes from the overlying till and the bedrock in the southwest, and discharge is to Buttermilk Creek. Underneath the recessional sequence is the less permeable Kent till.

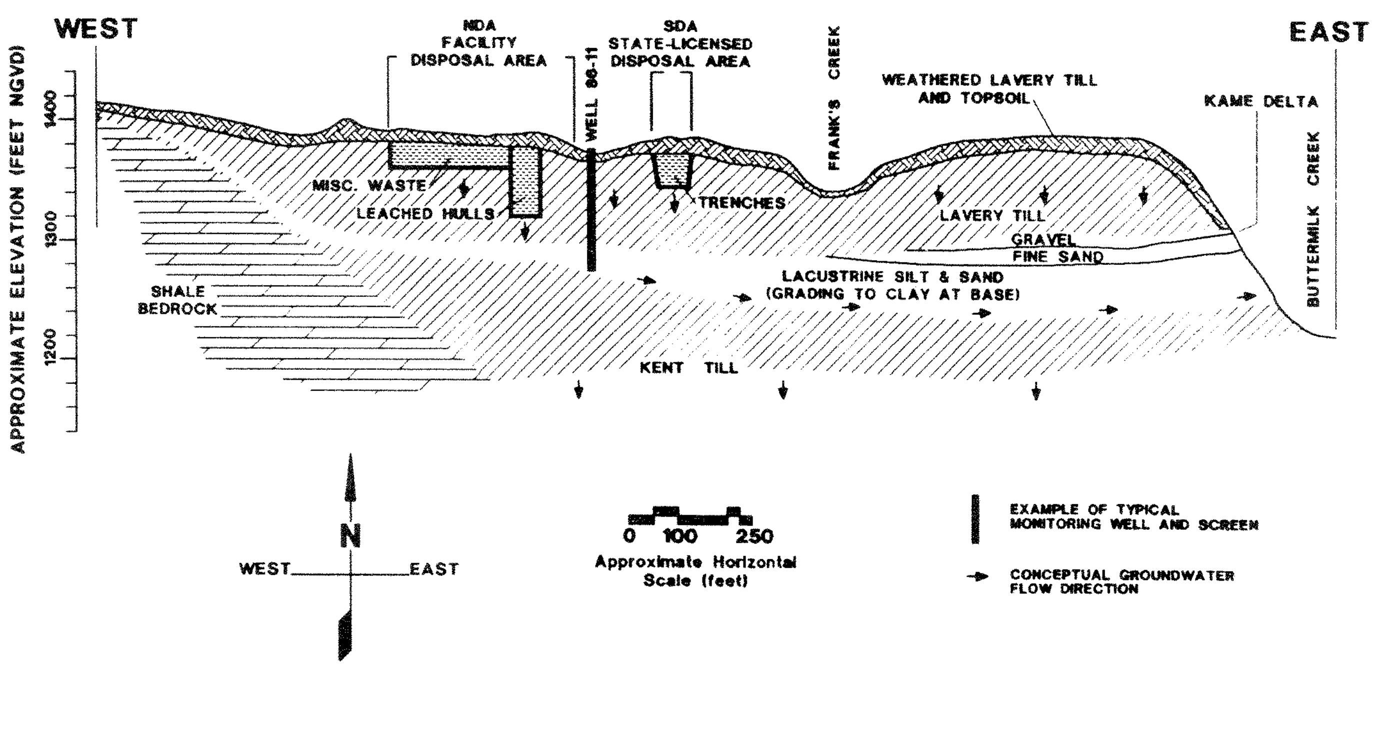


Figure 3-2. Geologic Cross Section through the South Plateau

North Plateau

Surficial Sand and Gravel Layer

The surface of the north plateau is covered by 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 12.5 meters (41 ft) in thickness near the center of the plateau and are absent along the northern, eastern, and southern edges of the plateau, where they have been removed by erosion.

Depth to groundwater within this layer varies from 0 meters to 5 meters (0 ft to 16 ft), being deepest generally beneath the central north plateau (beneath the main plant facilities) and intersecting the surface farther north towards the security fence. Groundwater in this layer generally flows across the north plateau from the southwest (near Rock Springs Road) to the northeast (towards Frank's Creek) with an average velocity of 18.6 m/yr (61 ft/yr). The mean hydraulic conductivity is 1.5×10^{-4} cm/sec (0.43 ft/day). Groundwater near the northwestern and southwestern margins of the sand and gravel layer flows radially outward toward Quarry Creek and Erdman Brook, respectively. A very small percentage of groundwater flows downward into the underlying Lavery till.

Till-Sand

On-site investigations from 1989 through 1990 have identified a sandy unit of limited areal extent and variable thickness within the Lavery till, primarily beneath the north plateau. This unit, called the till-sand, was not specifically identified in previous studies as a hydrologic unit. Groundwater flow through this unit is limited, and surface discharge locations have not been observed.

South Plateau

Weathered Lavery Till

On the south plateau, the upper portion of Lavery till exposed at the surface is referred to as the weathered till. It is physically distinct from the underlying unweathered till, as it has been oxidized to a brown color and contains numerous fractures and root tubes. The thickness of this layer generally varies from 0.9 to 4.9 meters (3 to 16 ft). On the north plateau, the weathered till layer is much thinner or nonexistent.

Groundwater that occurs in the upper 4.5 meters (15 ft) flows both horizontally and vertically. This enables the groundwater to move laterally across

Measuring a Soil Core Sample

the plateau before moving downward into the unweathered Lavery till or discharging to nearby land-surface depressions or stream channels. The hydraulic conductivity of the weathered till varies from 10^{-8} to 10^{-5} cm/sec (10^{-5} to 10^{-2} ft/day), with the highest conductivities associated with fracture zones.

Groundwater Monitoring Program Overview

An expanded groundwater monitoring program was phased in during 1991. The 105 groundwater monitoring points provided radiological and chemical surveillance of both active and inactive super solid waste management units (SSWMUs) and of general site-wide conditions. A full schedule of monitoring for all points was in effect for all of 1992. Two additional sampling points were added for the second half of the year, bringing the total to 107 monitoring points. On-site groundwater monitoring point locations are shown on Figure 3-3.

Monitoring includes the five different geologic units discussed above: the sand and gravel unit, the weathered Lavery till, the unweathered Lavery till, the till-sand unit, and the lacustrine unit. Table 3-1 lists the twelve identified super solid waste management units, the well position within the waste management unit, the geologic unit monitored, and the depth of each well. Figure 3-3 shows the outline of these twelve super solid waste management units at the West Valley Demonstration Project. (Twenty-one of the wells are in the state-licensed disposal area [SDA] and are the responsibility of the New York State Energy Research and Development Authority [NYSERDA]. Although the state-licensed disposal area is a closed radioactive waste landfill contiguous to the Project premises, the WVDP is not responsible for the facilities or activities relating to it. Under a joint agreement with NYSERDA, however, the Project provides specifically requested technical support to NYSERDA in SDA-related matters.)

Groundwater monitoring fulfills multiple technical and regulatory requirements, which are summarized in the site's ENVIRONMENTAL MONITORING PROGRAM PLAN (West Valley Nuclear Services 1992), the draft SAMPLING AND ANALYSIS PLAN FOR THE GROUNDWATER MONITORING NETWORK (West Valley Nuclear Services 1990), the annual site GROUNDWATER PROTECTION MANAGEMENT PROGRAM PLAN, (West Valley Nuclear Services 1990), and the draft RCRA FACILITY INVESTIGATION WORK PLAN (West Valley Nuclear Services 1992).

The data generated as part of the groundwater monitoring program also will be used to support preparation of an environmental impact statement (EIS) that will assess the effect of Project completion and site closure or long-term management.

Four designations are often used to indicate a well's function within a groundwater monitoring program:

Upgradient well. A well installed hydraulically upgradient of the unit under study that is capable of yielding groundwater samples that are representative of local conditions and that are not affected by the unit in question.

Downgradient well. A well installed hydraulically downgradient of the unit that is capable of detecting the migration of contaminants from the unit under study.

Background well. A well installed hydraulically upgradient of all waste management units that is capable of yielding groundwater samples that are representative of natural conditions. In some cases upgradient wells may be downgradient of other units, which makes them unsuitable for use as true background wells. However, they are still useful for providing upgradient information about the unit under study.

Crossgradient well. A well installed to the side of the major downgradient flow path.

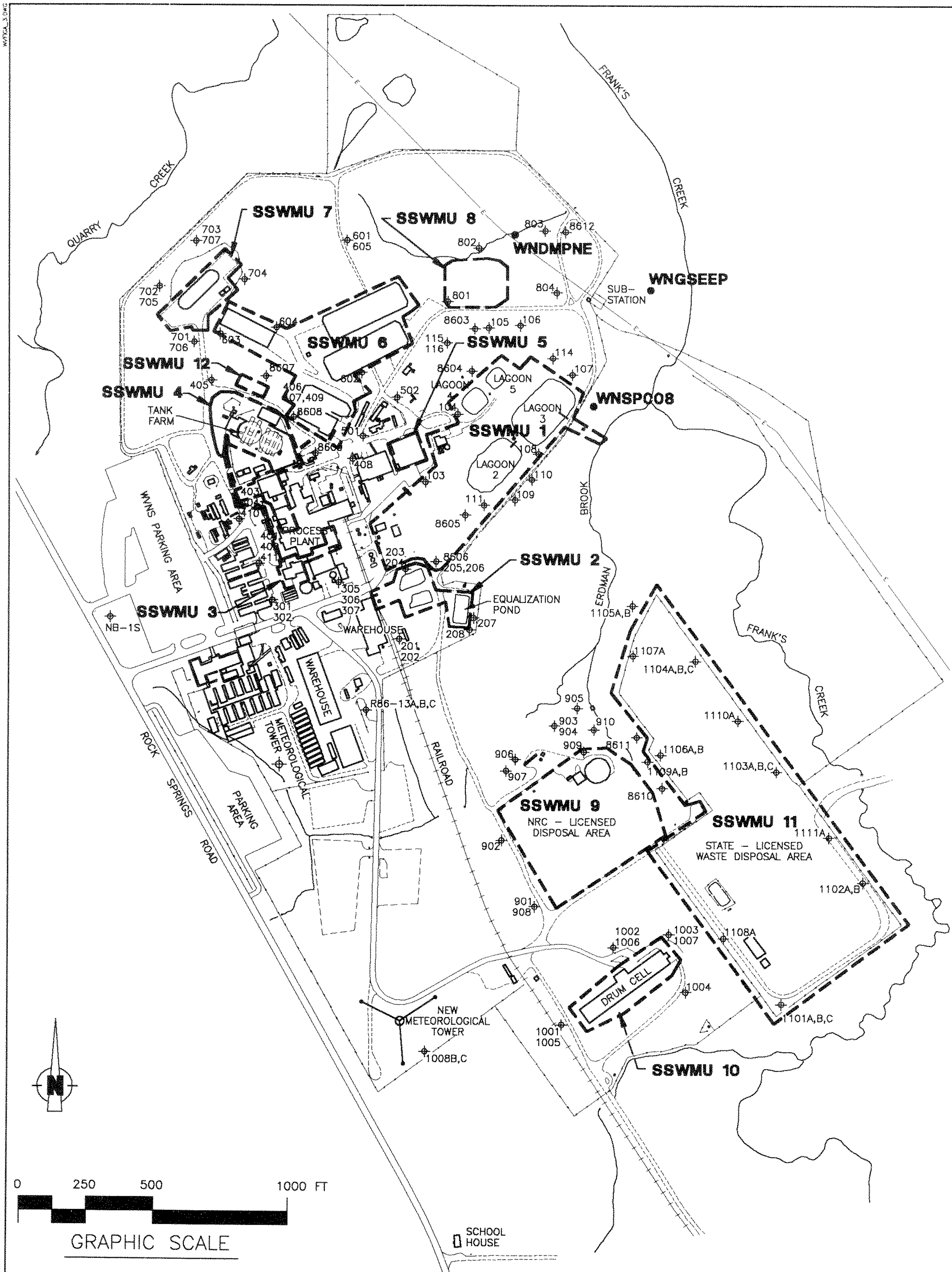


Figure 3-3. Location of On-Site Groundwater Monitoring Network Wells.

TABLE 3-1

GROUNDWATER MONITORING NETWORK: SUPER SOLID WASTE MANAGEMENT UNITS

SSWMUs and Constituent SWMUs	Well Identification Number	Geological Unit Monitored	Well Position in SSWMU	Depth (ft) Below Grade
SSWMU No. 1 - Low-Level Waste Treatment Facilities:				
	WNW0103	S	U	21.00
• Former Lagoon 1	WNW0104	S	U	23.00
• LLWTF Lagoons	WNW0105	S	D	28.00
• LLWTF Building	WNW0106	S	D	14.50
• Interceptors	WNW0107	U	D	28.00
• Neutralizer Pit	WNW0108	U	D	33.00
	WNW0109	U	D	33.00
	WNW0110	U	D	33.00
	WNW0111	S	D	11.00
	WNW0114	U	D	29.00
	WNW0115	U	D*	28.00
	WNW0116	S	D*	11.00
	WNW8603	S	D*	25.42
	WNW8604	S	C*	23.00
	WNW8605	S	D	13.00
	WNSP008	Groundwater French Drain Monitoring Point		
SSWMU No. 2 - Miscellaneous Small Units:				
	WNW0201	S	U	20.00
• Sludge Ponds	WNW0202	TS	U	38.00
• Solvent Dike	WNW0203	S	U	18.00
• Effluent Mixing Basin	WNW0204	TS	U	43.00
• Paper Incinerator	WNW0205	S	D	11.00
	WNW0206	TS	D	37.80
	WNW0207	S,[U]	D	11.00
	WNW0208	TS	D	23.00
	WNW8606	S	D	13.00
SSWMU No. 3 - Liquid Waste Treatment System:				
	WNW0301	S	U	16.00
• Liquid Waste Treatment System	WNW0302	TS	U	28.00
	WNW0305	S	D*	31.00
• Cement Solidification System	WNW0306	L	D*	81.00
• Main Process Bldg. (specific areas)	WNW0307	S	D*	16.00
• Background (North Plateau)	WNWNB1S	S,[W]	B	13.00

Key:

* Position to be further evaluated
Well position in SSWMU: U = upgradient; D = downgradient; B = background; C = crossgradient
Geologic Unit. Primary units monitored are: W = weathered till; U = unweathered till; S = sand and gravel; L = lacustrine; TS = till-sand
Units enclosed in brackets indicate the geologic unit is only a secondary monitoring unit.

TABLE 3-1 (continued)

GROUNDWATER MONITORING NETWORK: SUPER SOLID WASTE MANAGEMENT UNITS

SSWMUs and Constituent SWMUs	Well Identification Number	Geological Unit Monitored	Well Position in SSWMU	Depth (ft) Below Grade
SSWMU No. 4 - HLW Storage and Processing Area:				
	WNW0401	S,[U]	U	16.00
• Vitrification Facility	WNW0402	TS	U	29.00
• Vitrification Test Tanks	WNW0403	S	U	13.00
• HLW Tanks	WNW0404	TS	U	36.50
• Supernatant Treatment System	WNW0405	U	D	12.50
	WNW0406	S	D	16.80
	WNW0407	L,[U]	D	75.50
	WNW0408	S	D	38.00
	WNW0409	U	D	55.00
	WNW0410	L	U	78.00
	WNW0411	L,[U]	U	65.50
	WNW8607	S	D	18.75
	WNW8608	S	D	19.00
	WNW8609	S	D	25.00
SSWMU No. 5 - Maintenance Shop Leach Field:				
	WNW0501	S	U	33.00
• Maintenance Shop Leach Field	WNW0502	S	D	18.00
SSWMU No. 6 - Low-Level Waste Storage Area:				
	WNW0601	S	D	6.00
• Hardstands (Old and New)	WNW0602	S	D	13.00
• Lag Storage	WNW0603	S	U	13.00
• Lag Storage Additions	WNW0604	S	D	11.00
	WNW0605	S,[U]	D	11.00
	WNW8607	S	U	18.75
	WNW8608	S	U	19.00
SSWMU No. 7 - CPC Waste Storage Area:				
	WNW0701	TS	U	28.00
• CPC Waste Storage Area	WNW0702	U	D	38.00
	WNW0703	U	D	21.00
	WNW0704	U	D	15.50
	WNW0705	U	D	21.00
	WNW0706	S	U	11.00
	WNW0707	U,[W]	D	11.00

Key:

* Position to be further evaluated
Well position in SSWMU: U = upgradient; D = downgradient; B = background; C = crossgradient
Geologic Unit. Primary units monitored are: W = weathered till; U = unweathered till; S = sand and gravel; L = lacustrine; TS = till-sand
Units enclosed in brackets indicate the geologic unit is only a secondary monitoring unit.

TABLE 3-1 (continued)

GROUNDWATER MONITORING NETWORK: SUPER SOLID WASTE MANAGEMENT UNITS

SSWMUs and Constituent SWMUs	Well Identification Number	Geological Unit Monitored	Well Position in SSWMU	Depth (ft) Below Grade
SSWMU No. 8 - Construction and Demolition Debris Landfill:				
	WNW0801	S	U	17.50
• **Former Construction and Demolition Debris Landfill**	WNW0802	S,[U]	D	11.00
	WNW0803	S	D	18.00
	WNW0804	S	U	9.00
	WNGSEEP	Groundwater Seepage		
	WNDMPNE	Monitoring Points		
	WNW8612	S	D	18.83
SSWMU No. 9 - NRC-Licensed Disposal Area:				
	WNW0901	L,[U]	U	136.0
• **NRC-Licensed Disposal Area**	WNW0902	L,[U]	U	128.0
• **Container Storage Area**	WNW0903	L,[U]	D*	133.0
• **Trench Interceptor Project**	WNW0904	U	D	26.00
	WNW0905	TS	D	23.00
	WNW0906	W	D*	10.00
	WNW0907	W,[U]	D*	16.00
	WNW0908	W,[U]	U	21.00
	WNW0909	W,[U]	D	23.0
	WNW0910	U	D	29.6
	WNW8610	L	D	114.0
	WNW8611	L	D	120.0
SSWMU No. 10 - IRTS Drum Cell:				
	WNW1001	L,[U]	U	116.0
• **IRTS Drum Cell**	WNW1002	L,[U]	D	113.0
	WNW1003	L	D	138.0
	WNW1004	L,[U]	D	108.0
	WNW1005	W,[U]	U	19.00
	WNW1006	W,[U]	D	20.00
	WNW1007	W,[U]	D	23.00
• **Background (South Plateau)**	WNW1008B	L,[U]	B	51.00
	WNW1008C	W,[U]	B	18.00

Key:

* Position to be further evaluated
Well position in SSWMU: U = upgradient; D = downgradient; B = background; C = crossgradient
Geologic Unit. Primary units monitored are: W = weathered till; U = unweathered till; S = sand and gravel; L = lacustrine; TS = till-sand
Units enclosed in brackets indicate the geologic unit is only a secondary monitoring unit.

TABLE 3-1 (concluded)

GROUNDWATER MONITORING NETWORK: SUPER SOLID WASTE MANAGEMENT UNITS

SSWMUs and Constituent SWMUs	*Well Identification Number*	*Geological Unit Monitored*	*Well Position in SSWMU*	*Depth (ft) Below Grade*
SSWMU No. 11 - State-Licensed Disposal Area:				
	WNW1101A	*W,[U]*	*U*	*16.00*
• State-Licensed Disposal Area (SDA) [NYSERDA]	*WNW1101B*	*U*	*U*	*30.00*
	WNW1001C	*L*	*U*	*110.0*
	WNW1102A	*W,[U]*	*D*	*17.00*
	WNW1102B	*U*	*D*	*31.00*
	WNW1103A	*W,[U]*	*D*	*16.00*
	WNW1103B	*U*	*D*	*26.00*
	WNW1103C	*L*	*D*	*111.0*
	WNW1104A	*W,[U]*	*D*	*19.00*
	WNW1104B	*U*	*D*	*36.00*
	WNW1104C	*L*	*D*	*114.0*
	WNW1105A	*U*	*D*	*21.00*
	WNW1105B	*U*	*D*	*36.00*
	WNW1106A	*W,[U]*	*U*	*16.00*
	WNW1106B	*U*	*U*	*31.00*
	WNW1107A	*W,[U]*	*D*	*19.00*
	WNW1108A	*W,[U]*	*U*	*16.00*
	WNW1109A	*W,[U]*	*U*	*16.00*
	WNW1109B	*U*	*U*	*31.00*
	WNW1110A	*W,[U]*	*D*	*20.00*
	WNW1111A	*U*	*D*	*21.00*
SSWMU #12 - Hazardous Waste Storage Lockers	***(No wells installed for SSWMU #12)***			
Motor Fuel Storage Area (Monitors Underground Storage Tanks. Not a SSWMU.)	*R8613A*	*S,[U]*	*C*	*8.00*
	R8613B	*S*	*C*	*8.00*
	R8613C	*S*	*D*	*6.50*

Key:

* *Position to be further evaluated*
Well position: U = upgradient; D = downgradient; B = background; C = crossgradient
Geologic Unit. Primary units monitored are: W = weathered till; U = unweathered till; S = sand and gravel; L = lacustrine; TS = till-sand
Units enclosed in brackets indicate the geologic unit is only a secondary monitoring unit.

Table 3-1 identifies the position of a well relative to the waste management unit monitored. The wells monitoring a given geologic unit (e.g., sand and gravel, lacustrine) also may be arranged in a generalized upgradient to downgradient order based upon their location within the geologic unit. The hydraulic position of a well relative to a super solid waste management unit (SSWMU), i.e., upgradient or downgradient, does not necessarily match that same well's position within a geologic unit. For example, a well that is upgradient in relation to a SSWMU may be located at any position within a geologic unit, depending on the geographic position of the SSWMU within the geologic unit. In general, the following text and graphics refer to the hydraulic position of monitoring wells within their respective geologic units, thus providing a site-wide geologic unit perspective.

Initial sampling of selected wells in the expanded network began in 1990. All wells were gradually incorporated into the program during 1991, and the entire expanded network followed a full sampling schedule in 1992 (Table 3-2) except for the two wells that were added to the network in 1992 (WNW0909 and WNW0910).

The wells were sampled for indicator, groundwater, and drinking water parameters. The one-year planned sampling for U.S. EPA interim primary drinking water standards to establish a baseline for water quality was completed in 1992.

Groundwater Sampling Parameters

The three categories of groundwater sampling parameters, collected as noted in Table 3-3, are contamination indicator parameters, groundwater quality parameters, and EPA interim primary drinking water quality parameters. Table 3-2 indicates the sampling schedule for these parameters during 1992.

Contamination indicator parameters: Samples were collected eight times a year. Monitoring the contamination indicator parameters helps to identify more quickly any potential effect of past or present site operations.

Groundwater quality parameters: Samples were collected two times a year. The groundwater quality parameters selected provide information on the major chemical constituents of the groundwater.

EPA interim primary drinking water quality parameters: Samples were collected four times a year for one year only. These samples establish a baseline for water quality and allow comparison with the drinking water and groundwater standards.

Sampling Methodology

Samples are collected from the monitoring wells using either Teflon well bailers or bladder pumps. Both of these methods meet all regulatory requirements for groundwater sample collection.

The method of collection used depends on well construction, water depth, and the water-yielding characteristics of the well. Teflon bailers are used in wells with low standing volume; bladder pumps are used in wells with good water-yielding characteristics.

The Teflon bailer, a tube with a check valve at the bottom and the top, is lowered into the well until it reaches the desired point in the water column. The bailer is lowered slowly to ensure that the water column is not agitated and is then withdrawn from the well with a sample and emptied into a sample container. The bailer, bailer line, and bottom-emptying device used to drain the bailer are dedicated to the well, i.e., are used exclusively for that well at all times.

Bladder pumps use compressed air to gently squeeze a Teflon bladder, encased in a stainless steel tube, that is located near the bottom of the well. The air forces water out of a sample line extending from the pump to the top of the well. When the pressure is released, new groundwater flows into the bladder. A series of check valves ensures that the water flows only in one direction. The drive air is always kept

Table 3 - 2
1992 Schedule for Expanded Groundwater Monitoring Network

Date	*Sample Rep*	*Contamination Indicator Parameters Scheduled and Collected*	*Groundwater Quality Parameters Scheduled and Collected*	*Drinking Water Quality Parameters Scheduled and Collected*
1/1/92 - 2/15/92	1	F		
2/16/92 - 3/31/92	2	F		F
4/1/92 - 5/8/92	3	F		
7/10/92 - 8/15/92	4	F	F	P
11/1/92 - 11/29/92	5	F		
8/16/92 - 9/30/92	6	F		
10/1/92 - 10/31/92	7	F		
11/30/92 - 12/31/92	8	F	F	P
Total Sample Sets per Well in 1992:		**8**	**2**	**1-3**

Key:

F = All wells sampled for full parameters.

P = Project wells only were sampled for full parameters.

Table 3-3

Schedule of Groundwater Sampling and Analysis

Contamination Indicator Parameters **(Scheduled eight times per year)**	*pH** *Total Organic Carbon* † *Gross Alpha* *Gamma Scan* *Conductivity** *Total Organic Halogens* *Gross Beta* *Tritium* *Volatile Organic Analysis*
Groundwater Quality Parameters **(Scheduled two times per year)**	*Chloride* *Iron* *Sodium* *Manganese* *Phenols* *Sulfate* *Magnesium* *Nitrate + Nitrite-N* *Calcium* *Potassium* *Ammonia* *Bicarbonate/Carbonate*
EPA Interim Primary Drinking Water Quality Parameters **(Scheduled four times per year, one year only)**	*Arsenic* *Barium* *Cadmium* *Chromium* *Lead* *Mercury* *Selenium* *Silver* *Fluoride* *Endrin* *Methoxychlor* *2,4 D* *Radium* *Nitrate + Nitrite-N* *Lindane* *Toxaphene* *2,4,5 - TP (Silvex)* *Turbidity**

* *Field measurement.*
† *Includes non-purgeable organic carbon only.*

separate from the sample and is expelled to the surface by a separate line.

Bladder pumps reduce mixing and agitation of the water in the well. Each bladder pump system is dedicated to its individual well to reduce the likelihood of sample contamination from external materials or cross contamination. The compressor and air control box can be used from well to well because they do not contact the sample.

To ensure that only representative groundwater is sampled, three well volumes are removed (purged) from the well before the actual samples are collected. If three well-casing volumes cannot be removed because of limited recharge, purging the well to dryness achieves the same results. Conductivity and pH are measured before and after sampling to help determine if the quality of the groundwater changed while samples were being collected.

Immediately after the samples are collected they are put into a cooler and returned to the Project's Environmental Laboratory. The samples are then either packaged for overnight delivery to an off-site contract laboratory or put into controlled storage to await on-site testing.

Ten off-site wells, sampled for radiological parameters, pH, and conductivity, were also part of the groundwater monitoring program during 1992. These wells are used by site neighbors as sources of drinking water (Fig. 3-4).

Groundwater Monitoring Results

Results of the 1992 groundwater monitoring program are summarized below. These results reflect the first comprehensive compilation of data from the expanded groundwater program. Complete data are found in *Appendix E*.

Following last year's format, this year's results are grouped and summarized based upon the five geologic units. The purpose of grouping results based on geologic units is two-fold: it presents the results of the groundwater monitoring program on a site-wide basis, and it provides an overview of the results of the groundwater monitoring program that may form the basis for additional reports to follow. More detailed assessments of potential effects of SSWMUs on the environment will be prepared in accordance with the site's RCRA FACILITY INVESTIGATION WORK PLAN, as required by the RCRA 3008(h) Order on Consent.

There are many aspects to the successful implementation of the WVDP's groundwater monitoring program, all of which are integral to generating high quality results representative of the groundwater environment. Some of these aspects include the proper placement of groundwater monitoring wells, the use of appropriate methods to collect samples and to identify and track samples and analytical results, thorough review of analytical data and quality control information, and appropriate methods of presenting, summarizing, and evaluating the resulting data.

Presentation of Results in Tables

Appendix E contains tables showing individual results of sampling for contamination indicator parameters, (Tables E-1 through E-5), groundwater quality parameters, (Tables E-6 through E-10), and EPA interim primary drinking water quality parameters, (Table E-13 through E-17). These parameters are listed in Table 3-3.

The tables in *Appendix E* present the results of the groundwater monitoring program grouped according to the five different geologic units monitored: the sand and gravel unit, the till-sand unit, the unweathered lavery till unit, the lacustrine unit, and the weathered lavery till unit. Results of sampling for volatile organic compounds, part of the contamination indicator parameter grouping, are reported only where confirmed positive values

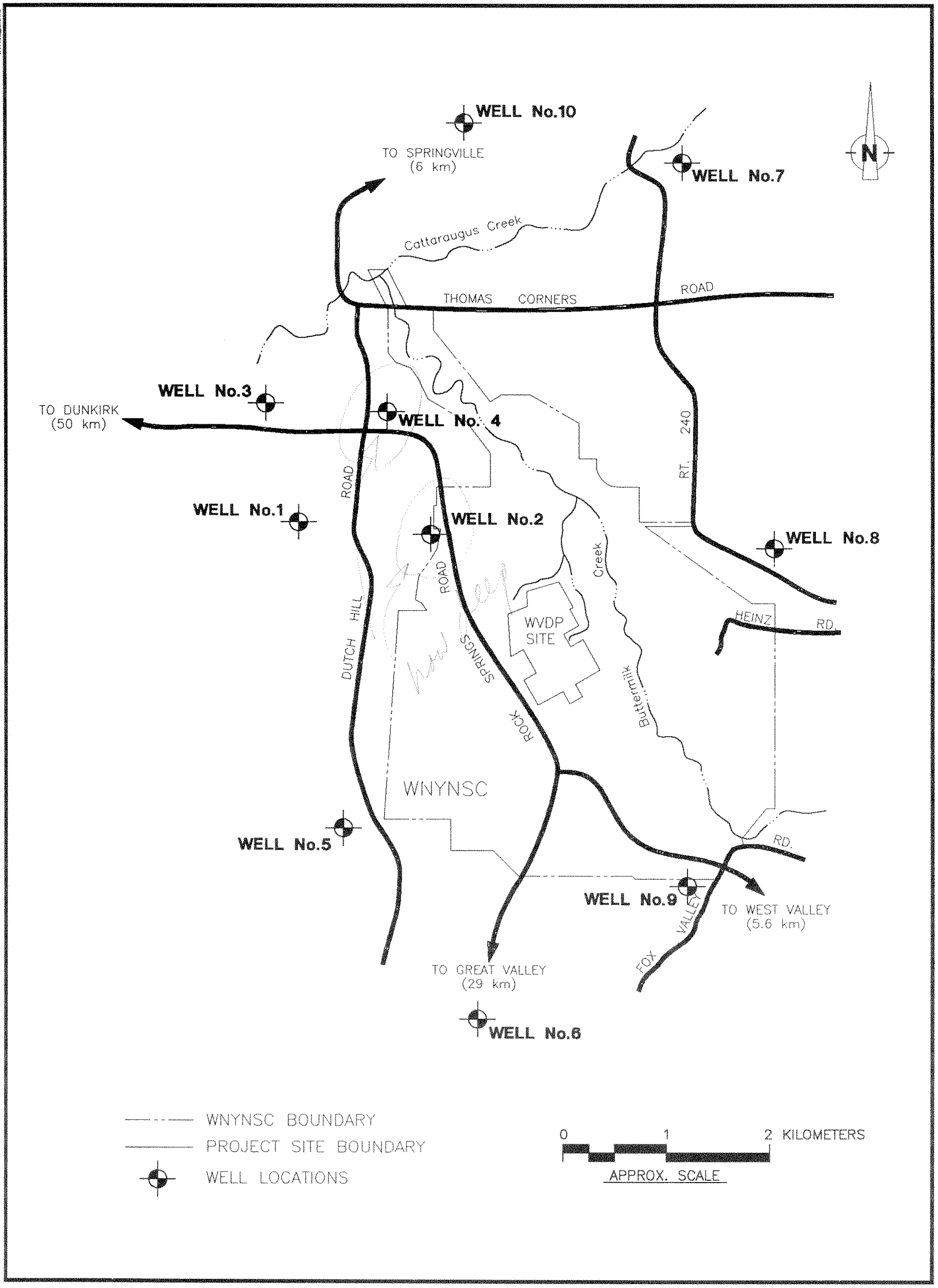


Figure 3-4. Off–Site Groundwater Monitoring Points.

were obtained. (See *Appendix E*, Table E-12, and **Results of Monitoring Site Groundwater for Volatile Organic Compounds** below.)

The tables summarizing the contamination indicator parameters also include general information about each well's hydraulic position relative to other wells within the same geologic unit. These positions are identified as "UP," which refers to either background or upgradient wells, and "DOWN - B," "DOWN - C," and "DOWN - D." Upgradient locations are designated "UP" because they are upgradient of all the other locations. Downgradient locations are designated B, C, or D to indicate their positions relative to each other. For example, wells denoted as "DOWN - C" in the sand and gravel unit are downgradient of "UP" and "DOWN - B" wells and upgradient to "DOWN - D" wells. These groupings have been used in order to provide a logical basis for presenting the groundwater monitoring data in the tables and graphics within this report.

The tables of contamination indicator data also give information about the sample collection period. The groundwater collection year is divided into two semi-annual periods. Each semi-annual period is divided into evenly spaced six-week periods, called "reps," during which each well is sampled once for the specific constituents listed on Table 3-3. The fourth sample rep, originally scheduled to start in mid-May, was collected starting in July because RCRA land disposal restrictions temporarily suspended groundwater sample collection. Consequently, five reps instead of four were taken in the second half of 1992. The sample rep indicates the constituents analyzed, not necessarily the date of the sampling. (See Table 3-2 and Table 3-3.)

Presentation of Results in Graphs

A second way in which groundwater monitoring results are presented is through graphs that show trends in the data or that summarize large amounts of data into an interpretable format. Three different graphic aids are used in this report:

Multiple Box-and-Whisker Plots: The multiple box-and-whisker plot is used to present contamination indicator data well by well for all wells grouped within the same geologic unit. All individual analytical results obtained for a selected parameter (pH, conductivity, total organic carbon, total organic halogens, gross alpha, gross beta, and tritium) were used to form the dimensions of the box-and-whisker diagram for each well within a given geologic unit. Box-and-whisker plots allow results of similar sample analyses for all wells within a geologic unit to be visually compared to each other.

Figure 3-5 is an example of a multiple box-and-whisker plot.

- The horizontal line within the box shows the median of the data set for a given well.

- The box outline itself shows the range of the middle 50% of the data for a given well (the upper and lower quartiles).

- The whisker extension shows the range of the data for a given well. (Values beyond 1.5 times the length of the box are plotted as individual points.)

The sample counting results for gross alpha, gross beta, and tritium, even if below the minimum detectable concentration, were used to generate the box-and-whisker plots. Thus, negative values were included. This is most common for the gross alpha analyses, where sample radiological counting results may be lower than the associated instrument background. In these cases, the sample results would be reported as "less than" values in the data tables in *Appendix E*.

All box-and-whisker plots shown in this section present the upgradient wells on the left side of the figure with the upgradient location code prefixed with the letter "A." Downgradient locations are plotted to the right and use the letters "B" through

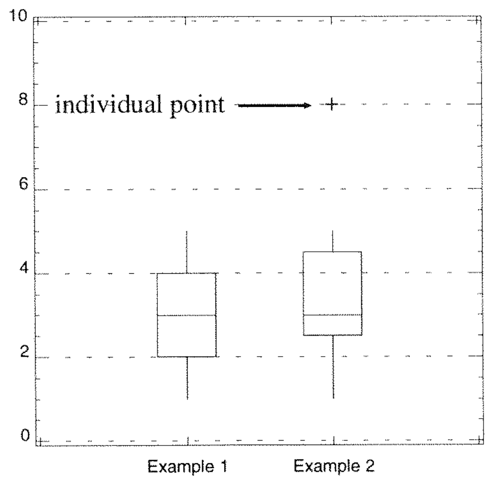


Figure 3-5. Sample Box-and-Whisker Plot

"D," as discussed above, to distinguish relative position within the downgradient flow regime. A well that plots higher in the box-and-whisker plot than the upgradient wells (for example, the well coded C0103 in Fig. 3-7 for pH) indicates that chemistry for that constituent is different than the upgradient well.

Trend Plot: Trend plots or line plots can show how concentrations of a particular parameter change over time at selected monitoring locations. Results for the volatile organic compounds 1,1-dichloroethane (1,1-DCA) and 1,1,1-trichloroethane (1,1,1-TCA) are plotted using this format. (See Fig. 3-42.) Long-term trends of gross beta and tritium for selected groundwater monitoring locations are also shown in Figures 3-43 and 3-44.

Pie Charts: Pie charts showing the major ion composition of groundwater for each well are found in *Appendix E.* These charts were constructed using averaged results of two samples collected for the major cations (calcium, magnesium, sodium, and potassium) and anions (chloride, sulfate, bicarbonate and carbonate and, in some cases, hydroxide). The pie charts also indicate how the levels of cations and anions in the sample balance. Figure 3-6 is an example of a pie chart.

Results of Contamination Indicator Monitoring of the Sand and Gravel Unit

Figures 3-7 through 3-13a show box-and-whisker plots for selected contamination indicator parameters for forty-four wells monitoring the sand and gravel unit of the north plateau of the WVDP. Background site conditions are monitored

- Percentage composition for cations is shown in the upper half of the circle
- Percentage composition for anions is shown in the lower half of the circle
- Difference between the radii of the two circles indicates the measured cation and anion balance expressed in meq/L

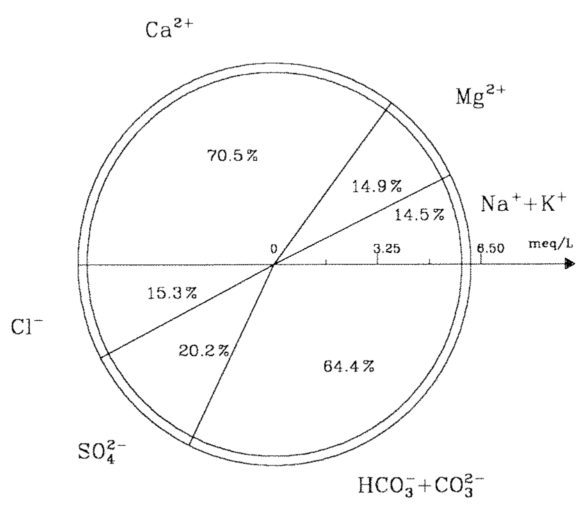


Figure 3-6. Sample Pie Chart

by well WNWNB1S (coded ANB1S on the box-and-whisker plots), and upgradient monitoring is provided by wells WNW0301, WNW0401, and WNW0403 (coded A0301, A0401, and A0403, respectively, in the figures). These four wells are shown in the first four positions on the left of the box-and-whisker charts. Tabular contamination indicator data are presented in *Appendix E*, Table E-1.

Downgradient conditions are monitored at forty locations within the sand and gravel unit. These locations are subdivided into three categories according to the well's general position within the groundwater flow regime. For example, downgradient wells prefixed with "B" in the figures are nearest to the background or upgradient wells (prefixed "A"), while wells prefixed with a "D" are farthest downgradient.

Wells monitoring downgradient conditions in the sand and gravel unit are part of the monitoring network for eight of the identified on-site SSWMUs and for the motor fuel storage area. The SSWMUs monitored by wells in the sand and gravel unit are: SSWMU #1 — the low-level waste treatment facility, SSWMU #2 — miscellaneous small units, SSWMU #3 — the liquid waste treatment system, SSWMU #4 — the high-level waste storage and processing area, SSWMU #5 — the maintenance shop leach fields, SSWMU #6 — the low-level waste storage area, SSWMU #7 — the chemical process cell waste storage area, and SSWMU #8 — the construction and demolition debris landfill. (See Table 3-1, which identifies the SSWMUs and associated individual SWMUs, the geologic unit monitored, and the depth of each well.)

The box-and-whisker plots for the sand and gravel geologic unit show elevated levels of pH at well WNW0103 (coded C0103 in the box-and-whisker plots) and elevated levels of conductivity in wells WNW0103, WNW0205, and WNW8606. Well WNW0103 is part of the monitoring network for the low-level waste treatment facility (SSWMU #1) and is located in the vicinity of a spill of caustic sodium hydroxide that occurred in 1984. Results of groundwater quality analyses of WNW0103 water indicate that elevated levels of sodium and hydroxide have contributed to these elevated levels of conductivity. The levels of pH, the conductivity, and concentrations of associated anions and cations have declined during monitoring performed during 1992 at this location. Wells WNW0205 and WNW8606 are next to each other and monitor groundwater downgradient of the sludge ponds in SSWMU #2. Elevated conductivity values at these locations may be attributed primarily to elevated levels of sodium and chloride. This is shown in the groundwater quality pie plots of major cations and anions in *Appendix E*, Figure E-1 for these two wells. The pH levels for all other sand and gravel wells appear to rest within a normal environmental range.

Figures 3-9 and 3-10 show the box-and-whisker plots for total organic carbon (TOC) and total organic halogens (TOX). Wells WNW0111 and WNW8605 are both near former lagoon 1 in SSWMU #1 and show similarly elevated levels of both TOC and TOX. Wells WNW0205 and WNW8606 are located next to each other in SSWMU #2 and also show very similar levels of TOC and TOX. Well WNW0103 also exhibits an elevated level of TOC. The box-and-whisker plots show fairly tight ranges, as indicated by the relatively small sizes of the central box for most of the remaining sand and gravel wells.

Results of radiological analysis of samples collected from wells monitoring the sand and gravel unit indicate various levels of tritium and gross beta activity across the unit. Results of gross alpha activity are mostly below minimum detectable concentrations except at location WNW8605, which shows seven out of eight of the analyses as positive results, and well WNW0111, which shows four out of eight of the analyses as positive results. This is indicated in Figure 3-11. Gross alpha results at these locations near former lagoon 1 are only marginally above the minimum detectable concentration.

Gross beta results are shown in Figures 3-12, 3-12a, and 3-12b. Three figures are presented to allow for adequate scaling of the y-axis. Figure 3-12 shows results for wells with the highest gross beta concentrations. The wells clearly visible on this figure, WNW0408, WNW0501, WNW0502, and WNW8605, exhibit the highest levels of gross beta activity in on-site groundwater and are very similar to results reported last year for these locations. Trends of gross beta activity for these and other selected groundwater locations are shown in Figures 3-43 and 3-43a.

Sampling with a Dedicated Bladder Pump

Figure 3-12a and 3-12b show gross beta results for the remainder of the sand and gravel wells. Background well WNWNB1S had an average gross beta concentration of 3.17E-09 µCi/mL for 1992. This compares to an average concentration of 2.32E-04 µCi/mL at well WNW0408, which had the highest level of gross beta activity. This represents an approximate 75,000-fold difference in concentration between background and this downgradient location. The available trend data for the background well WNWNB1S is included in Figure 3-43a to allow comparison to downgradient trend data.

Well WNW0408 also showed the highest level of tritium activity for the sand and gravel unit. The concentration observed during 1992 averaged 1.97E-05 µCi/mL. This compares to an average of 1.0E-07 µCi/mL for background well WNWNB1S, representing approximately a 200-fold difference in concentration between these two locations. Results for tritium monitoring of wells within the sand and gravel unit are presented in Figures 3-13 and 3-13a. Two figures are presented to show adequate scaling of the y-axis. These two figures indicate that many of the wells in the sand and gravel unit show tritium concentrations above those observed at background or upgradient locations.

The New York State groundwater quality standard (applicable to water used for drinking) for gross beta activity (1E-6 µCi/mL) was exceeded at wells WNW0408, WNW0501, WNW0502, WNW8605, WNW0111, WNW0104, and WNW8604. The New York State quality standard for tritium (2E-5µCi/mL) was exceeded only at well location WNW0408.

Monitoring of the wells in the sand and gravel geologic unit indicates some measurable effects on groundwater, primarily in areas associated with and downgradient of the main plant facility and the low-level waste treatment facility. These locations are near the central buildings on-site where various operations historically associated with fuel reprocessing have occurred. There is no indication that the groundwater from these areas affects human health or the environment because this water is not used for drinking or general facility needs. In addition, the surface water leaving the site, which includes groundwater flow from this surficial sand and gravel unit, meets the appropriate standards.

Comparisons made to both upgradient groundwater monitoring results and groundwater quality standards indicate differences that imply effects on groundwater. Identification, continued monitoring, and follow-up evaluation of these localized areas will provide the information necessary for either near-term response or eventual facility closure.

Using data obtained during the first two years of the current groundwater monitoring program, the Project is currently evaluating this program to focus on those areas of more immediate concern. Continued development of the groundwater monitoring program in this direction will ensure that adequate information is available to continue to ensure the safety of the public and the environment.

Results of Contamination Indicator Monitoring of the Till-Sand Unit

Nine wells monitor groundwater in the till-sand unit. As noted in the discussion on hydrogeology, the till-sand unit, located within the Lavery till, is limited in extent and thickness. General upgradient conditions are monitored by wells WNW0302, WNW0402, and WNW0404. Wells WNW0202, WNW0204, WNW0206, WNW0208, WNW0701, and WNW0905 monitor general downgradient conditions. Well WNW0905 may be reclassified in a different unit; this reclassification is currently being evaluated.

Figures 3-14 through 3-20 show the box-and-whisker plots for selected contamination indicator parameters for the till-sand unit. Tabular data for contamination indicator parameters for these wells are presented in *Appendix E*, Table E-2. Well WNW0202, which is 38 feet below grade, continues to show elevated levels of pH. This elevated pH condition indicates the presence of measurable hydroxide alkalinity. As indicated by conductivity measurements, the overall ion content of groundwater at WNW0202 is much lower than WNW0103, which also shows elevated levels of pH due to hydroxide. There is no clear connection between the elevated pH values observed at these two groundwater monitoring locations.

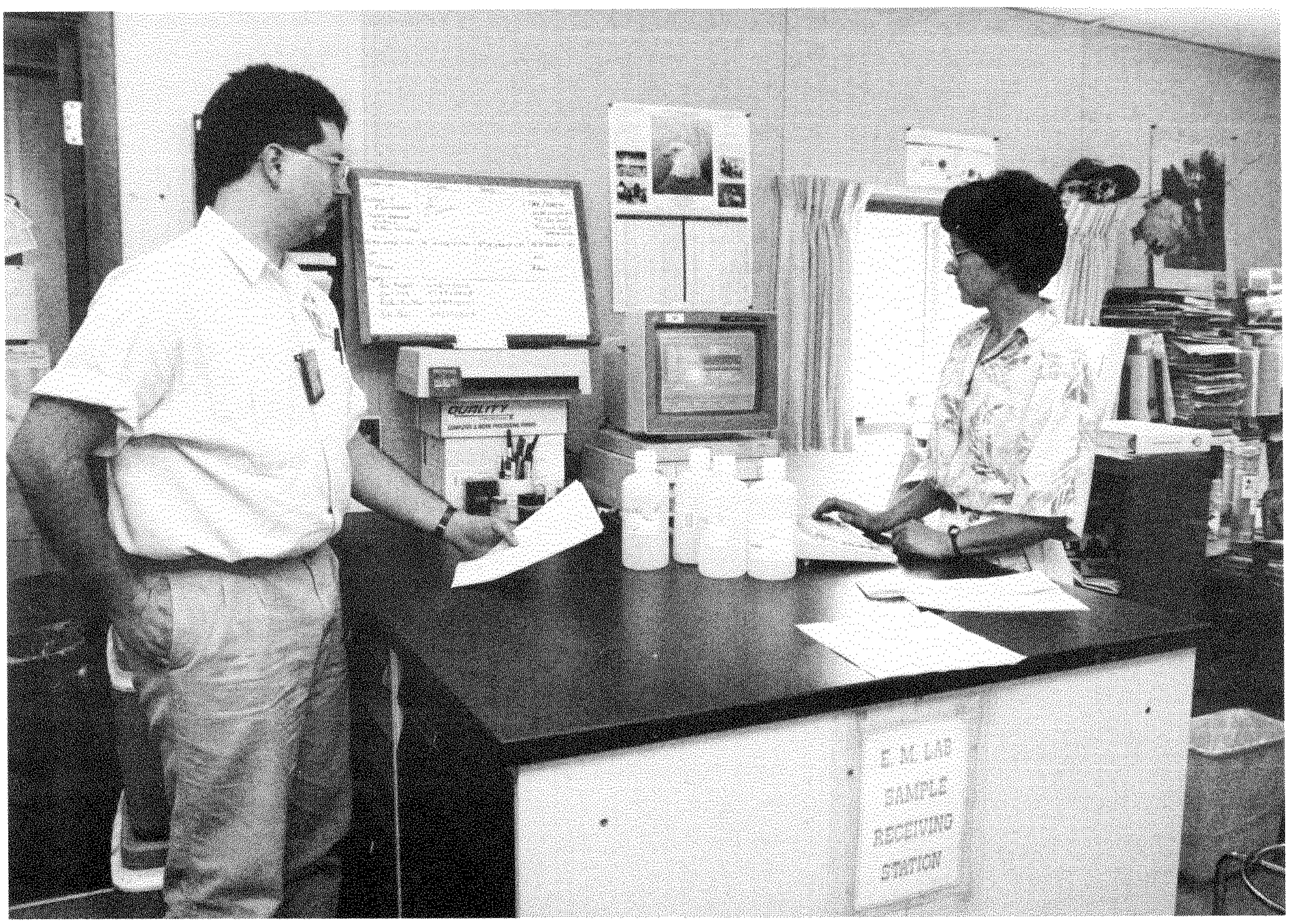
Groundwater quality pie charts for major groundwater constituents for the till-sand unit are shown in *Appendix E*, Figure E-2. The pie chart for well WNW0202 clearly shows the influence of hydroxide alkalinity on the overall ion balance of groundwater at this location. Groundwater monitoring of the surficial sand and gravel well WNW0201 at a depth of 20 feet at the same location indicates no apparent effect on pH from hydroxide. (See Fig. 3-7.)

The box-and-whisker plots for TOC and TOX, Figures 3-16 and 3-17 respectively, indicate no clear separation between upgradient and downgradient monitoring points, although TOC tends to be marginally higher than upgradient concentrations for locations WNW0202 and WNW0905.

Concentrations of all radiological constituents are low in all wells monitoring the till-sand unit, as shown in Figures 3-18 through 3-20. Marginally elevated levels of gross alpha, although below the statistically derived minimum detectable concentration, are indicated at location WNW0905. This location also shows marginally positive tritium concentrations just above the minimum detectable concentration of 1E-7 µCi/mL. This well is 23 feet below grade and is positioned downgradient of SSWMU #9, the NRC-licensed disposal area (NDA). Well WNW0202 shows marginally elevated levels of gross beta activity. The gross beta results shown for this well (*Appendix E*, Table E-2) indicate a slight decline in concentrations as monitoring progressed through 1992. Levels of gross beta and tritium are well below the New York State groundwater quality standards for these constituents (1.0E-6 µCi/mL and 2.0E-5 µCi/mL, respectively).

Results of Contamination Indicator Monitoring of the Unweathered Lavery Till Unit

Twenty-four wells monitor the unweathered Lavery till unit, which extends across both the north and south plateaus of the WVDP. General upgradient conditions of the unweathered till are monitored by wells WNW0405, WNW0704, and



Receiving Groundwater Samples at the Environmental Laboratory Computerized Receiving Station

WNW0707. Although not included as unweathered Lavery till wells, both WNW1008B and WNW1008C may provide additional background information for this unit. These latter wells are located on the western portion of the south plateau.

Wells monitoring the unweathered Lavery till are part of the monitoring network for several SSWMUs: SSWMU #1 — the low-level waste treatment facility, SSWMU #4 — the high-level waste storage and processing area, SSWMU #7 — the chemical process cell waste storage area, SSWMU #9 — the NRC-licensed disposal area, and SSWMU #11 — the state-licensed disposal area for which New York State Energy Research and Development Authority (NYSERDA) is responsible. In addition, most of the wells monitoring SSWMU #10, the IRTS drum cell, may provide useful information about this unit even though they are classified as monitoring primarily the weathered Lavery till or the lacustrine unit. Results of groundwater contamination indicator monitoring for the unweathered Lavery till geologic unit are shown in the box-and-whisker Figures 3-21 through 3-27. Tabulated data are presented in *Appendix E*, Table E-3.

There are no particularly noteworthy anomalies for pH or conductivity data for wells within this geologic unit.

Concentrations of both total organic carbon (Fig. 3-23) and total organic halogens (Fig. 3-24) are elevated at well WNW0704. This well, although generally positioned upgradient in the unweathered Lavery till, is located downgradient in SSWMU #7 and is 15.5 feet deep. Well WNW0910 also indicates a level of total organic carbon that appears higher than concentrations for other wells monitoring this geologic unit. Monitoring at well WNW0910 began in 1992, following installation in the region downgradient of SSWMU #9. Because of the later installation, only two complete sample sets were collected from this location in 1992.

Results of radiological monitoring of unweathered Lavery till wells are shown in Figures 3-25 through 3-27. Results for gross alpha analyses (Fig. 3-25) are mostly below the minimum detectable concentration. Results shown for gross beta (Fig. 3-26) indicate that concentrations at downgradient wells are similar to those of upgradient locations. Figure 3-27 shows results of tritium measurements for wells monitoring the unweathered Lavery till. Wells WNW0107, WNW0109, WNW0110, WNW0114, and WNW0115 of SSWMU #1 showed low but consistently positive results for tritium. Well WNW1109B, which monitors SSWMU #11 (NYSERDA's SDA) also showed low but consistent tritium concentrations. Eight other wells monitoring the unweathered Lavery till near the SDA were below the minimum detectable concentration. Well WNW1109B is located between NYSERDA's SDA and the NDA. (See Fig. 3-3.) The concentrations of gross beta and tritium detected in these unweathered Lavery till wells are below the groundwater quality standard of 1E-06 μCi/mL for gross beta and 2E-05 μCi/mL for tritium. Although some positive results are shown for gross beta and tritium, all concentrations are low and indicate a negligible effect on site groundwater.

Levels of total organic carbon (TOC) and total organic halogens (TOX) for all NYSERDA's SDA wells within this geological unit also are indistinguishable from background.

Results of Contamination Indicator Monitoring of the Lacustrine Unit

Thirteen wells monitor groundwater conditions within the lacustrine unit. These wells are all situated on the site's south plateau and represent the deepest groundwater monitoring points on-site.

Background conditions are monitored by well WNW1008B, which is 51 feet below grade. Three additional wells, WNW0901, WNW0902, and

On-screen Review of a Tritium Sample Count

WNW1001, provide upgradient monitoring of the lacustrine unit. These wells range in depth from 116 to 136 feet below grade.

General downgradient monitoring is provided by eight wells ranging in depth from 108 to 138 feet.

The lacustrine unit is monitored as part of the groundwater monitoring program associated with SSWMU #9 — the NDA, SSWMU #10 — the integrated radwaste treatment system drum cell, and SSWMU #11 — NYSERDA's SDA.

Results of contamination indicator monitoring of the lacustrine unit are seen in Figures 3-28 through 3-34. The pH and conductivity box-and-whisker plots (Figs. 3-28 and 3-29) show variations across well locations. These variations may reflect differences in groundwater geochemistry. Some of the wells in the lacustrine unit exhibit very low groundwater recharge rates, which limit the ability to collect enough sample for all analyses and can also impair the ability to thoroughly flush or purge the well before sampling. For example, NYSERDA's SDA well WNW1103C exhibits very limited recharge, allowing only a limited set of analyses to be made.

Results of sampling for the remaining contamination indicator parameters suggest the lack of any direct site-induced effects on the waters of the lacustrine unit. For example, detection of tritium in groundwater would probably be the first indicator of contamination from tritium becoming incorporated into and moving with the groundwater. Figure 3-34 shows that all tritium values for all wells monitoring this unit are below the minimum detectable level of 1.0E-07 μCi/mL.

NYSERDA's SDA well WNW1103C indicates slightly elevated levels of gross beta activity. However, this well does not show a corroborating level of tritium activity. Further analysis of this beta component would be necessary to help identify its origin.

All levels of radioactivity measured within the lacustrine unit are below New York State groundwater quality standards. These results indicate that little, if any, effect on the lacustrine unit groundwater has occurred because of site operations.

Results of Contamination Indicator Monitoring of the Weathered Lavery Till Unit

Seventeen wells are used to monitor groundwater in the weathered Lavery till unit, which is the surficial geologic unit on the south plateau of the site. Three SSWMUs are monitored as part of groundwater monitoring in the weathered Lavery till: SSWMU #9 — the NDA, SSWMU #10 — the IRTS drum cell, and SSWMU #11 — NYSERDA's SDA.

Well WNW1008C monitors background conditions in the weathered Lavery till. Well WNW0908 and WNW1005, within the weathered Lavery till unit, monitor general upgradient conditions. Wells monitoring this unit range in depth from 10 to 23 feet below grade.

The median results of downgradient monitoring of pH (Fig. 3-35) fall within a range of about 6.5 to 7.5 for wells within this geologic unit. The range of conductivity values is relatively wide across this unit, with the variability within a given well generally small. Downgradient values for conductivity are within the range of the upgradient and background results are as shown in Figure 3-36.

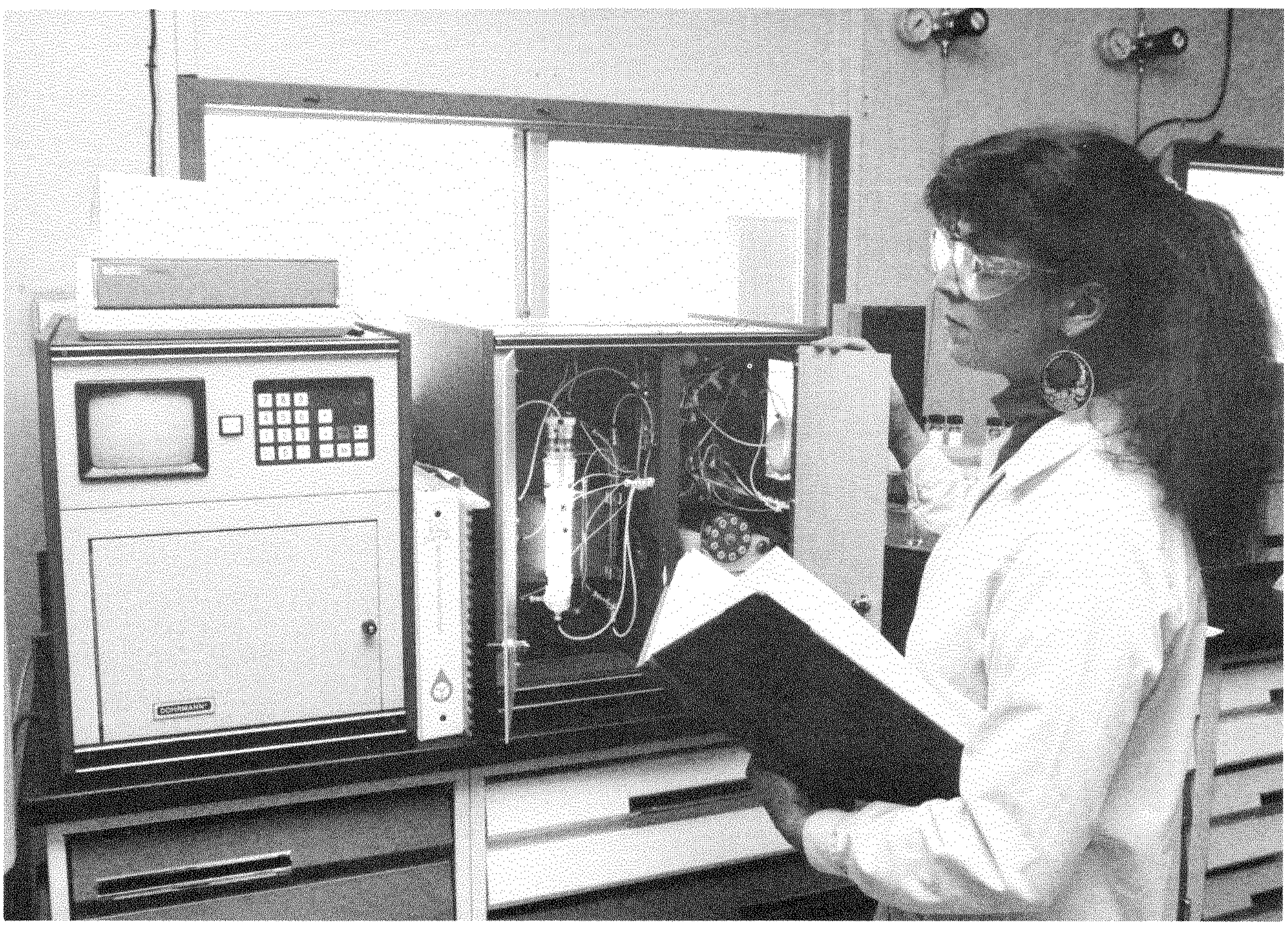
Results for total organic carbon (Fig. 3-37) indicated elevated levels of this constituent at wells WNW0906, WNW0909, WNW1007, and WNW1107A. Additional sampling and analysis followed up these apparently elevated levels of total organic carbon in WNW1107A; the results were reported previously in the 1991 SITE ENVIRONMENTAL REPORT.

Gross alpha (Fig.3-39) and gross beta (Fig.3-40) showed levels for downgradient wells grouped within a range covered by the upgradient wells for this unit, with the exception of well WNW0909, which showed elevated gross beta concentrations. Several of the wells within the unit, e.g., WNW0906, WNW0907, WNW0908, and WNW1108A, exhibit a very limited recharge rate, making them difficult to sample. The variation in gross alpha levels indicated in Figure 3-39 for WNW0908 represents a range of below minimum detectable concentrations associated with elevated levels of dissolved solids in the samples. The apparently elevated levels of gross beta activity in upgradient well WNW0908 (1.18E-08 μCi/mL to 1.87E-08 μCi/mL), although representing positive values, may be related to the elevated levels of dissolved solids discussed above for gross alpha activity. Gross beta concentrations at WNW0909 are higher than upgradient concentrations. However, gross beta results are well below the groundwater quality standard of 1.0E-06 μCi/mL.

Several wells monitoring the weathered Lavery till show detectable levels of tritium activity (Figs. 3-41 and 3-41a). Levels of tritium in well WNW1107A are slightly above the New York State groundwater quality standard of 2.0E-05 μCi/mL. Several other wells (WNW0909, WNW1102A, WNW1103A, WNW1104A, WNW1106A, and WNW1109A) consistently show much lower levels of tritium that are well below the groundwater quality standard. (See Fig. 3-41a.)

Results of Monitoring of Site Groundwater for Volatile Organic Compounds

All groundwater wells that are part of the on-site groundwater monitoring program are routinely monitored for volatile organic compounds (VOCs) as part of the contamination indicator parameters. (See Table 3-3, which summarizes the 1992 sampling schedule.) Samples collected for volatile organic compounds are analyzed by off-site contract laboratories according to method 8240 (Test Methods for Evaluating Solid Waste, SW-846 [U.S.EPA 1986]). Results of the analysis of these samples generate data on fifty-eight volatile organic compounds. *Appendix E*, Table E-11 lists the individual compounds and the practical quantitation limit (PQL) for each compound. The practical quantitation limit is the lowest concentration of the compound that can be reliably determined within the method-specified level of precision and accuracy under routine laboratory conditions. (Practical quantitation limits are roughly equivalent to method detection limits [MDLs]). This listing of volatile organic compounds originates from Appendix IX, 40 CFR Part 264, "Groundwater Monitoring List." The volatile organic compounds are a sub-list of the entire Appendix IX listing.



Checking a Total Organic Carbon Analyzer Run

The results of groundwater monitoring for volatile organic compounds (VOCs) during 1992 reveal the continued positive detection of 1,1-dichloroethane at well WNW8612. The concentration of 1,1-dichloroethane in well WNW8609 has decreased over the year from levels just above the PQL (5µg/L) to just below the PQL at year's end. The compound 1,1,1-trichloroethane continues to be present at WNGSEEP, a location where water emerges to the surface from the sand and gravel unit. However, 1992 concentrations have declined to levels below the PQL and are below 5µg/L. The compounds 1,1,1-trichloroethane and 1,1-dichloroethane are solvents commonly used by industry for degreasing processes. Analytical results for these compounds for the above locations are shown in *Appendix E*, Table E-12. There were additional VOC detections in 1992. These include the positive quantifiable detection of dichlorodifluoromethane at wells WNW8612 and WNW0803 and the positive detection of acetone at WNW0909. While the detections of dichlorodifluoromethane in wells WNW8612 and WNW0803 have persisted, the detection of acetone in waters from WNW0909 has not. Dichlorodifluoromethane is also known as Freon-12, a coolant widely used for air conditioning and refrigeration.

Groundwater wells WNW8612 and WNW0803 and monitoring point WNGSEEP are located on the northeastern side of the site, downgradient of the main plant and the former construction and demolition debris landfill (CDDL). The possibility that detections of 1,1-dichloroethane, dichlorodifluoromethane, and 1,1,1-trichloroethane at these sites may originate from a common source is under investigation. The detection of 1,1,1-trichloroethane at WNGSEEP is the subject of a report that was prepared to fulfill the RCRA 3008(h) Order on Consent, GROUNDWATER SEEP INVESTIGATION REPORT: 1,1,1-TRICHLOROETHANE DETECTION (West Valley Nuclear Services 1992).

Analysis of volatile organic compounds by method 8240 uses an instrument known as a gas chromatograph/mass spectrometer (GC/MS). This instrument has the ability to identify the presence of compounds below the PQL listed in Table E-11. Such detections, taken on an individual basis, must be viewed with caution since they may be false. However, when the same compound is detected repeatedly at levels below the PQL at the same groundwater location, it may actually indicate the presence of that compound, but at levels below that which can be accurately measured. The repeated detection of compounds below their associated PQLs has occurred at the following groundwater monitoring locations:

- WNW8612: 1,1,1-trichloroethane below its PQL of 5µg/L.
- WNW8609: 1,1,1-trichloroethane below its PQL of 5µg/L.
- WNW0202: toluene below its PQL of 5µg/L, acetone below its PQL of 10µg/L, and total xylene below its PQL of 5µg/L.
- WNW1104A: toluene below its PQL of 5µg/L, acetone below its PQL of 10µg/L, and total xylene below its PQL of 5µg/L.
- WNW0803: 1,1-dichloroethane below its PQL of 5µg/L and chloroethane below its PQL of 10µg/L.

Volatile organic compounds in WNW0202 may be related to historical de minimis losses during site motor vehicle fueling; routine bulk storage tank integrity testing and inventory control procedures support this conclusion. Although the source of VOCs in WNW1104A cannot be determined, the compounds toluene and total xylene are common components of petroleum-based products and are known to exist in the trenches of NYSERDA's SDA.

Further sampling and analysis for VOC analytes continues to be performed at all of the locations mentioned above to track the detection of these compounds. (See Tables 3-2 and 3-3 for the groundwater sampling and analysis schedule.) Figures 3-42 and 3-42a present trend plots for selected VOCs over time.

Although several wells show positive concentrations of volatile organic compounds, these levels are very low. They have no potential for affecting human health because on-site groundwater is not used as a source of drinking water. In perspective, the VOC concentrations found in on-site groundwater are quite similar to the levels typically found in a public water supply that is disinfected by chlorination.

It should be pointed out that the VOC detections mentioned above have been compared with relevant New York State groundwater quality standards. This comparison has been performed for VOCs appearing both above and below their appropriate PQLs. In summary, positive detections of 1,1,1-trichloroethane, 1,1-dichloroethane, and dichlorofluoromethane above 5µg/L have exceeded guidelines for class GA groundwaters. (See *Glossary*.) There is no indication that the groundwater from these areas affects human health or the environment because this water is not used for drinking or general facility needs. Other VOC detections on-site show concentrations below the New York State water quality standards.

Long-term Trends of Gross Beta and Tritium at Selected Groundwater Monitoring Locations

Trend graphs showing results of groundwater monitoring from 1986 through 1992 for gross beta (Fig. 3-43) and tritium (Fig. 3-44) were prepared for selected locations. These graphs show annual averaged results for these constituents over a seven-year period. Results are presented on a logarithmic scale to adequately represent locations of differing concentrations. These specific groundwater monitoring locations were selected for trending because they have shown elevated or rising levels of these constituents (WNW8605 and WNW8604, Fig. 3-43), or falling trends (Fig. 3-44) over time.

The results for gross beta activity (Fig. 3-43) indicate a steadily rising trend for location WNW8604. Well WNW8604 is located to the north of lagoon 4 in SSWMU #1 and is 23.0 feet below grade. Well WNW8603, which is north of WNW8604, at a depth of 25.4 feet, shows much lower and consistent levels of gross beta activity. Although the specific source of the increasing gross beta activity at WNW8604 has not been identified, this well is positioned downgradient of wells with higher levels of activity (WNW0408 and WNW0502, both downgradient of the main plant facility) and is crossgradient to the low-level waste treatment facility. Lagoon 1, formerly part of the low-level waste treatment facility, was previously identified as a source of contamination and is believed to be contributing to the gross beta activity at wells WNW8605 and WNW0111. The concentration of gross beta activity at location WNW8604 is lower than that measured for WNW8605. Identification, continued monitoring, and follow-up evaluation of this area will provide the information necessary for either near-term response or eventual facility closure.

Monitoring point WNGSEEP, which has shown elevated levels of some VOCs, as discussed above, exhibits a fairly level long-term trend for gross beta activity.

Figure 3-44 shows the seven-year trend for tritium concentrations for the same monitoring points presented in Figure 3-43. All points, including WNW8604, which shows rising beta activity, show a gradually declining trend for tritium.

Figures 3-43a and 3-44a present gross beta and tritium concentrations for selected wells over the two-year period that the WVDP's expanded groundwater monitoring program has been in place. The results presented in these two figures are individual sample results as opposed to annual averages as presented in Figures 3-43 and 3-44. Well WNWNB1S is a site background well that is included in the figures as a point of reference. The wells selected for these two-year trend graphs represent on-site locations with elevated levels of gross beta and tritium activity. All wells shown in these figures monitor the sand and gravel geologic unit.

Gross beta and tritium concentrations at these locations are generally consistent, with a slightly rising trend noted for gross beta. Well WNW0111 shows a relatively large degree of variability for tritium concentrations. This well is located near former lagoon 1 and well WNW8605 in SSWMU #1. Concentrations shown in these two figures are well above the background concentrations shown for well WNWNB1S.

Groundwater Quality Parameters

Results of the two rounds of sampling for groundwater quality parameters are in *Appendix E,* Tables E-6 through E-10. The results for the major cations (calcium, magnesium, sodium, and potassium) and anions (chloride, sulfate, bicarbonate, carbonate, and, in some cases, hydroxide) are also summarized in pie charts in Figures E-1 through E-5 in *Appendix E.* Compiling groundwater quality results in pie charts provides a convenient way to present data in a format that allows rapid comparison of results between different wells. These pie charts are very useful for identifying the major constituents of the groundwater, the relative percentages of these various constituents, the degree to which the cation and anions balance, and the overall ion content of the groundwater. The pie charts are grouped by geologic unit, and the wells are presented in the same order as in the tables for contamination indicator parameters. (See *Appendix E.*)

Sampling Site Groundwater for EPA Interim Drinking Water Quality Parameters

Site groundwater was sampled for EPA interim primary drinking water quality parameters a total of four times, beginning in 1991 and ending in 1992. (See Table 3-3 for this list.) These results are found in *Appendix E,* Tables E-13 through E-17. The results may be compared to New York State groundwater quality standards for Class GA groundwater. (See *Glossary.*) These standards are derived from Title 6 of the New York Code of Rules and Regulations (NYCRR), Chapter X, Part 703.5. Water meeting these standards is acceptable as a source of drinking water. These standards provide a conservative reference for comparison to site groundwater. However, site groundwater is not used for either on- or off-site drinking water.

Tables E-13 through E-17 of *Appendix E* present four rounds of chronologically ordered analytical results and the mean of the four rounds below them. The mean of the four rounds of analytical results is used for comparison with NYCRR groundwater quality standards.

Comparison of the drinking water metals standards to site groundwater results indicate that there are instances in which groundwater total metals results exceed the respective quality standards. However, it is more appropriate to compare dissolved metals results with these standards: the total metals fraction of groundwater may include solid materials, introduced during the sampling process, that are filtered out in the dissolved fraction. This dissolved fraction is therefore the most realistic portion of the sample for comparison because it best represents actual groundwater conditions.

Comparison of New York State quality standards to site dissolved metals data reveals that with the exception of three wells in the sand and gravel geologic unit, site groundwater met all these standards. Dissolved chromium in WNW0403 and

WNW8613B and dissolved lead in WNW0103 all exceeded their respective New York State quality standard by small margins. The individual results that contribute to the mean for these constituents were sporadic throughout the year of sampling and analysis for these wells. In addition, the mean concentration of nitrate+nitrite–nitrogen in well WNW0403, which is upgradient in SSWMU #4, exceeded the quality standard. Also, the site background well — WNWNB1S — nearly exceeded the nitrate+nitrite–nitrogen quality standard of 10.0 mg/L by exhibiting a resultant mean of 9.4 mg/L. The groundwater quality standards for 2,4-D and 2,4,5-TP (Silvex) are, in some cases, lower than the analytical method detection limit. In these cases, the method detection limit may be above the groundwater quality standard, but the analyte is not detectable.

Discussion of Site Groundwater Monitoring

While these monitoring data do not indicate a potential for immediate adverse effects on human health or the environment, evaluation of the need to mitigate the contamination indicated by the data is in progress in accordance with applicable laws and regulations. An environmental impact statement is being prepared in accordance with the decision-making requirements of the National Environmental Policy Act (NEPA) and the New York State Environmental Quality Review Act. The decontamination and restoration of radiologically affected environmental media at the WNYNSC will be included in this environmental impact statement. The decision-making process will include public review and comment. When completed, an alternative will be selected and implemented. Since the monitoring data also revealed the presence of chemical effects, the results of a facility investigation being performed in accordance with an Administrative Order on Consent under section 3008(h) of the Resource Conservation and Recovery Act of 1976, as amended, will also be considered in the mitigation process. On the basis of these results, the U.S. Environmental Protection Agency and the New York State Department of Environmental Conservation will issue appropriate requirements for corrective action.

Off-Site Groundwater Monitoring Program

During 1992 all of the off-site groundwater residential wells were sampled for radiological constituents, pH, and conductivity. Sampling and analysis indicated no evidence of contamination by the WVDP of these off-site water supplies. Analytical results are found in Table C-1.8 in *Appendix C-1*.