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PHASE I REMEDIAL INVESTIGATION REPORT
WELLSVILLE-ANDOVER LANDFILL SITE
TOWNS OF WELLSVILLE AND ANDOVER
ALLEGHANY COUNTY, NEW YORK
SITE NUMBER 9-02-004

March 1992

Prepared for:

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ENVIRONMENTAL CONSERVATION
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1. INTRODUCTION

1.1 PURPOSE OF REMEDIAL INVESTIGATION

Ecology and Environment Engineering, P.C. (E & E), under contract to the New York State Department of Environmental Conservation (NYSDEC), Division of Hazardous Waste Remediation (DHWR), was requested to perform a Remedial Investigation and Feasibility Study (RI/FS) at the Wellsville-Andover Landfill, site number 9-02-004, an inactive municipal landfill in the towns of Wellsville and Andover, Allegany County, New York. The objectives of the RI/FS, as outlined in this summary report, are to:

- Assess the cause, extent, and effects of the presence of hazardous materials in the project area;
- Identify and evaluate remedial alternatives selected to mitigate contamination problems that pose threats to the environment or to public health, as determined by the fieldwork and data evaluation conducted during the RI; and
- Recommend remedial alternatives.

The RI/FS specifications were formulated in accordance with criteria presented in the State Superfund Standby Contract (Work Assignment No. D002625-8).

1.2 SITE DESCRIPTION

The Wellsville-Andover Landfill site is located along the east side of Snyder Road (formerly Gorman Road) in a sparsely populated rural area of eastern Allegany County, New York (see Figure 1-1). The site straddles the border between the towns of Wellsville and Andover, with approximately the southern third in Wellsville and the northern two-thirds in Andover. The property owned by the Village of Wellsville is roughly rectangular in shape, measuring approximately 4,000 feet north-to-south by 1,500 feet east-to-west, for a total area of approximately 120 acres. The northernmost portion of the property, consisting of approximately 35 acres, has not been used for waste deposition and was not included in the site investigation.

The landfill is located on a hillside on the west side of Duffy Hollow with nearly 200 feet of relief from north to south. The north end of the property is on top of the hill at an approximate elevation of 2,230 feet above mean sea level (AMSL). This area is currently used by a local community group, the Wellsville Area Small Plane Society, for recreational purposes. Access to the undisturbed portion of the site is gained only by a central dirt road that runs north-south through the filled areas. The east side of the site is bounded by open fields and patches of mature beech/sugar maple forests and slopes downward to Duffy Creek at grades of 14% to 20%. Numerous permanent and seasonal residences exist along Duffy Creek approximately 1,400 to 1,500 feet east of the eastern border of the site. The southern border of the site is fenced with barbed wire and lies adjacent to fields often grazed by horses. The nearest residence south of the site is seasonal and located 600 feet to the southeast. Snyder Road borders the southern third of the site to the west. One permanent and one seasonal residence exist along the west side of Snyder Road within 300 feet of the landfill. The remainder of the west side is bounded by mature beech/sugar maple forests, with one seasonal residence located approximately 500 feet west of the site.

Approximately 1,500 feet east of the site is Duffy Creek, a Class C stream (6 NYCRR 821.6). An unnamed intermittent tributary to Duffy Creek begins along the west side of the site and flows south-southeast until it converges with Duffy Creek approximately 3,000 feet southeast of the site. Duffy Creek flows south, eventually joining Dyke Creek 1.8 miles south-southeast of the site. Dyke Creek, also a Class C stream, is a direct tributary of the Genesee River.

Numerous man-made containment ditches exist at the site for the purpose of diverting surface runoff from the filled areas. Surface water from the northeast area of the site is collected in a drainage collection pond in the center of the site. This pond, which contains water perennially, is designed with an overflow to allow excess water to drain via ditches toward Snyder Road. Surface water from other areas of the site generally flows to the south and west, eventually draining into a ditch along the east side of Snyder Road. A series of culverts then divert this water directly into the unnamed tributary west of the site.

1.3 SITE HISTORY

The following site history contains information and data from numerous sources, including the Phase I and Phase II reports, that have not been combined in a single document before.

The Wellsville-Andover Landfill was operated by the Village of Wellsville from 1964 until 1983. The site consists of four fill areas, as shown on Figure 1-2. The south, south-central, and northwest fill areas accepted municipal, industrial, and hazardous waste between 1964 and 1978. According to NYSDEC's 1983 Phase I Report, the Rochester Button Company

of Wellsville, New York disposed of unknown quantities of methylene chloride (MC) and possible trichloroethene (TCE) at the site between 1960 and 1973. However, correspondence between the Rochester Button Company and the Village of Wellsville Department of Public Works (DPW) indicates that the waste stream reaching the landfill consisted of two phases, solid and sludge (Massey 1978). The solid portion reportedly consisted of polymerized polyester scraps, while typical sludge, composed of 65% solids, consisted of approximately 44% pumice, 22% polyester fines, 35% water, trace amounts of talc and detergent, and 0.04 ppm lead carbonate. The total amount of solid waste produced by the Rochester Button Company (including paper and office waste) was reportedly 481,500 tons per year (Massey 1978).

The northeast fill area, open from 1978 to 1983, accepted municipal and industrial solid waste similar to the solid wastes described above. As described in the Phase I report, other wastes disposed of at the landfill included plastics, sodium cyanide salt, cutting oils, chromium and zinc chromate paints, solvents, coolants, and lubricating oils (NYSDEC 1983).

In addition to the above wastes, the landfill also accepted water-soluble cutting oils from two Wellsville area heavy metal manufacturing plants, C.E. Air Preheater Company, Inc. and Turbodyne Division of McGraw-Edison (MacFarquhar 1973).

Of the four fill areas, only the northeast area had a leachate collection system installed prior to waste deposition. However, as was the case with the other three fill areas, no liner was installed beneath the waste. The three older areas were in operation prior to modern regulatory requirements for design and operation of landfills. Apparently, no accurate documentation of the location or construction of cells in these areas was recorded. The available information suggests that the trench method of landfill operation was used and that the depth of waste varies but probably is less than 14 feet below ground surface.

In 1986, the Village of Wellsville prepared a Phase II Superfund investigation report under an Order on Consent filed by NYSDEC in August 1985. As described in this Phase II report prepared by Malcolm Pirnie, the Village of Wellsville installed a leachate collection system along the west side and central portion of the site in 1984 and 1985 to curtail the off-site migration of leachate. The system consists of a series of perforated 6-inch polyvinyl chloride (PVC) pipes in trenches backfilled with number 2 round stone. The trenches were excavated to depths of approximately 9 to 14 feet, which was stated to be below the estimated depth of the fill material. The layout of the system was based on the assumed direction of local groundwater flow--that is, from north to southwest in the central and western portion of the landfill. As shown in Figure 1-2, one main collection line runs along the west side of the site, adjacent to the northwest fill area. This line is joined at the northern access gate by another main line, which runs along the east side of the northwest fill area and joins with the system installed in the northeast fill area. A separate main line was installed along the

south side of the south fill area. Lateral lines with vertical risers at the terminal ends were extended from the main lines into areas displaying visible leachate seeps. Leachate collected in the northwest, northeast, and south-central fill areas flows by gravity to a sump adjacent to Pump Station 1 (see Figure 1-2). Leachate from the south fill area flows by gravity to Pump Station 2, consisting of a cistern with a submersible pump, where it is then pumped to the sump at Pump Station 1. Leachate from the sump is then stored in two 10,000-gallon holding tanks adjacent to Pump Station 1. An 80,000-gallon pond located on site near the southern access gate stores leachate that overflows from the two holding tanks. This unlined pond is rarely dry and shows evidence of having overflowed.

During E & E's site visit in February 1991, Pump Station 2 was full, and excess leachate was flowing off site to the south onto the property of Mr. D. LaDue.

Between July and December 1991, during the Phase I RI field work, E & E observed the conditions of the pump stations and pond. The excess-leachate holding pond was found to be full on numerous occasions, but no evidence of overflow from this pond was observed. During the dry mid- to late-summer months, the pond was often drained by the DPW, and no overflow from the sumps at either pump station was observed. During E & E's investigation, it was noted that the DPW drained the holding tanks at Pump Station 1 up to four times per day. The frequency of drainings was dependent upon the amount of leachate in the tanks and holding pond. Precipitation increased in September and October 1991, and during this time, leachate was observed overflowing from Pump Station 2 and migrating south onto Mr. LaDue's property.

In addition, during a site visit in February 1992, leachate was observed overflowing from Pump Station 2 as well as from the holding pond. Leachate overflow from the pond was followed and seen entering the unnamed stream west of the site.

The results of previous sampling programs at the site prior to 1986 were discussed in the Phase II investigation report prepared by Malcolm Pirnie for the Village of Wellsville in 1986. The sampling performed prior to the Phase II investigation concentrated on leachate, Duffy Hollow Creek, and residential wells in the vicinity of the landfill. The residential wells showed low-level cyanide and zinc contamination but at concentrations below NYSDEC Class GA standards. Duffy Hollow Creek samples showed low-level zinc contamination but at a concentration below NYSDEC Class C standards. Analyses of the leachate indicated the presence of phenol, cadmium, chromium, and lead. No analyses for toxic organic substances were performed. The accuracy of this reported data is questionable because appropriate NYSDEC Contract Laboratory Program (CLP) methods were not utilized.

NYSDEC sampled a number of private wells and springs in the vicinity of the Wellsville-Andover Landfill in 1984. The samples were tested for oil and grease, phenols, volatile organic contaminants (VOCs), and metals. Analytical results indicated that:

- Phenols were not detected in any of the samples;
- No metals were detected above NYSDEC Class GA groundwater quality standards;
- All samples were free from VOCs, with the exception of those collected from the LaDue spring, which contained 150 ppb of trans-1,2-dichloroethene (tDCE) and 9 ppb of TCE; and
- All of the samples, with the exception of those collected from the LaDue spring, showed low levels of oil and grease contamination.

VOC results of this sampling effort are presented in Table 1-1, along with Allegany County Department of Health (ACDOH) sampling results for residential water supplies in the area. Figure 1-3 depicts the approximate residential well and spring locations sampled between 1984 and 1989.

NYSDEC again sampled a number of residential water supplies in August 1987. The results of this sampling effort, which are included in Table 1-1, indicate the following:

- The Miller spring contained 20 µg/L tDCE and 15 µg/L TCE; and
- The LaDue spring contained 40 µg/L tDCE and 23 µg/L TCE.

As summarized in Table 1-1, ACDOH has sampled numerous residential water supplies in the vicinity of the site. The only locations found to contain VOCs were the LaDue and Miller springs, as follows:

- In April 1985, the LaDue spring contained 67 µg/L tDCE, 16 µg/L TCE, and 20 µg/L benzene;
- In May 1989, the LaDue spring contained 17 µg/L of cis-1,2-dichloroethene (cDCE) and 14 µg/L TCE;
- In December 1989, the LaDue spring contained 18 µg/L tDCE, 10 µg/L TCE, and 1 µg/L bromodichloromethane (a trihalomethane); and
- In December 1989, the Miller spring contained 2 µg/L cDCE and 1 µg/L of TCE.

Sampling performed by Malcolm Pirnie in 1986 during the Phase II investigation included analyses of leachate, groundwater, residential well and spring water, surface water, and sediment. The leachate, groundwater, and residential water supplies were analyzed for priority pollutant metals (unfiltered), organic substances, cyanide, pH, and conductivity. The surface waters were analyzed for the same five constituents as well as temperature and dissolved oxygen. Sediment samples were analyzed for priority pollutant metals, organic

substances, and cyanide. Tables 1-2 and 1-3 summarize the residential water, groundwater, and leachate sampling results. A summary of the results is as follows:

- The presence of cyanide or chromium at the significantly elevated levels indicated by the Phase I investigation was not confirmed in the various media sampled.

- Seven VOCs were detected in the leachate, including MC, acetone, vinyl chloride (VC), tDCE, 2-butanone, toluene, and ethyl benzene. Cadmium and manganese were also detected at elevated levels in the leachate.

- Two of the three downgradient groundwater monitoring well samples exhibited elevated levels of acetone and/or MC. In addition, one groundwater sample exhibited an elevated pH value. One potable residential water source (the LaDue spring) contained tDCE and TCE at levels exceeding NYSDEC Class GA standards. The Miller spring, which is not a source of potable water, contained MC, tDCE, and TCE at concentrations above regulatory levels.

- Iron was detected above the NYSDEC Class GA standard in the upgradient seep and downgradient groundwater, residential well, and spring water samples. Manganese was detected above the Class GA standard in downgradient groundwater, residential well water, and leachate samples. Sodium was detected above the NYSDEC Class GA standard in the groundwater and leachate samples but not in the residential water supply samples. No other metals were detected in excess of Class GA standards.

- Iron was detected at levels above the Class C surface water standard in the on-site drainage pond and Duffy Hollow Creek downstream samples.

Table 1-1

ACDOH AND NYSDEC
RESIDENTIAL WATER SUPPLY VOC SAMPLING RESULTS

Name	Date	Organic Compounds Detected (µg/L)				
		cDCE	tDCE	TCE	THM	Benzene
Baker[a]	05-01-89[c]	--	--	--	--	--
	08-05-87[b]					
Bauer	11-14-84[b]	--	--	--	--	--
Fanton	11-14-84[b]	--	--	--	--	--
Gephart	12-03-89[c]	--	--	--	1	--
Green	11-14-84[b]	--	--	--	--	--
Kelly, Jr.	11-14-84[b]	--	--	--	--	--
LaDue	12-03-89[c]	--	18	10	1	--
	05-01-89[c]	17	--	14	--	--
	08-05-87[b]	--	40	23	--	--
	04-30-85[c]	--	67	16	--	20
	11-14-84[b]	--	150	9	--	--
Miller	12-04-89[c]	2	--	1	--	--
	08-05-87[b]	--	20	15	--	--
Ormsby	05-01-89[c]	--	--	--	--	--
Rosini	05-01-89[c]	--	--	--	--	--
	11-14-84[b]	--	--	--	--	--
Teller	05-01-89[c]	--	--	--	--	--
	11-14-84[b]	--	--	--	--	--

[a] Former Fitzgibbon residence.
[b] Sampled by NYSDEC.
[c] Sampled by ACDOH.

Key:

cDCE = cis-1,2-Dichloroethene.
tDCE = trans-1,2-Dichloroethene.
TCE = Trichloroethene.
THM = Total trihalomathanes.
NA = Not analyzed.

Sources: Vossler 1989a, 1989b, 1989c, 1989d, 1989e, 1990a, 1990b, and 1990c; Clare 1987; and Bates 1986.

Table 1-2

PHASE II INVESTIGATION[a]
GROUNDWATER AND LEACHATE SAMPLING RESULTS
(JUNE 1986)

Sample	Organic Compounds Detected (µg/L)								Inorganics Above Standards[b] (µg/L)			
	VC	MC	Acet	tDCE	2-But	Tol	EB	TCE	Cd	Fe	Mn	Na
Groundwater												
3B	--	19	470	--	--	--	--	--	--	17,400	707	25,600
4A	--	--	5,100	--	--	--	--	--	--	10,200	4,240	20,900
4B	--	--	--	--	--	--	--	--	--	18,500	4,110	45,500
Leachate												
Trench	670	--	--	1,400	--	--	--	--	--	914	689	--
Sump	--	J	2,100	8,300	3,200	540	950	--	47	529	22,900	135,000

[a] Malcolm Pirnie 1986.
[b] Indicates only those inorganic analytes detected above NYSDEC Class GA standards per 6 NYCRR Part 701.

Key:

VC = Vinyl chloride.
MC = Methylene chloride.
Acet = Acetone.
tDCE = trans-1,2-Dichloroethene.
2-But = 2-Butanone.
Tol = Toluene.
EB = Ethylbenzene.
TCE = Trichloroethene.
J = Detected below sample quantitation limit.

Source: Village of Wellsville 1986.

Table 1-3

PHASE II INVESTIGATION[a]
RESIDENTIAL WATER SUPPLY SAMPLING RESULTS
(JUNE 1986)

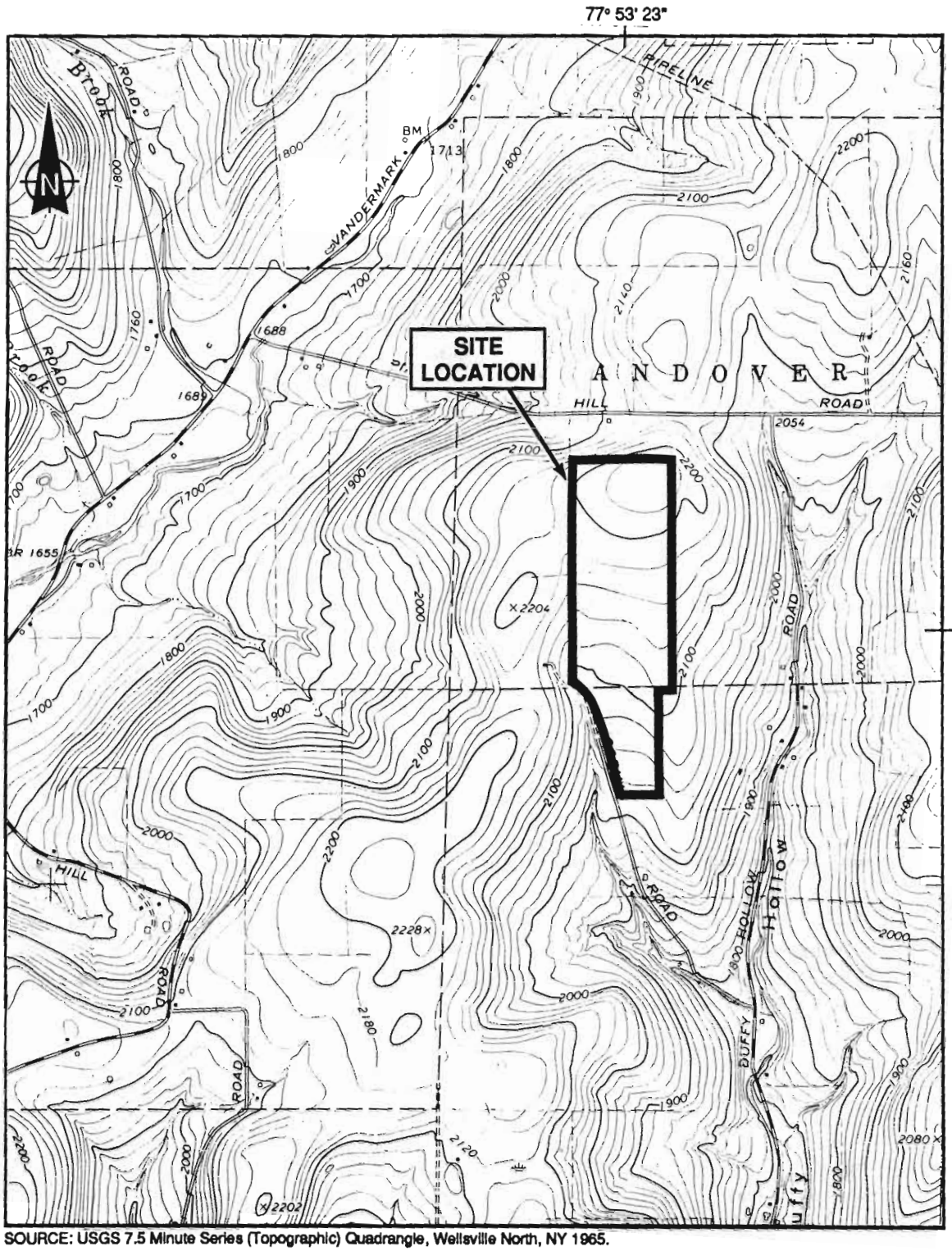
Name	Organic Compounds Detected (µg/L)						Inorganics above MCLs[b] (µg/L)	
	MC	tDCE	TCE	DEP	Phenol	4MP	Iron	Manganese
Fitzgibbon	--	--	--	--	--	--	--	--
Kelly	--	--	--	--	--	--	--	--
LaDue	--	72	34	--	--	--	--	--
Miller	24	32	21	J	J	1,900	1,130	--
Rosini	--	--	--	--	--	--	650	508
Teller	22	--	--	--	--	--	--	--

[a] Performed by Malcom Pirnie in 1986.
[b] Indicates only those inorganic analytes detected above Maximum Contaminant Levels (MCLs) per 10 NYCRR Subpart 5-1.

Key:

MC = Methylene chloride.
tDCE = trans-1,2-Dichloroethene.
TCE = Trichloroethene.
DEP = Diethylphthalate.
4MP = 4-Methylphenol.
J = Detected below sample quantitation limit.

Source: Village of Wellsville 1986.



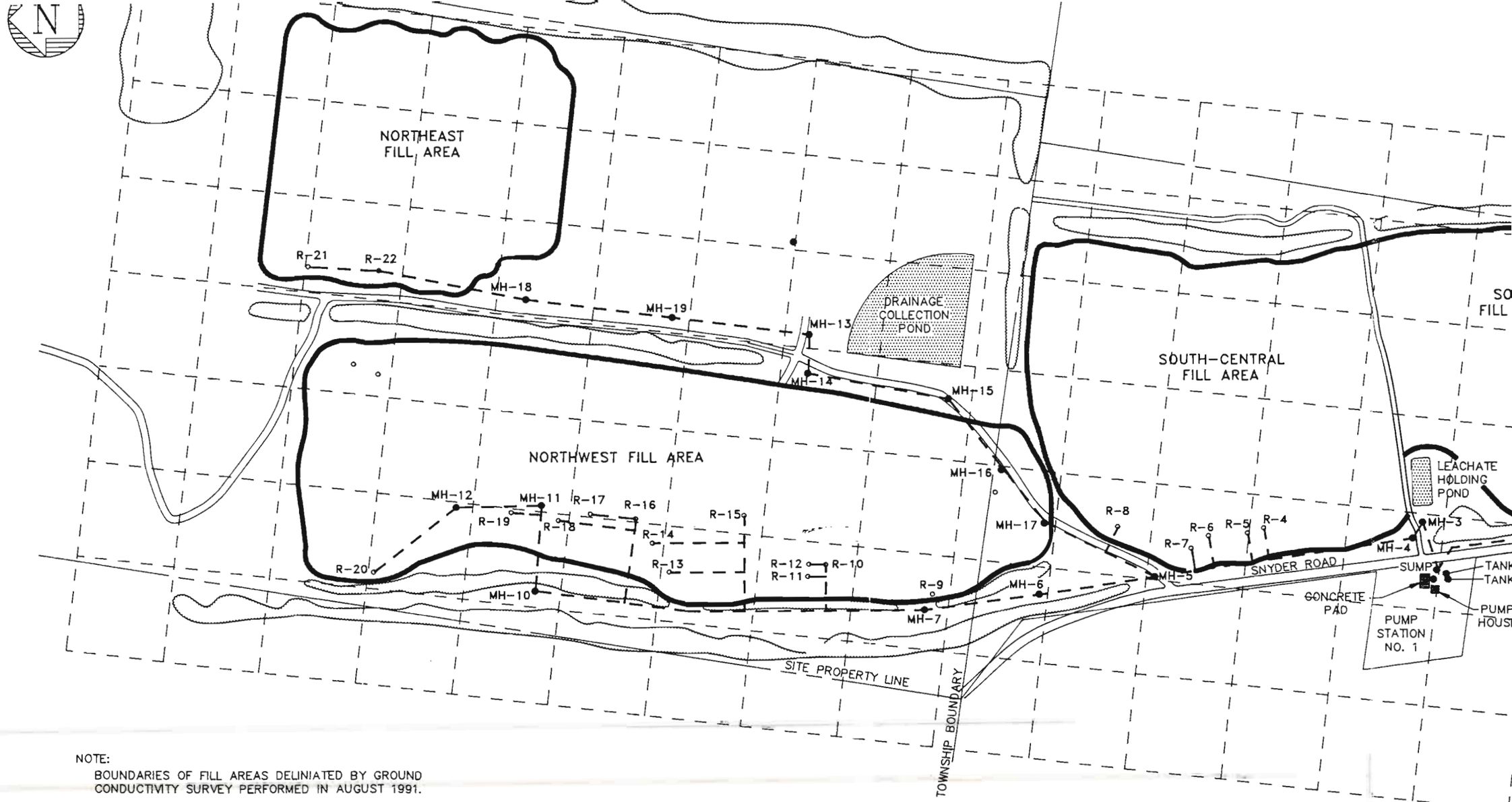
SOURCE: USGS 7.5 Minute Series (Topographic) Quadrangle, Wellsville North, NY 1965.

SCALE 1:24,000

0 ½ 1 Mile

0 .5 1 Kilometer

Figure 1-1
SITE LOCATION MAP, WELLSVILLE-ANDOVER LANDFILL



NOTE:
BOUNDARIES OF FILL AREAS DELINIATED BY GROUND CONDUCTIVITY SURVEY PERFORMED IN AUGUST 1991.

LEGEND

- MANHOLE (MH-1 TO MH-19)
- RISER (R-1 TO R-22)
- FENCE
- LEACHATE COLLECTION SYSTEM
- TREE LINE

SCALE IN FEET

0 250 500 750

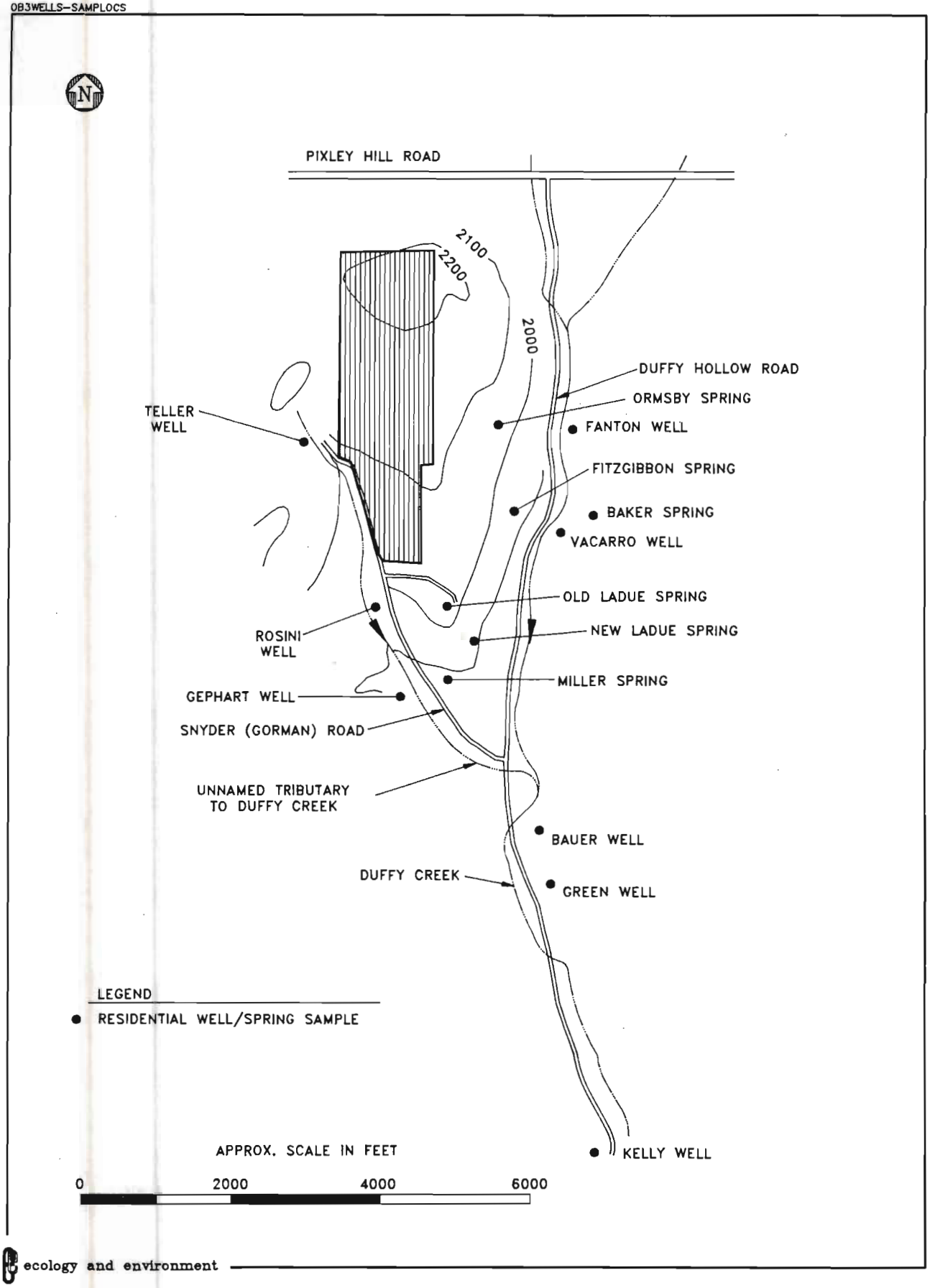


Figure 1-3 RESIDENTIAL WELL AND SPRING SAMPLE LOCATIONS, 1984-1989

2. ENVIRONMENTAL SETTING

2.1 INTRODUCTION

This section discusses the physical setting of the Wellsville-Andover area to provide a framework for a detailed discussion of the Wellsville-Andover Landfill site. Specific discussions regarding site characteristics (i.e., geology, topography, hydrology, and hydrogeology) are presented in Section 4.

2.2 PHYSIOGRAPHY AND TOPOGRAPHY

Wellsville is located in southeast Allegany County in the southern tier of New York State. The area is part of the Allegheny Plateau region of the Appalachian physiographic province (Woodruff 1942) and is characterized by a mature, medium-textured upland of moderate relief developed on sedimentary rocks with a gentle southward regional dip (Muller 1957). All of Allegany County was affected by moderate glaciation during two or more episodes of the Pleistocene Epoch and therefore contains the characteristic open valleys, glacially scoured summits, and drift deposits of the southern New York section of the Appalachian province (Muller 1957).

Allegany County includes some of the most rugged topography in Western New York, with a maximum relief of 1,400 feet. Average local relief is approximately 600 to 800 feet. The highest elevation in the area is Alma Hill near Belmont, New York, with a summit elevation of 2,548 feet AMSL. The lowest elevation in Allegany County is where the Genesee River crosses into Wyoming County at an elevation of less than 1,120 feet AMSL (Muller 1957 and Woodruff 1942).

While glacial history has played an important role in the topographic development of the area, the underlying Paleozoic strata also influence topography. Interbedded shales, sandstones, and conglomerates produce scarplets and benches in many areas with relatively erosion-resistant caprock of sandstone and conglomerate.

derived from glacial till and contain a high percentage of thinly bedded sandstone and shale fragments.

The soils in the vicinity of the south fill area included Mardin channery silt loam, Lordstown flaggy silt loam, and Bath Channery silt loam, all of which have been described previously.

2.3.2 Bedrock

The Late Devonian strata of the Wellsville area are some of the least understood in the New York Devonian sequence. Different group and formation names as well as different time relationships have been used by different authors. The majority of the following discussion is based on the works of Woodruff 1942, Rickard 1957, and Rickard 1975, using the names and temporal relationships described by Rickard 1975.

The stratigraphic section exposed in Allegany County consists primarily of interbedded shale and sandstone, with numerous locally conspicuous conglomerate layers in the upper portion of the column. While the majority of the county consists of Upper Devonian formations, the strata became progressively younger to the south, and outcrops of Mississippian units and Pennsylvanian conglomerate can be found near the New York-Pennsylvania state line. Regional dip is to the south at a fraction of a degree; however, the strata have been warped into open fields with anti- and synclinal axes trending northeast-southwest. This gentle folding causes local variation and reversal of dip (Woodruff 1942).

The Upper Devonian strata of Allegany County represent lateral facies changes that occurred during deposition of the Catskill Delta. As the Catskill mountains shed debris westward into a shallow sea, a progression of depositional environments developed from east to west across New York State. Deep depositional environments occur to the west and near the bottom of the stratigraphic section. Shallow depositional environments occur to the east and near the top of the section. As the basin filled and the sea regressed, progressively shallower type sediments were deposited in the Wellsville area.

In the Wellsville area, the base of the Upper Devonian section is formed by the Genesee and Sonyea groups (see Figure 2-1). These groups consist primarily of shales including the Geneseo, Penn Yan, West River, Middlesex, and Cashagua formations. These groups represent deposition in a relatively deep, anaerobic, distal basin. Above the Sonyea Group is the West Falls Group. At the base of the West Falls is the Rhinestreet Shale, which was deposited in an environment similar to that of the Genesee and Sonyea groups. Above the Rhinestreet, but within the West Falls Group, are numerous formations consisting of shale, siltstone, and sandstone representing deposition in a proximal basin and on an open shelf well below the wave base (Rickard 1975).

trends northwest-southeast joining the second feature where Dyke Creek enters the village (Isachsen and McKendree 1977).

Two pervasive joint sets have been mapped in the Wellsville area. One set of unspecified prominence with vertical and subvertical planes trends N20°W/S20°E. The second set, also of unspecified prominence, trends N29°W/S29°E (dip not given) (Isachsen and McKendree 1977).

2.4 REGIONAL HYDROLOGY

The Wellsville-Andover Landfill is located within the Genesee River Basin. The basin extends from the mouth of the Genesee River at Lake Ontario to northern Pennsylvania and has a total drainage area of 2,480 square miles (NYSWRC 1966). This section summarizes the hydrologic features of this basin in order to provide a framework for the discussion of the site hydrology presented in Section 4.

2.4.1 Surface Water

The Genesee River drains three-fourths of Allegany County. The river enters the county in the southeast, generally flows north, and exits the county to the north. A small southeastern portion of the county is drained by the Allegheny River, which flows south. Surface waters of the northeastern part of the county drain through tributaries of the Canisteo River into the Susquehanna River system, and surface waters from the northwestern corner of Allegany County drain into Lake Erie (USDA 1956). The Wellsville area is part of the Genesee River drainage basin. The major tributary streams to the Genesee River are Cryder, Dyke, and Angelica creeks east of the river and VanCampen, Black, and Caneadea creeks to the west. The principal lakes in the Genesee basin are the Little Finger Lakes: Conesus, Honeoye, Canadice, and Hemlock (NYSWRC 1966).

Springs, both intermittent and continuous, are common throughout the county. In upland areas, the underlying bedrock is close to the surface and is generally covered by glacial till with very low permeability. Water seeps downslope above the till layer and often comes to the surface as springs in wet seasons. If the impermeable layer is deep, permanent springs may be present (USDA 1956).

The Village of Wellsville relies on the Genesee River as its potable water source, while most residents outside the village rely on groundwater wells and/or springs.

2.4.2 Groundwater

Within Allegany County, water is found in both the overburden and the bedrock. Most of the unconsolidated sediments were deposited during glaciation. Low-lying areas were

in a long, steady manner, rather than in torrential downpours. Flash floods are rare for the area. The driest year recorded only 22 inches of rain, while the wettest year had 54 inches.

Prevailing winds are from the west; however, local variations in wind speed and direction can occur due to topography, especially during fair-weather, light-wind conditions. Destructive wind velocities are rare, but the area does experience severe thunderstorms during the late spring and early summer months.

3. SITE INVESTIGATION METHODOLOGY

3.1 INTRODUCTION

Field investigation activities were performed on and adjacent to the Wellsville-Andover Landfill site between July 15, 1991 and February 27, 1992. The primary objectives of the field investigation were to:

- Determine the nature of on-site contamination;
- Determine the geologic and hydrogeologic characteristics of the site that may affect contaminant migration; and
- Assess possible contaminant migration off site.

The field tasks that were performed in order to complete these objectives were as follows:

- Base map development;
- Geophysical surveys (total earth field magnetics, ground conductivity, and seismic refraction);
- Trench excavation;
- Monitoring well installation (including description of the overburden and upper bedrock geology);
- Subsurface soil sampling;
- Groundwater sampling;
- Residential well and spring sampling;
- Surface water and sediment sampling;
- Surface soil sampling;
- Leachate sampling;
- Air sampling;

- To detect and define the boundary of potential groundwater contaminant plumes containing conductive heavy metals;
- To determine the depth to, and morphology of, the bedrock surface and delineate subsurface stratigraphy; and
- To assist in the selection of monitoring well locations.

Three surface geophysical surveying techniques were selected to accomplish the preceding goals: total earth field magnetics, electromagnetic ground conductivity, and seismic refraction.

A grid system was established over the site during the initial survey in July 1991. Transect lines trending north-south and east-west were surveyed with a node spacing of 200 feet. Within this surveyed grid, geophysical survey data points were located on a 40-foot north-south by 20-foot east-west grid system.

Data collected in the unfilled area north of the containment ditch are considered representative of background conditions and have been used for comparison with data collected in filled and disturbed areas.

3.3.1 Total Earth Field Magnetics

Total earth field magnetic data were collected with an EG&G model G856 magnetometer. The magnetometer was used to delineate subsurface ferrous objects and screen monitoring well locations prior to drilling. Data were collected every 20 feet along east-west transects spaced 40 feet north to south as described above.

In order to correct for diurnal variations in the earth's magnetic field, periodic readings were made at a single background location. Due to the vast extent of the survey area, it was impractical to periodically return to the same background location. Therefore, a second G856 magnetometer was employed at the background location. This magnetometer was used to collect data at 15-minute intervals from the beginning until the end of the magnetometer survey, thus allowing for correction of diurnal drift. The background location, or base station, was located in the tree line between the northwest fill area and the central access road. The exact location and magnitude of the readings are relatively unimportant, but the fluctuations in the earth's magnetic field recorded are of primary importance.

All magnetic data were stored directly in the memory of the G856 magnometer. At each location, the G856 stores the magnetic field strength, time, station number (incremented by one for each reading), and assigned survey line number. These data, along with the data collected at the base station, were downloaded into an IBM-compatible computer using the software package MAGPAC, version 4.1.5, by EG&G Geometrics. MAGPAC allows the field data to be corrected for diurnal drift (using the base station data) and then converted to a form

All recorded data were downloaded to a computer for interpretation. Interpretation included picking the first arrivals from each record, plotting time-distance graphs, and analyzing these graphs to assign arrival times. The site was found to best fit a three-layer model representing overburden, weathered bedrock, and competent bedrock. Data were analyzed using the RF software package developed by the U.S. Bureau of Reclamation, which uses algorithms from the widely-accepted Society of Exploration Geophysicists' General Reciprocal Method (GRM).

Appendix A contains the seismic refraction survey report prepared by Davenport/Hadley for this site, which contains detailed information on the collection, interpretation, and analysis of the seismic refraction data.

3.4 TRENCH EXCAVATION

The results of the total earth field magnetics and electromagnetic ground conductivity surveys indicated that numerous anomalies with varying intensity and areal extent exist at the site. Based on these results, which are discussed in Section 4.2.2, five areas were selected for trench excavation. These locations are shown in Figure 3-1. Trench 1 was excavated in the northwest corner of the northwest fill area in an area of very strong magnetic and ground conductivity (in both the horizontal and vertical dipoles) anomalies. Trench 2 was excavated in the central portion of the northeast fill area in an area exhibiting strong ground conductivity anomalies (in both the horizontal and vertical dipoles) and adjacent to a strong magnetic anomaly. Trench 3 was excavated in the southeast portion of the northwest fill area in an area exhibiting a very strong ground conductivity anomaly (in both the horizonal and vertical dipoles) and a moderately strong magnetic anomaly. Trench 4 was excavated in the northeast corner of the south-central fill area in an area exhibiting a very strong ground conductivity anomaly (in both the horizontal and vertical dipoles) and a moderately strong magnetic anomaly. Trench 5 was excavated in the central portion of the south fill area in an area exhibiting a very strong ground conductivity anomaly (in both the horizontal and vertical dipoles) and a moderately strong magnetic anomaly.

In terms of temporal distribution, landfilling reportedly proceeded in a north-to-south direction, beginning with the northwest fill area followed by the south-central, south, and northeast fill areas, respectively (Village of Wellsville 1986). Therefore, Trench 1 represents the oldest fill followed by Trench 3, Trench 4, Trench 5, and Trench 2, respectively. During excavation of Trench 1, a newspaper dated 1967 was found. Newspapers found in Trench 3 and Trench 2 date these areas to 1974 and 1980, respectively.

All trenches were excavated by E & E's subcontractor, Entech Management Services Corporation, using a Caterpillar Model 426 backhoe equipped with non-sparking teeth. All trenches were excavated approximately 3 feet wide by 12 to 15 feet long. The trench depths

would exist in the overburden, even during periods of high precipitation. Three pairs of shallow and deep wells and a single deep well were installed along the eastern perimeter of the site. Monitoring well pair 2S and 2D was installed southeast of the northeast fill area in order to intercept possible groundwater contamination migrating from that area. MW-2S was installed 66 feet south of MW-2D near a small pond that is assumed to be spring fed based on its continual presence during the dry summer. MW-4D was installed as a single bedrock well at the northern end of the southern borrow pit. Competent bedrock was encountered at 9 feet, thereby precluding the installation of an overburden well. Monitoring well pair 5S and 5D was installed northeast of the southern fill area to intercept possible contamination from the south-central and/or south fill areas. Monitoring well pair 6S and 6D was installed just east of the south fill area to assess the fill area's impact on the groundwater.

Three well pairs were installed along the western perimeter of the site. Monitoring well pair 10S and 10D was installed just west of the northwest fill area and the leachate collection system. MW-9S and MW-9D were installed near the north access gate to assess the potential for contamination migrating south from the northwest area. MW-8S and MW-8D were installed immediately west of the south fill area in a bedrock "trough" identified during the seismic survey. However, after completion, MW-8D was deemed incompetent due to the presence of grout in the well casing. While subsurface information collected during the drilling of MW-8D has been used in this report, MW-8D was not used as a groundwater sampling point because the PVC casing had apparently collapsed and rendered the well inoperable. This well was subsequently abandoned and a new one drilled (as directed by NYSDEC on February 4, 1992) in its place on February 26 and 27, 1992. As agreed upon with NYSDEC, this new well will be sampled during the Phase II RI.

In addition to the perimeter wells, MW-3S and MW-3D were installed near the center of the site in a wide drainage swale adjacent to the drainage collection pond. Two additional wells were installed south of the site. MW-7D was installed to penetrate a bedrock trough trending north-south. At this location, no water was encountered in the overburden. Therefore, rather than install MW-7S, a new location was chosen approximately 190 feet west and downhill of MW-7D. This well was designated MW-11S.

Deep (Bedrock) Wells

All deep wells were screened entirely within the bedrock underlying the site. The screened intervals were determined in the field based on such factors as the presence of fractures, drilling water loss or gain, and well recharge determined by a bailer test. The bailer test consisted of bailing out the standing water in the open core hole and measuring the subsequent recharge. Additionally, an attempt was made to set all bedrock well screens in the

well and the depth at which water was encountered. Number 2 Q-Rok® quartz/silica sand was used in all wells except MW-7D and MW-10D, where Number 3 Q-Rok® was used. A bentonite seal was then placed above the sand pack. All deep wells were sealed within bedrock or across the interface to prevent direct overburden/bedrock communication within the well. All deep wells except MW-4D were sealed by mixing a slurry of 4 to 5 gallons of Benseal® (Wyoming bentonite chips) and pumping it downhole with tremie lines. This resulted in a 3.9- to 8.5-foot seal, depending on the amount of void space surrounding the riser. Since MW-4D was relatively shallow, a 2.5-foot bentonite pellet seal was emplaced by hand. Table 3-3 summarizes the monitoring well construction data for each well.

The remainder of the annulus around the well was filled to the surface with grout consisting of Portland cement and 5% bentonite. Bentonite was not used in the upper 3 feet of the grout to ensure stability for the locking steel protective casing that was furnished for each well. Each well was completed with a concrete drainage pad constructed on the ground surface around the protective casing to divert surface runoff away from the well. All wells were secured with a No. 3252 Master lock. Figure 3-2 depicts the deep (bedrock) well design.

Shallow (Overburden) Wells

One shallow well was installed at each monitoring well location depicted on Figure 3-1 with the exception of the locations adjacent to wells MW-1D, MW-4D, and MW-7D. As discussed previously, these locations were not suitable for overburden wells. All shallow wells were screened entirely within the overburden at and around the site. The depth of each shallow well was predetermined during split-spoon sampling of the adjacent deep well. The screens in the overburden wells were set at such a depth as to intercept the water table and to allow for seasonal variations in the elevation of the water table.

The boreholes were advanced to the appropriate depth below the water table with 4.25-inch ID, hollow-stem, continuous-flight augers. Two-inch ID, 0.010-inch machine-slotted, schedule 40, PVC well screen was then placed into the borehole. Ten feet of screen was used in all wells except MW-2S and MW-6S. Due to the shallow depths of these wells, 4 feet of screen was used in MW-2S and 7 feet was used in MW-6S. Number 2 Q-Rok® quartz/silica sand was then placed around the screen to serve as a filter pack. The height of sand above the screen varied from 1 foot to 5 feet and was dependent upon the depth of the well and the depth to water. In all shallow wells except MW-2S, a 2-foot thick bentonite seal was placed above the sand using hydrated Wyoming bentonite pellets. Since MW-2S was only 9 feet deep, there was only sufficient room for a 1-foot seal. The remainder of each well was constructed identically to the deep wells, as described previously. Figure 3-3 depicts the shallow (overburden) well design, and Table 3-3 contains monitoring well construction data.

standing water in the well. All readings stabilized prior to completion of development; however, the turbidity of the disturbed groundwater remained well above the NYSDEC goal of 50 nephelometric turbidity units (NTU) in all cases.

Due to the high percentage of silt and clay in the formation, the turbidity goal of 50 NTU could not be achieved without sacrificing the integrity of the wells. However, when the wells were allowed to recharge and stabilize prior to sampling, much of the suspended material settled out, yielding relatively clear samples (see Section 4.4.2).

3.5.3 Subsurface Soil Sampling

During subsurface drilling activities, the deep boring from each monitoring well pair was continuously sampled with a split spoon as described in Section 3.5.1. The samples were logged by a field geologist and monitored for the presence of VOCs using an HNu and OVA. Two subsurface soil samples were obtained from each of the 10 deep wells, with the exception of MW-2D. Due to the shallow depth to bedrock and the coarseness of the overburden, only one sample was collected from MW-2D. Including the duplicate sample, a total of 20 samples were collected for laboratory analysis. Eight samples consisting of two samples from the upgradient well MW-1D and two each from MW-6D, MW-7D, and MW-8D were collected and analyzed for full TCL parameters according to NYSDEC CLP methods. Samples from each of the remaining six deep borings were collected and analyzed for TCL VOCs and inorganic substances only. Table 3-4 lists the samples collected, and Figure 3-1 depicts the monitoring well/boring locations.

In addition to the samples retained for chemical analyses, subsurface soil samples were also collected from each deep boring for geotechnical analyses (see Table 3-4). Samples were collected from each major lithologic unit encountered at each well pair location. Geotechnical samples were retained until all drilling was complete. At that time, 19 samples were chosen for moisture content, grain-size distribution, hydrometer, and Atterberg limits testing.

All split-spoon samples were screened with an HNu and OVA immediately upon opening the spoon. Any sample in which VOCs were detected with the HNu were screened with vinyl chloride Draeger tubes. No readings were observed with the Draeger tubes.

No HNu readings were observed on any split-spoon sample except in MW-1D and MW-5D. HNu readings up to 5 ppm were observed in the upper 4 feet of MW-1D; however, these readings were interpreted as interference from water vapor in the topsoil. Fluctuating HNu readings of 0 to 2 ppm and 0 to 1 ppm were observed in the 6- to 8-foot and 8- to 10-foot interval split spoons, respectively, in MW-5D. Various OVA readings up to 10 ppm were observed in numerous wells. However, based on associated HNu readings, these readings were interpreted as methane and other light hydrocarbons.

bailer was used to carefully remove water from the top of the standing water column without agitating the settled sediment. The bottle for metals analysis was filled prior to the bottle for cyanide analysis, and both turbidities were recorded. Ten of the metals sampled had turbidities less than 50 NTU, while only two (GW-2S and GW-9S) had very high turbidities (>4,000 NTU).

Due to very slow recharge, sufficient sample volume could not be collected from MW-2S, MW-9S, and CW-3B for full TCL analysis. Therefore, samples GW-2S, GW-9S, and GW-12S were analyzed only for VOCs and metals.

All analyses were performed on unfiltered samples. Field QA/QC samples included a trip blank analyzed for TCL VOCs, as well as one field duplicate and one MS/MSD sample set analyzed for full TCL parameters. The field duplicate, designated GW-11SDD, was collected from MW-11S, and the MS/MSD sample set was collected from MW-10D. Sample preservation, shipping, and handling procedures were performed in accordance with the QAPjP for all groundwater samples.

3.6 RESIDENTIAL WELL AND SPRING SAMPLING

Five residential wells (Rosini, Teller, Kelly, Bauer, and Vacarro) and two groundwater springs (LaDue and Miller) were sampled on October 24 and 25, 1991 (see Figure 3-4). All samples were analyzed for full TCL parameters according to NYSDEC CLP methods, with the exception of VOCs, which were analyzed according to United States Environmental Protection Agency (EPA) Drinking Water Method 524.2.

Following sample collection, measurements of conductivity, temperature, and turbidity were recorded. These data are presented in Section 4.4.3. Due to an instrument malfunction, no pH data were collected.

Samples DW-2, DW-3, DW-4, and DW-7 (from the Teller, Kelly, Bauer, and Vacarro residences, respectively) were collected from the cold water tap of the kitchen sink. The Tellers and Vacarros use their wells for drinking and washing, whereas the Kellys and Bauers use their wells only for washing. All wells are used on a regular basis, and none is equipped with any type of filtration system. In each case, the cold water tap was allowed to run for 3 to 5 minutes. Vials of water for VOC analysis were collected first and in a manner that minimized disturbance.

The Vacarro residence is the site of the Fitzgibbon spring, sampled during previous investigations. The now-dry Fitzgibbon spring was located on the hillside west of Duffy Creek and Duffy Hollow Road. Following the sale of the Fitzgibbon property to the Bakers, the new owners utilized a spring on the hillside east of Duffy Creek. This spring still exists. The property was then purchased by Vacarro, and a bedrock well was drilled adjacent to the east

3.7 SURFACE WATER AND SEDIMENT SAMPLING

A total of six surface water samples were collected from the two streams bordering the site. At each surface water sampling location, a sediment sample was also obtained. The approximate locations of the surface water and sediment samples are shown in Figure 3-4 and are described as follows:

- Two samples were collected as far upgradient in each stream as possible, in order to determine background conditions. One sample (SW-1/SED-1) was obtained from the unnamed tributary north of Pump Station 1. The furthest upstream that SW-1/SED-1 could be collected was where surface runoff from the site first enters the tributary. Upstream of this location, the tributary was nearly dry and did not facilitate sample collection. Therefore, SW-1/SED-1 is not considered representative of background conditions in the unnamed tributary. Sample SW-2/SED-2 was taken from Duffy Creek west of Duffy Hollow Road, approximately 1,000 feet south of Pixley Hill Road. This sample is expected to represent background conditions in Duffy Creek.

- Sample SW-3/SED-3 was collected from a pool in the unnamed tributary west and slightly downstream of Pump Station 1.

- Sample SW-4/SED-4 was obtained from a pool downstream of the site in Duffy Creek, approximately 500 feet upstream of its confluence with the unnamed western tributary.

- Sample SW-5/SED-5 was collected approximately 350 feet downstream of the confluence of Duffy Creek and its unnamed western tributary.

- Sample SW-6/SED-6 was obtained approximately 800 feet downstream of the confluence of Duffy Creek and its unnamed western tributary to determine if there is any downstream risk associated with the site.

Samples were collected from downstream to upstream so that any disturbances (turbulence) caused by sampling activities would not affect downstream sampling locations. Additionally, the surface water samples were collected prior to the sediment samples at each location. Samples were collected by carefully submerging precleaned bottles directly into the creek in such a way as to minimize agitation of the water.

The six surface water samples were analyzed for full TCL parameters, as well as hardness, by the methods described in Section 3.1. All samples were analyzed unfiltered. Field QA/QC samples included one field duplicate (SW-4D) for full TCL and hardness analyses and one MS/MSD sample set for full TCL analysis, both of which were collected from the same location as SW-4.

The six corresponding sediment samples were analyzed for full TCL parameters according to the NYSDEC CLP methods, as well as percent organic matter by ASTM methods (see Section 3.1). Field QA/QC samples include one field duplicate for full TCL and percent

Due to the lack of liquid leachate, only two locations were sampled. Sample L-1 was collected from Manhole 4 across Snyder Road from Pump Station 1. Through this manhole, leachate from the northeast, northwest, and south-central fill areas passes prior to entering the sump at Pump Station 1. Sample L-2 was collected from the sump at Pump Station 2, which collects leachate from the south fill area only. These locations are shown on Figure 3-1.

The following procedures were used to collect the leachate samples:

- Upon opening the manhole, the head space and breathing zone were monitored with an HNu.
- A dedicated polyethylene bailer was lowered slowly into the manhole as often as necessary to fill the required sample jars. VOC sample bottles were filled from the initial bail of leachate at each location.
- Leachate samples were poured carefully from the bailer into precleaned and prelabeled sample bottles.
- Preserving, shipping, and handling procedures were performed in accordance with the QAPjP.

Field parameters, including pH and conductivity, were measured. These results are discussed in Section 4.4.7.

The two samples collected from the leachate collection system were analyzed for full TCL parameters according to NYSDEC CLP methods. Field QA/QC samples included one MS/MSD sample set for full TCL analysis collected from the same location as L-2. Analytical methods are outlined in Section 3.1.

In accordance with the work plan, no leachate samples were collected from the pump stations for Toxicity Characteristic Leaching Procedure (TCLP) analysis because the analytical results from L-1 and L-2 did not warrant this analysis.

3.10 AIR SAMPLING

The sampling strategy involved a graduated approach. First, all of the manholes and risers in the leachate collection system were screened using an HNu, OVA, and vinyl chloride Draeger tubes. The screening was accomplished by inserting the probe directly into the manhole or riser, either through an existing hole or by lifting the cover just enough to admit the probe. This procedure was used to avoid venting the manholes and risers and dispersing any gas collected in them. The readings obtained reflect the total concentration of the VOCs (aromatics such as benzene, toluene, and xylene and chlorinated alkenes such as tetrachlorethene [PCE], TCE, DCE, and vinyl chloride) of interest from a risk standpoint. Originally, leachate samples were to be collected from various areas of the leachate collection system in order to assess the relative contributions of contaminants from each fill area.

- Estimation of flow rates at various points in the collection system to determine the relative contribution of leachate from the individual fill areas.

Data will be used in the determination of which areas, if any, are suited for phased or interim remedial actions in addition to the development of final remedial solutions. Results pertaining to the leachate collection system are not included in this draft of the RI report but will be included in the first draft of the FS report.

3.12 HABITAT-BASED ECOLOGICAL ASSESSMENT

In order to characterize the ecological resources associated with the Wellsville-Andover Landfill site, E & E conducted initial background research. In addition, E & E biologists conducted a field reconnaissance of the terrestrial and aquatic communities existing at and in the general vicinity of the site on October 24, 1991.

E & E's scope of work addresses items identified in Step I of the NYSDEC document Fish and Wildlife Impact Analysis for Inactive Hazardous Waste Sites.

The following is a discussion of the approach E & E utilized to characterize ecological communities associated with the Wellsville-Andover Landfill site.

Terrestrial Ecosystems

Prior to field work, E & E analyzed current USGS topographic maps, United States Department of Agriculture (USDA) Soil Conservation Service (SCS) soils maps, and NYSDEC Wetland Maps to distinguish vegetative cover types. Cover type designations correlate to cover types described by the New York State Natural Heritage Program (NYSNHP) in its Ecological Communities of New York State. Both the NYSNHP and NYSDEC regional offices, as well as any other pertinent agencies, were contacted to identify any significant habitats known to occur on or near the site.

Field reconnaissance was used to verify the initial cover type mapping. Each cover type was surveyed in the field by traversing random but representative transects. Within each cover type, dominant species in the overstory, understory, and herbaceous layers were identified.

Potential wetlands were characterized and map-delineated following procedures detailed in the Corps of Engineers Wetland Delineation Manual (Department of the Army 1987) that use hydric soils, wetland hydrology, and hydrophytic vegetation for making wetland determinations.

Evidence of disturbed or stressed vegetation was noted, and each cover type was evaluated with regard to its relative value for wildlife habitat. Potential wildlife utilization was determined primarily through literature review supported by in-field observations. Because of

was collected by pouring laboratory deionized water through a split spoon previously decontaminated according to the procedures in Section 3.14. This sample, analyzed for full TCL parameters, was used to check the decontamination procedure. The air sample blank consisted of an unopened SUMMA® canister transported to and from the field with the other canisters in order to assess potential leakage and ambient conditions. This sample was analyzed for VOCs by Method TO-14. Three trip blanks, analyzed for VOCs only, were incorporated with sample shipments containing water samples on October 2, 4, and 25, 1991.

In addition to the above, a sample of the water used for drilling and decontamination (DW-1) was collected from the driller's holding tank. This water, analyzed for full TCL parameters, consisted of potable water collected from a hydrant at the Village of Wellsville's water treatment plant.

3.14 DECONTAMINATION PROCEDURES

All decontamination was performed in accordance with NYSDEC-approved procedures. Sampling methods and equipment were chosen to minimize decontamination requirements and prevent the possibility of cross-contamination. All drilling equipment was decontaminated prior to drilling, after drilling each monitoring well, and after the completion of all monitoring wells. Specific attention was given to the drilling assembly, augers, split spoons, and PVC casing and screens. Split spoons were decontaminated prior to and following each use. Decontamination of drilling equipment consisted of:

- Removal of foreign matter, followed by
- High-pressure steam-cleaning.

Sampling equipment, including stainless-steel spoons, was decontaminated using the following procedure:

- Washing in a trisodium phosphate (TSP) solution;
- Rinsing with potable water;
- Rinsing with 10% nitric acid;
- Rinsing with deionized water;
- Rinsing with pesticide-quality methanol;
- Rinsing with deionized water; and
- Air drying.

Table 3-1

ANALYTICAL METHODS SUMMARY

Method Reference	Method Number	Brief Description of Method	Matrix
Atterberg Limits ASTM	D4318-84	Liquid and plastic limit, plasticity index	Soil
Cyanide-Total ASP	335.2	Spectrophotometric	Water
ASP	9010	Colorimetric	Soil
Grain Size ASTM	D422-63	Sieve and hydrometer analysis	Soil
Hardness ASP	130.2	Titrimetric, EDTA	Water
Moisture Content ASTM	D2216-90	Heat to 110°C	Soil
Percent Organic Matter ASTM	D2974-87	Ash content, heat to 440°C in muffle furnace	Sediment
Aluminum ASP CLP	200.7-M	ICP	Soil, Water
Arsenic ASP CLP	206.2-M	Furnace AA	Soil, Water
ASP	6010	ICP	Soil, Water
Barium ASP CLP	200.7-M	ICP	Soil, Water
ASP	6010	ICP	Soil, Water
Beryllium ASP CLP	200.7-M	ICP	Soil, Water
Cadmium ASP CLP	200.7-M	ICP	Soil, Water
ASP	6010	ICP	Soil, Water
Calcium ASP CLP	200.7-M	ICP	Soil, Water
Chromium ASP CLP	200.7-M	ICP	Soil, Water
ASP	6010	ICP	Soil, Water
Cobalt ASP CLP	200.7-M	ICP	Soil, Water

Table 3-1

ANALYTICAL METHODS SUMMARY

Method Reference	Method Number	Brief Description of Method	Matrix
Base/Neutral/Acid Extractables			
ASP CLP	89-2	Extraction, GC/MS	Soil, Water
Volatile Organic Compounds			
ASP CLP	89-1	Purge & Trap, GC/MS	Soil, Water
ASP	524.2	Purge & Trap, GC/MS	Drinking water
Pesticides/PCBs			
ASP CLP	89-3	Extraction, GC/ECD	Soil, Water

Key:

AA = Atomic absorption spectroscopy.
ASP = NYSDEC Analytical Services Protocol, September 1989.
ASTM = American Society of Testing and Materials, 1991.
GC/MS = Gas chromatograph/mass spectrometer.
GC/ECD = Gas chromotograph/electron capture detector.
CLP = Contract Laboratory Program SOW, July 1988, modified.
ICP = Inductively coupled argon plasma.

Source: Ecology and Environment Engineering, P.C. 1992.

Table 3-3

MONITORING WELL CONSTRUCTION DATA[a]

Well	Depth to Auger Refusal	Total Depth	Depth of Screened Interval	Depth of Sand Pack	Depth of Bentonite Seal
1D	44.0	74.5	64.5 - 74.5	61.9 - 74.5	58.0 - 61.9
2D	24.0	61.0	49.0 - 59.0	43.0 - 61.0	36.5 - 43.0
2S	9.0[b]	9.0	5.0 - 9.0	4.0 - 9.0	3.0 - 4.0
3D	25.0	41.6	30.0 - 40.0	28.0 - 41.6	22.5 - 28.0
3S	19.0[b]	19.0	9.0 - 19.0	7.0 - 19.0	5.0 - 7.0
4D	9.0	23.3	12.0 - 22.0	10.0 - 23.3	7.5 - 10.0
5D	23.5	36.8	26.5 - 36.5	25.0 - 36.8	19.0 - 25.0
5S	--	22.0	10.0 - 20.0	8.0 - 22.0	6.0 - 8.0
6D	14.6	28.3	18.0 - 28.0	16.0 - 28.3	11.0 - 16.0
6S	14.8	13.5	6.5 - 13.5	5.0 - 13.5	3.0 - 5.0
7D	26.0	45.4	35.1 - 45.1	31.0 - 45.4	24.0 - 31.0
8D[c]	64.0	77.0	67.0 - 77.0	65.5 - 77.0	57.0 - 65.5
8S	--	20.7	7.0 - 17.0	5.5 - 20.7	3.5 - 5.5
9D	29.0	45.4	35.1 - 45.1	32.0 - 45.4	26.0 - 32.0
9S	--	19.3	9.0 - 19.0	7.0 - 19.3	5.0 - 7.0
10D	29.0	43.4	33.1 - 43.1	31.0 - 43.4	26.0 - 31.0
10S	--	24.3	14.0 - 24.0	9.0 - 24.3	7.0 - 9.0
11S	>24	23.6	8.0 - 18.0	6.0 - 23.6	4.0 - 6.0

[a] All depths are in feet below ground surface (BGS).
[b] Different depths to auger refusal in shallow well achieved due to change in bit type.
[c] Well found to be incompetent after completion.

Source: Ecology and Environment Engineering, P.C. 1991.

Table 3-4

SUBSURFACE SOIL SAMPLES COLLECTED DURING WELL DRILLING

Well Number	Sample ID	Depth (feet)	Date	Analysis
MW-11S	11S[a]	17 - 18	10-03-91	Geotechnical
--	CL-1[d]	1.5 - 2	10-25-91	Geotechnical

Note: Geotechnical analysis refers to moisture content, grain size, and hydrometer analysis and Atterburg limits testing.

[a] Portion for TCL volatile analysis re-collected 10-03-91.
[b] MS/MSD sample set also collected for QA/QC.
[c] Duplicate sample for QA/QC.
[d] Sample of confining layer material collected from area of Miller spring.

Source: Ecology and Environment Engineering, P.C. 1991.

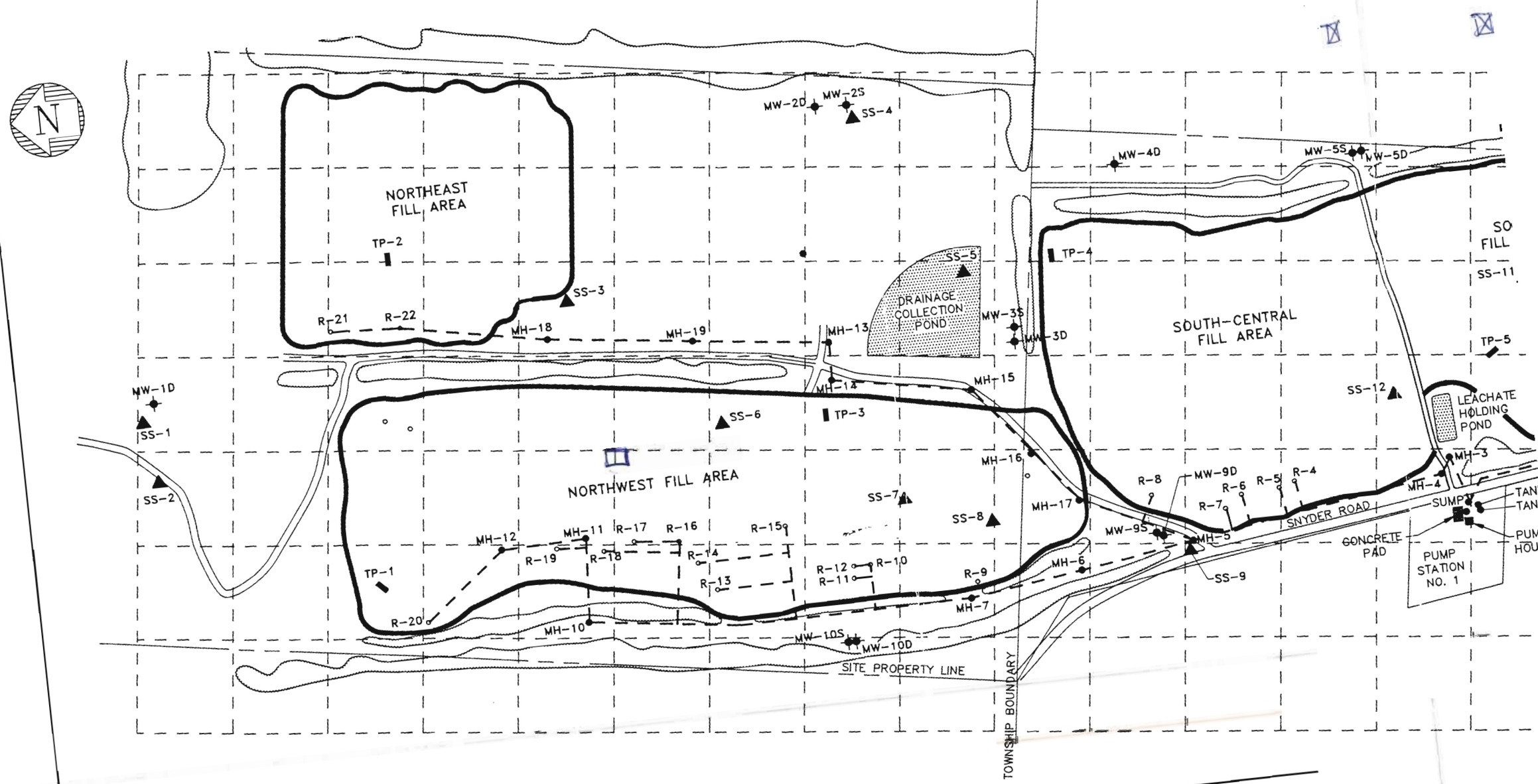
Table 3-6

AIR SAMPLES COLLECTED FROM THE LEACHATE COLLECTION SYSTEM DECEMBER 19, 1991

Sample Number	Canister Number	Manhole/Riser	Description
A-1	11302	MH-10	Collected to evaluate the relative VOC contribution from the northern portion of the northwest fill area.
A-2	11303	R-10	Collected to evaluate a "hot spot" in the northwest fill area.
A-3	11306	MH-6	Collected to evaluate the relative VOC contribution from the southern portion of the northwest fill area.
A-4	11305	MH-15	Collected to evaluate the relative VOC contribution from the northeast fill area.
A-5	11300	R-2	Collected to evaluate a "hot spot" as well as the relative VOC contribution from the south fill area.
A-6	11301	R-2	Duplicate of A-5 for QA/QC.
A-7	11299	MH-3	Collected to assess the relative VOC contribution from the south-central fill area.
A-8[a]	11298	NA	Field blank for QA/QC.

[a]Purified nitrogen from E & E's ASC collected on 12-20-91.

Source: Ecology and Environment Engineering, P.C. 1991.


N
NORTHEAST FILL AREA
NORTHWEST FILL AREA
SOUTH-CENTRAL FILL AREA
DRAINAGE COLLECTION POND
LEACHATE HOLDING POND
PUMP STATION NO. 1
CONCRETE PAD
SUMP
SNYDER ROAD
SITE PROPERTY LINE
TOWNSHIP BOUNDARY
MW-1D
MW-2D
MW-2S
MW-3S
MW-3D
MW-4D
MW-5S
MW-5D
MW-9S
MW-9D
MW-10S
MW-10D
SS-1
SS-2
SS-3
SS-4
SS-5
SS-6
SS-7
SS-8
SS-9
SS-11
SS-12
TP-1
TP-2
TP-3
TP-4
TP-5
MH-1
MH-2
MH-3
MH-4
MH-5
MH-6
MH-7
MH-10
MH-11
MH-12
MH-13
MH-14
MH-15
MH-16
MH-17
MH-18
MH-19
R-1
R-4
R-5
R-6
R-7
R-8
R-9
R-10
R-11
R-12
R-13
R-14
R-15
R-16
R-17
R-18
R-19
R-20
R-21
R-22
LEGEND
MANHOLE (MH-1 TO MH-19)
MONITORING WELL (MW-X AND CW-X)
SURFACE SOIL SAMPLE (SS-1 TO SS-14)
TRENCH (TP-1 TO TP-5)
RISER (R-1 TO R-22)
FENCE
LEACHATE COLLECTION SYSTEM
TREE LINE
SCALE IN FEET
500
750

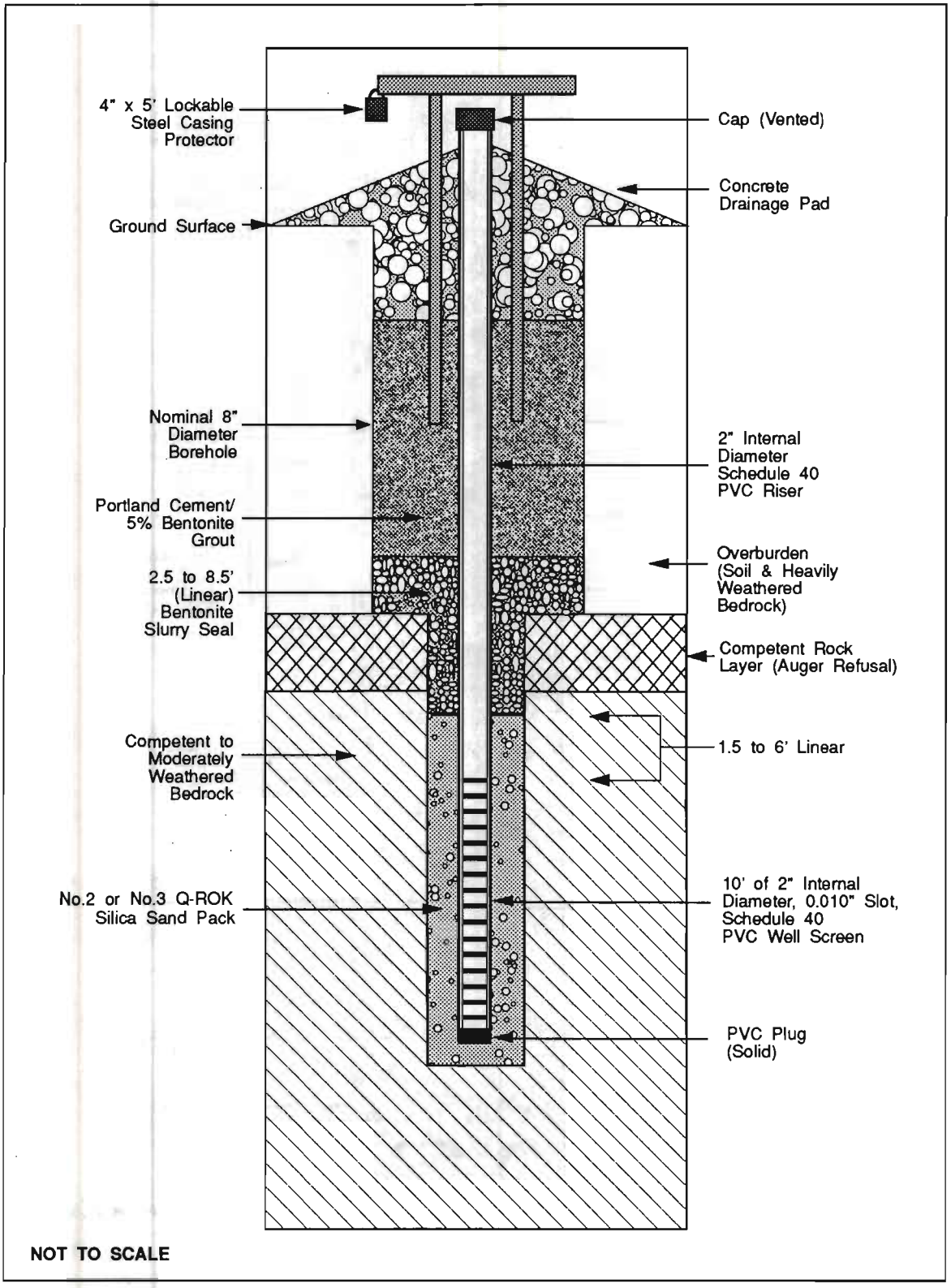


Figure 3-2
DEEP MONITORING WELL CONSTRUCTION

4. NATURE AND EXTENT OF CONTAMINATION

4.1 INTRODUCTION

To develop an understanding of the nature and extent of contamination at the Wellsville-Andover Landfill site, this section discusses the primary environmental media that influence contaminant migration, such as geology, surface hydrology, and hydrogeology. This is followed by a discussion of the concentrations and areal extent of contamination that exist in these media.

All analytical data (including field and laboratory samples) are presented on data summary sheets in Appendix D. Tables summarizing the organic and inorganic analytes detected in each sample type are provided in this section.

4.2 SITE GEOLOGY

4.2.1 Introduction

The geology at the Wellsville-Andover Landfill and throughout Allegany County can be subdivided into two primary units. One unit is the Paleozoic sedimentary rocks that underlie all of western New York and northern Pennsylvania. The second unit is a thin overburden of unconsolidated Pleistocene glacial deposits and recent alluvium. Section 2.3 provides a discussion of the regional geology. Site-specific interpretations of the geology at the Wellsville-Andover Landfill site were developed using primarily the following techniques:

- Field observations of soils as well as local bedrock outcrops;
- Interpretation of geophysical surveys;
- Examination of split-spoon samples and rock cores collected during the drilling of the 10 deep monitoring wells;
- Geotechnical analyses performed on selected samples; and
- Review of drilling log records and photos.

Subsurface boring logs were developed for each of the monitoring wells installed during the Phase I RI and are presented in Appendix B. Geologic cross-sections and a groundwater potentiometric surface contour map were generated from data collected from the monitoring wells and are discussed below.

4.2.2 Geophysical Survey Interpretation

Geophysical investigations performed at the site included total earth field magnetics, electromagnetic ground conductivity, and seismic refraction surveys. Data collection methods are described in Section 3.3 of this report.

As discussed in Section 3.3.1, magnetometer data were corrected for diurnal variations and then contoured using Surfer, version 4.10 (see Figure 4-1). Magnetic field strength in undisturbed areas was approximately 55,500 to 56,000 gammas. Anomalous areas of unusually high or low magnetic field strength were then noted for possible trench excavation. Several unusual features were noted on the generated contour map. Among them is the east-west linear feature with high magnetic field strength, located at the north end of the site. This feature correlates with the cut-off ditch at the north end of the filled areas. Since it is unlikely that metallic objects exist below the ditch, it is assumed that the sidewalls of the ditch interfered with the magnetic field. Another linear feature noted on Figure 4-1 occurs along the north side of the northeast fill area. This feature may represent a buried linear object or may again be due to magnetic field interference caused by the sloped embankment of the northeast fill area.

As discussed in Section 3.3.2, Surfer was used to generate contour maps of ground conductivity in both the horizontal and vertical dipole modes of the EM31 (see Figures 4-2 and 4-3). The ground conductivity in undisturbed areas was approximately 5 to 15 micromhos per meter (μMhos/M) in the horizontal dipole mode and approximately 10 to 20 μMhos/M in the vertical mode. The horizontal dipole was especially effective in defining the fill areas. In addition, Figure 4-2 appears to indicate that linear east-west cells were filled in the northeast area, while irregularly shaped cells exist in the other fill areas. Anomalous areas were noted on the contour maps, and those that correlated with magnetic anomalies were selected for trenching. The locations of the trenches are shown on Figure 3-1. The strong anomaly near coordinate 815,1285 on both Figures 4-2 and 4-3 was due to a concrete pad adjacent to the central access road.

As discussed in Section 3.3.3, seismic refraction data were collected around the perimeter of the fill area as well as along two transects across the center of the site (see Figure 1, Appendix A). Data interpretation involved selecting the first-break arrival times from the seismic traces. These measurements represent the arrival times of the primary wave (P-wave) of the seismic energy refracted along layers exhibiting significant velocity contrast. A P-wave

is the fastest-propagating type of seismic wave. The number of layers and their associated velocities are determined from the first-break data.

Algorithms from the GRM were used to convert the data from measurements of time to measurements of layer thickness. The approximate accuracy of this method is ±15%. Due to lack of borehole control at the time the survey was performed and analyzed, absolute depth estimates varied. However, the relative changes in bedrock topography interpreted along seismic profiles can be used to evaluate changes in overburden stratigraphy and bedrock topography.

A complete seismic report prepared by Davenport/Hadley, including seismic profiles, is presented in Appendix A. Based upon these results, overburden thickness appears to be consistent with topography with localized variations caused by erosional alteration of the bedrock surface. In general, the seismic data indicate three layers are present. The upper layer ranges in P-wave velocity from 1,090 to 2,220 feet per second (fps), typical of unconsolidated, unsaturated surficial soil. Generally, this layer is less than 10 feet thick. The middle layer ranges in velocity from about 2,090 to 5,400 fps, which is representative of dense soils or weathered rock. Velocities in excess of 5,000 fps represent saturated conditions. Based on subsurface boring information, the middle layer is thought to represent dense soil with many rock fragments derived from the local bedrock. The third layer generally has P-wave velocities in excess of 10,000 fps and was interpreted as competent rock. However, the subsurface boring logs indicate that the third layer may represent an increase in density from dense soil to either very dense soil with structurally intact rock lenses or to relatively competent, yet still highly fractured, bedrock.

4.2.3 Characteristics of the Overburden

As previously described, the Wellsville-Andover Landfill occupies a hill between Duffy Creek and its unnamed tributary. The site slopes generally to the south at approximately 5% to 6%. A description of the soils encountered in the area is provided in Section 2.3.1. In general, the soils consist of glacial till of local derivation underlain by hardpan and soils formed *in situ*.

The nature of the overburden was characterized using the results from the subsurface investigation. Split-spoon sampling was performed in MW-11S and each of the 10 deep wells installed at the site. Split-spoon sampling was performed in accordance with ASTM Designation D1586-84. In general, blow counts recorded during split-spoon sampling indicate mixed soils of varying density; however, the general pattern appears to be medium-density soils (10 to 29 blows/ft) underlain by dense (30 to 49 blows/ft) to very dense (≥50 blows/ft) soils, as expected.

The thickness of overburden at the site does not appear to change with topography; rather, localized bedrock erosional patterns and anthropogenic alterations control overburden

thickness. This is seen in the seismic cross sections in Appendix A. In borrow areas, the overburden is artificially thin (9 feet at MW-4D). Overburden thickness in undisturbed areas ranged from about 10 feet in MW-2D to 64 feet in MW-8D.

Nineteen subsurface soil samples were collected at and around the site for geotechnical analyses. All samples were subject to Atterberg limits testing (ASTM D4318), grain size analysis including hydrometer (ASTM D422), and water content analysis (ASTM D2216). The results of these analyses, including classification by the Unified Soil Classifications System (ASTM D2487-85), are presented in Appendix E. In general, the soil samples collected were well graded, with a fairly uniform distribution of gravels, sands, silts, and clays. Ten samples, including those from the north end (MW-1D) and south end (MW-8D) of the site, were classified as sandy lean clay with gravel (CL) or gravelly lean clay with sand (CL). Seven samples from various depths across the site were classified as clayey gravel with sand (GC) or clayey sand with gravel (SC). The general trend is for finer-grained soils (CL) to overlie coarser-grained soils (GC and SC).

One soil sample (CL-1) was collected from the Millers' property south of the site at the same location as the Millers' domestic water sample. At this location, perched water flowed on top of an unsaturated clay and silt layer. This sample contained more clay than any sample collected on site (24%) but contained enough silt (47%) and sand (16%) and was of sufficiently low plasticity to be classified as a silt with sand (ML). The clay portion of this sample has a low enough activity to be considered a mixture of illite and kaolinite (Holtz and Kovacs 1981). The low activity of the clay in the remainder of the samples suggests that most clay found at the site is illite. The presence of the clay- and silt-rich layer, as well as the existence of springs south of the site, suggests that as glacial ice receded from Duffy Hollow, outwash deposits of fine-grained soils were deposited in the area. These low-permeability units create perched water zones that emerge from hillsides as springs.

Trench excavation indicated that local materials were used for cover and that this material also contained a uniform grain-size distribution. Visual classification during trenching indicated the presence of various grain sizes from clay to boulder. Boulders consisted of locally derived sandstone ranging up to an 8-inch thick flagstone 6 feet in diameter.

4.2.4 Bedrock Geology

The characterization of the bedrock was determined from literature published regarding local geology as well as site investigation activities, including the seismic refraction survey and well drilling.

The site lies within the glaciated Allegheny Plateau section of the Appalachian Plateau physiographic province. This area is known locally as the Southwestern Plateau (USDA 1956). The entire region is underlain by Paleozoic sedimentary strata. The bedrock beneath the site is

part of the Late Devonian Canadaway Group (Rickard 1975). As described in Section 2.3.2, this group consists of approximately 700 to 1,200 feet of subtidal and peritidal deposits of shale, siltstone, and sandstone. Specifically, the bedrock beneath the site consists of the Wellsville Formation (called the Whitesville Formation to the east and the Forty Bridge to the west) (Rickard 1975). The Wellsville Formation consists of thin sandstones and siltstones, 0.5 to 3 inches thick, interbedded with primarily argillaceous but sometimes arenaceous shales. The formation is generally olive green to gray, weathering to greenish brown or brownish gray. In addition, some brown to dull red beds have been noted in the upper Wellsville. Calcareous shale and siltstone beds are present throughout the section. Many beds exhibit cross-bedding, ripple marks, and mud flows, and many are highly fossiliferous, containing mostly brochiopods (Woodruff 1942).

Definition of the upper bedrock surface at the site is very difficult due to the high degree of weathering of the bedrock as well as erosional irregularities in the surface. Bedrock was encountered in each of the 10 deep wells installed across the site. In general, auger refusal was achieved on a relatively competent, light gray, laminated, calcareous siltstone or fine-grained sandstone ranging in thickness from 1 to 5 feet. However, as indicated by the seismic refraction survey, the former bedrock surface may also be defined by changes in soil density or type; i.e., from glacial till to clays weathered in place from native shale. In many instances, the first competent calcareous siltstone layer encountered was underlain by rock so severely weathered it may be considered soil. Geologic cross-sections of lines AA' and BB' (see Figure 4-4) are provided as Figures 4-5 and 4-6. Cross-section AA' runs N4°E/S4°W along the east side of the site. Cross-section BB' runs N54°W/S54°E across the center of the site. Both cross-sections indicate a complex, interbedded formation, with various layers appearing, disappearing, or lying unconformably on others. This complex interbedding indicates deposition in a very active subtidal and nearshore environment.

The seismic survey indicates that the bottom refractor dips south at approximately 3° to 5°. However, correlation of coal stringers encountered in wells MW-3D, MW-5D, and MW-6D and subsequent correction to an east-west strike (Woodruff 1942) indicates that the bedrock beneath the site dips approximately 1.4° south.

With the exception of the occasional competent sandstone bed, the majority of the bedrock encountered was extremely weathered and very highly fractured. In general, shale beds were more highly fractured and weathered than the silt and sandstone beds, and contained subhorizontal to subvertical fractures. Numerous fractures in a variety of beds were open, with visible oxidation residues present on the fracture surfaces. Horizontal and vertical clay-filled fractures were also encountered across the site. No significant zones of competent bedrock were encountered beneath the fractured zone. Therefore, the potential maximum depth of contaminant migration cannot be determined at this time.

4.3 SITE HYDROLOGY

4.3.1 Surface Water and Runoff

The Wellsville-Andover Landfill occupies a hillside that slopes to the south at approximately 5% to 6%. In addition, the majority of the site dips gently to the southwest toward the unnamed tributary to Duffy Creek. The hillside adjacent to the east side of the site slopes more steeply to Duffy Creek at approximately 14% to 20%. However, due to the presence of a low ridge along the east side of the site, the vast majority of surface water drains toward the unnamed tributary.

Numerous ditches were excavated at the site to divert surface runoff away from the filled areas. The northernmost trench, located approximately 160 feet north of the northeast fill area, runs east-west, diverting flow around the northeast and northwest fill areas. Flow diverted to the east runs via shallow ditches into the drainage collection pond. This pond is meant for temporary storage, as water can drain out to the west via a culvert. Pond overflow drains in a ditch toward the northern access gate. In addition, runoff on the west side of the site flows to the northern access gate, as does runoff from the north central portion of the site. All runoff that reaches the northern access gate flows through a culvert under Snyder Road directly into Duffy Creek's unnamed tributary. Ditches also exist around the perimeters of the south and south-central fill areas. Runoff in these areas is also diverted to the west, eventually ending up in the unnamed tributary via culverts under Snyder Road.

Throughout the field investigation, ponded surface water was present in the drainage collection pond as well as in a small depression adjacent to MW-2S, even when all ditches were dry. This suggests that springs may be present in these areas.

The unnamed tributary that flows along the west side of the site is registered as a Class C water body (6 NYCRR 821.6). This stream is shown to be intermittent by the USGS (1965b), and this was confirmed during surface water sampling. At the time of sampling, the stream consisted only of isolated pools. Duffy Creek, also classified as Class C (6 NYCRR 821.6), consisted primarily of pools connected by very low flow streams at the time of surface water sampling. Detailed characterization of these two streams is provided in Section 6 of this report.

4.3.2 Groundwater Hydrogeology

Groundwater data were collected from the nine bedrock and eight overburden wells installed during the Phase I RI as well as the four pre-existing wells. Water levels were measured in each of the wells after development but prior to sampling in October 1991 and then again in November 1991. These data are presented in Table 4-1.

During drilling and split-spoon sampling, saturated soils were not encountered, except in MW-11S. In this well, the soil became moist to wet at 15 to 16 feet below ground surface

(BGS). Prior to sampling, the water level in MW-11S rose to 5.7 feet BGS. In the remaining wells, alternating zones of wet and dry soils were encountered. In general, the coarser-grained zones (sands and gravels) were drier than the fine-grained zones (clays and silts). The presence of moisture in the slow-draining clays and silts is interpreted as residual moisture from a fluctuating water table. In general, however, moisture was first noticed at 6 to 8 feet BGS in most wells.

After well development but prior to sampling in October 1991, water levels in the overburden wells ranged from 1.1 feet BGS in MW-5S to 17.9 feet BGS in MW-9S. At this same time, water levels in the bedrock wells ranged from 1.3 feet BGS in MW-5D to 64.2 feet BGS in MW-1D. In general, water levels in November 1991 were similar to those in October 1991. Most water levels rose slightly by November, except in MW-1D, MW-2D, and MW-3D, where they dropped slightly, and in MW-9D, MW-10D, MW-10S, CW-3A, and MW-3B, where they dropped from 0.5 to 8.8 feet. In addition, the water level rose significantly (8.2 feet) in MW-3S between October and November 1991.

The water level data indicate that perched water exists in the overburden at and around the site, supporting data collected during well drilling and geotechnical analyses regarding the soils. The presence of springs near the site also supports this theory.

Using the data collected in November 1991, various hydraulic gradients were calculated. Vertical gradients are difficult to interpret at this site and may be misleading due to the presence of perched water. Nonetheless, the vertical gradient was found to be moderately uniform across the site, ranging from 0.3 to 0.6 ft/ft (downward) based on well pairs MW-3D/3S, MW-6D/6S, MW-9D/9S, and MW-10D/10S. The vertical gradient at well pair MW-5D/5S was found to be significantly less than that above (0.01 ft/ft). This pair is relatively close to MW-6D/6S, and the order of magnitude difference in vertical gradients between these two well pairs supports the theory that perched water zones are present in the overburden.

Horizontal hydraulic gradients were calculated based on the November 1991 bedrock well water levels. The average horizontal gradient across the entire site is to the south and was calculated to be 0.04 ft/ft between MW-1D and MW-7D. This is similar to but slightly less than the topographic gradient between these wells (0.05 ft/ft south), suggesting that the potentiometric surface is strongly influenced by topography. At the north end of the site, the horizontal hydraulic gradient is approximately 0.03 ft/ft south as calculated between MW-1D and MW-10D, MW-3D, and MW-2D. This is less than the topographic gradient of 0.06 ft/ft in this area. At the south end of the site, the horizontal gradient increases to a maximum of 0.10 ft/ft between MW-6D and MW-7D, which is greater than the topographic gradient between these wells (0.07 ft/ft). In some areas, the horizontal hydraulic gradient is reversed. For example, between MW-2D and MW-4D, the gradient is 0.01 ft/ft to the north, indicating the presence of a groundwater divide.

Contouring of water surface elevations for the bedrock wells indicates that groundwater flow mimics topography with a general flow direction in the northern and central portions of the site to the south-southwest (see Figure 4-6). An exception to this is seen on the west side of the site, where groundwater flows southwest toward the unnamed tributary to Duffy Creek. Additionally, flow at the south end of the site is directed more to the south. The contours also indicate that a groundwater divide exists on the east side of the site trending approximately north to N7°W. The presence of this divide is also supported by the reversal in horizontal hydraulic gradient between wells MW-2D and MW-4D, and MW-2D and MW-3D. Groundwater flow on the east side of the site is to the east, following the steep topographic gradient down to Duffy Creek. Some of this flow likely emerges as the springs present on the lower hillside between the site and Duffy Creek.

Due to the presence of complicating perched zones, a contour map of groundwater flow in the overburden is not included. However, comparison of water levels suggests that groundwater flow in the overburden is similar to the flow depicted in the bedrock.

Based on the water level data as well as subsurface boring logs, the overburden and bedrock beneath the site are interpreted as being one continuous aquifer. That is, no confining layer was found to be consistently present between the overburden and bedrock, and groundwater appears to be able to pass freely from one medium to the next. Low permeability zones of clayey silt are present throughout the overburden in the area as discussed; however, they appear to be discontinuous, creating perched but unconfined water-bearing zones. The springs in the area are interpreted as resulting from the convergence of these perched zones just beneath the ground surface.

Generally, groundwater flow in the overburden is restricted vertically by clay and silt lenses but is facilitated in sandy and gravelly zones. In the bedrock, the major component of flow appears to be the result of secondary porosity features of the bedrock--i.e., fractures and joints. Open and clay-filled fractures of all orientations were observed in both arenaceous and argillaceous beds, indicating that water can flow both horizontally and vertically and is generally unrestricted by usually confining shale beds. Interstitial flow due to the primary porosity of the bedrock is expected to be a relatively minor component. Interstitial pore flow is most likely restricted both horizontally and vertically by the presence of shale beds.

4.4 EXTENT OF CONTAMINATION OF ENVIRONMENTAL MEDIA

The following sections include a summary of the chemical contamination discovered at the Wellsville-Andover Landfill site during the Phase I RI between August and December 1991. The following media were sampled in order to assess the extent of contamination on and off the site:

- Subsurface soil and waste from trenches;
- Subsurface soil from borings;
- Groundwater;
- Residential wells and springs;
- Surface water;
- Sediment;
- Surface soil;
- Leachate; and
- Air.

Tables 4-2 through 4-21 contain a summary of the analytical data for the various media sampled. Appendix D contains a tabulation of all analytical results including tentatively identified compounds (TICs).

All of the analytical data were independently qualified and then reviewed by E & E prior to reporting. A discussion of the data qualification is presented in Section 4.5 of this report. In general, common laboratory contaminants including methylene chloride, acetone, and phthalate compounds are not discussed in this section when these compounds were detected in the field samples at concentrations similar to those in the method blanks.

4.4.1 Subsurface Soil/Waste Samples From Trenches

As discussed in Section 3.4, five trenches were excavated at the site, the locations of which were based upon the geophysical surveys performed. One soil/waste sample was collected from each trench shown in Figure 3-1. A description of the samples (TP-1 to TP-5) is provided in Table 3-2.

Trench 1 was excavated on December 19, 1991 in the northwest corner of the northwest fill area. The top 1.5 feet consisted of brown channery loam of local derivation consisting of clay- to boulder-sized material. This was underlain by approximately 1.5 feet of gray clay and silt containing large sandstone fragments. Municipal trash was encountered at 3 to 4 feet and continued down to at least 15 feet. No cause for the geophysical anomaly was observed, so a second trench was excavated 10 feet north of the first. In both, water was found to flow into the excavation at approximately 5 feet below grade. In the second excavation, two 55-gallon drums were encountered at approximately 6 feet. These drums were heavily rusted and contained a black liquid that may or may not have been groundwater

that entered the breached drums. Sample TP-1 was collected from soil adjacent to the drums on which the liquid had spilled. No markings were noted on the drums.

Trench 2 was excavated on December 19, 1991 in the central portion of the northeast fill area. The cover material consisted of only about 1.5 feet of brown channery loam of local derivation containing clay- to boulder-sized material. This trench was excavated to 7 or 8 feet, and only municipal trash was encountered. The source of the geophysical anomaly was determined to be numerous metal objects, including a steel trash can, an aluminum storm door, a roll of steel chicken wire, and copper tubing. Sample TP-2 was collected from this trench and consisted of soil composited from the full length of the trench at about 5 to 6 feet below grade.

Trench 3 was excavated on December 18 and 19, 1991 near the southeast corner of the northwest fill area. At this location, approximately 3 feet of cover material was encountered, consisting of medium brown and dark gray channery loam (clay- to boulder-sized material). Municipal trash in an ash-like matrix was encountered at 3 to 4 feet. Water was found to enter the trench at 4 and 6 feet. Excavation of the trench was completed the morning of December 19, 1991, and water had filled the trench to about 1.5 feet below grade by the next morning. The source of the geophysical anomaly was determined to be a large piece of scrap metal at 6 feet as well as numerous truck tire rims. Sample TP-3 consisted of a mixture of the soil and ash-like substance collected at about 6 feet.

Trench 4 was excavated on December 18, 1991 in the northeast corner of the south-central fill area. The cover material at this location consisted of about 2 to 2.5 feet of medium brown channery loam (clay- to boulder-sized material). Immediately below the cover, five heavily rusted and dented 55-gallon drums were encountered along the 15- to 20-foot length of the trench. These drums, which were all lying on their sides in the same orientation, contained a pink, white, gray, and brown mottled solid material. This material seemed to be a low-density plastic with many air bubbles. No markings were observed on the drums; however, the soil around the drums contained more than 50% plastic buttons and plastic scraps from which these buttons were apparently punched. Sample TP-4, composited from all five drums, consisted of soil, plastic scraps, and small fragments of the plastic-like material from the drums.

Trench 5 was excavated on December 17 and 18, 1991 in the central portion of the south fill area. The cover consisted of about 2 feet of brown channery loam (clay- to boulder-sized material). This trench contained municipal trash as well as construction and demolition debris. The source of the geophysical anomaly was found to be a car fender, a roll of steel barbed wire, and one empty, crushed 55-gallon drum marked "oil," all of which were found at less than 6 feet below grade. Water was found to enter the trench at approximately 4 feet and had a very slight oil sheen. Sample TP-5 was collected from the soil and waste below the crushed drum where water entered the trench.

Samples TP-1 through TP-5 were analyzed by E & E's ASC for full TCL parameters according to NYSDEC CLP methods. Sample preservation, shipping, and handling procedures were performed in accordance with the QAPjP. For QC purposes, additional sample volume was collected with TP-5 for MS/MSD analyses.

The organic compounds detected in the samples collected are included in Table 4-2. Numerous VOCs were detected in the samples including ketones, aromatic hydrocarbons, and chlorinated alkenes and alkanes. Acetone, a common laboratory contaminant, is included in Table 4-2 because it was detected in four of the samples but not in the laboratory method blank. However, even the relatively high acetone concentration in TP-1 may be due to laboratory contamination because this sample was analyzed as a medium-concentration sample, which amplifies the amount of laboratory contaminants, such as acetone, detected. Other ketones detected include 2-butanone and 2-hexanone in TP-1 and TP-5, and 4-methyl-2-pentanone in TP-1 only.

Several aromatic hydrocarbons were detected in the samples. Benzene was detected in TP-5 only, at an estimated concentration of 78 µg/kg. Ethylbenzene was detected in all five samples at estimated concentrations ranging from 31 µg/kg in TP-2 to 33,000 µg/kg in TP-1. Toluene was also detected in all five samples, ranging from an estimated 11 µg/kg in TP-2 to 3,200 µg/kg in TP-4. Styrene was detected in two samples only: 45 µg/kg in TP-1 and 4,200 µg/kg in TP-4. Xylenes were detected in all samples except TP-3, ranging from an estimated 51 µg/kg in TP-2 to 1,700 µg/kg in TP-1.

Several chlorinated aliphatic compounds were also detected in the trench samples. 1,1-Dichloroethane (1,1-DCA) was detected in TP-1 at 710 µg/kg. Total 1,2-dichloroethene (total 1,2-DCE) was detected in all samples except TP-2, ranging from an estimated 21 µg/kg in TP-5 to 3,900 µg/kg in TP-1. Tetrachloroethene (PCE) was detected in TP-4 only, at an estimated concentration of 520 µg/kg. TCE was detected in TP-1 at 73 µg/kg and TP-4 at 5,300 µg/kg. Vinyl chloride (VC) was detected in TP-1 only, at an estimated concentration of 980 µg/kg. MC, a common laboratory contaminant, is included in Table 4-2 because it was detected in TP-5 at concentrations significantly higher than in the associated method blank.

Several semivolatile organic compounds were detected in the trench samples, including phthalates, polynuclear aromatic hydrocarbons (PAHs), and phenols. Five phthalates were detected in the samples. While these compounds are common laboratory and field contaminants, most of the concentrations detected are higher than would be expected for background contamination. Bis(2-ethylhexyl)phthalate was detected in all samples except TP-3, ranging from an estimated 1,100 µg/kg in TP-1 and TP-2 to 8,300 µg/kg in TP-4 and TP-5. Butylbenzylphthalate was detected at 16,000 µg/kg in TP-2 and estimated concentrations of 1,000 and 2,700 µg/kg in TP-4 and TP-5, respectively. Di-n-butylphthalate was detected in all samples except TP-1 and TP-3, ranging from an estimated 270 µg/kg in TP-2 to 14,000

µg/kg in TP-4. Diethylphthalate was detected only in TP-1 and TP-3 at estimated concentrations of 110 and 25 µg/kg, respectively. Dimethylphthalate was detected only in TP-4 and TP-5, at estimated concentrations of 910 and 530 µg/kg, respectively.

Numerous PAHs were detected in samples TP-1, TP-2, and TP-5, but none was detected in TP-3 or TP-4. Benzo(b)fluoranthene, benzo(a)pyrene, and chrysene were detected in sample TP-2. 2-Methylnaphthalene and napthalene were detected in TP-2 and TP-5. Fluoranthene, phenanthrene, and pyrene were detected in samples TP-1, TP-2, and TP-5. Concentrations of individual PAHs ranged from an estimated 130 µg/kg (phenanthrene in TP-1) to approximately 720 µg/kg (fluoranthene in TP-2).

Several phenolic compounds were also detected in the trench samples. 4-Chloro-3-methylphenol was found only in TP-2, at approximately 300 µg/kg. 4-Methylphenol was detected in all of the samples except TP-4, ranging from an estimated 370 to 1,600 µg/kg. Pentachlorophenol was detected only in TP-5, at approximately 6,600 µg/kg.

In addition to the above compounds, benzyl alcohol was detected in TP-4 at approximately 1,200 µg/kg, and 1,2-dichlorobenzene was detected in TP-4 and TP-5 at estimated concentrations of 1,200 and 670 µg/kg, respectively.

No PCBs were detected in any of the five samples; however, several pesticides were detected at low concentrations in TP-1, TP-2, and TP-5. Sample TP-1 was found to contain beta-BHC at approximately 12 µg/kg, and TP-5 contained 4,4'-DDD at 120 µg/kg. TP-2 was found to contain dieldrin; 4,4-'DDE; 4,4'-DDD; and 4,4'-DDT at estimated concentrations ranging from 13 to 130 µg/kg.

Table 4-3 summarizes the inorganic analytes detected in the trench samples. Of the 24 inorganics analyzed for, 17 were detected. Concentrations of metals in the trench samples were compared to the common range detected in eastern United States soils as well as to the upper limit of the 90th percentile in order to preliminarily screen the metals of interest (Shacklette and Boerngen 1984). The upper limit of the 90th percentile, indicating the value below which 90% of background samples should fall, was calculated using the following formula:

$$90\text{th percentile} = M^{*}D^{1.282}$$

where:

M is the geometric mean, D is the geometric standard deviation, and 1.282 is the alpha value pertaining to the 90th percentile, provided in Shacklette and Boerngen (1984).

Aluminum, barium, beryllium, calcium, chromium, iron, manganese, potassium, sodium, and vanadium were detected in all five samples but at concentrations within the 90th percentile for eastern U.S. soils. Arsenic exceeded the 90th percentile only in TP-1 at an estimated 20.9

mg/kg. Cobalt exceeded the 90th percentile in all samples, ranging from 20.8 to 28.1 mg/kg. Copper exceeded the 90th percentile in TP-3 at 194 mg/kg. Elevated concentrations of lead were detected in all samples except TP-3 and ranged from approximately 15.3 mg/kg in TP-3 to about 86.9 mg/kg in TP-4. Nickel exceeded the 90th percentile in TP-1 only, at a concentration of 43.2 mg/kg. Zinc exceeded the 90th percentile in all samples except TP-4 and ranged from approximately 87.4 mg/kg in TP-4 to an estimated 269 mg/kg in TP-3. While many of the above metals exceeded the upper limit of the 90% percentile, none exceeded the observed range. In addition, no cyanide was detected in any of the samples.

In summary, TP-1 contained five metals above the 90th percentile for common eastern U.S. soils, while the remaining samples contained three such metals. Cobalt was detected at elevated concentrations in all samples but with a small difference between concentrations. This suggests that cobalt may be naturally abundant in the area. Chlorinated aliphatics were detected in four of the five samples, ranging from 21 µg/kg in TP-5 to 8,720 µg/kg in TP-4. Aromatic hydrocarbons were detected in all five samples and ranged from 93 µg/kg in TP-2 to 35,900 µg/kg in TP-1. PAHs were detected in three of the five samples, with the highest total concentration (3,170 µg/kg) detected in TP-2. Phthalates, detected in all of the samples, ranged from 204 µg/kg in TP-3 to 24,200 µg/kg in TP-4. Phenols ranged up to 6,870 µg/kg in TP-5. Pesticides, detected in three samples, ranged up to 201 µg/kg in TP-2.

4.4.2 Subsurface Soil Samples From Borings

As discussed in Section 3.5.3, 20 subsurface soil samples were collected during boring of the 10 deep monitoring wells. Samples from wells MW-1D, MW-6D, MW-7D, and MW-8D were analyzed for full TCL organic substances and inorganic substances, while samples from MW-2D, MW-3D, MW-4D, MW-5D, MW-9D, and MW-10D were analyzed for TCL VOCs and inorganic substances only. All analyses were performed according to NYSDEC CLP methods. Tables 4-4 and 4-5 summarize the organic and inorganic analytes detected in the subsurface soil samples, respectively.

VOCs were detected only in the soil samples collected from monitoring well MW-5D. Three chlorinated aliphatic compounds were detected in samples SB-5B and SB-5C. Sample SB-5B, collected from 8 to 9 feet below grade, contained total 1,2-DCE at 87 µg/kg, TCE at 22 µg/kg, and VC at 21 µg/kg. Sample SB-5C, collected from 18 to 19 feet below grade, contained 61 µg/kg of total 1,2-DCE, 13 µg/kg of TCE, and an estimated 7 µg/kg of VC. No semivolatile substances, PCBs, or pesticides were detected in any of the samples analyzed for those compounds.

Of the 24 inorganic analytes tested, 19 were detected in at least one subsurface soil sample. Concentrations of the metals detected were compared to the common range detected in eastern U.S. soils as well as to the upper limit of the 90th percentile (Shacklette and

Boerngen 1984). Aluminum, barium, beryllium, chromium, copper, iron, potassium, sodium, vanadium, and zinc were detected in all or most of the samples, but all at concentrations within the 90th percentile. Cadmium was detected above the contract required detection limit (CRDL) only in SB-2A and SB-10A, and mercury was detected only in SB-8B; however, all three concentrations were within the 90th percentile.

Arsenic, which was detected in all subsurface soil samples, exceeded the 90th percentile in samples SB-3A, SB-9A, and SB-9B at concentrations of 16.4 (estimated), 17.4, and 17.9 mg/kg, respectively. Calcium and magnesium, both detected in all samples, exceeded the 90th percentile in sample SB-10B only, at concentrations of 77,500 and 17,100 mg/kg, respectively. Cobalt, detected in all samples, exceeded the 90th percentile in all samples except SB-10B (including both background samples). Cobalt concentrations ranged from 14.5 to only 33.2 mg/kg, indicating a possible natural abundance of this metal in the area. Lead was detected in all samples except SB-4A, exceeding the 90th percentile in SB-6B and SB-10A at estimated values of 35.6 and 45.3 mg/kg, respectively. Manganese, detected in all samples, exceeded the 90th percentile in SB-4A only, at 1,670 mg/kg. Nickel, also detected in all samples, exceeded the 90th percentile in SB-1A, SB-4A, SB-4B, SB-6A, SB-7A, and SB-7B, with the highest concentration, 53.4 mg/kg, detected in background sample SB-1A. No cyanide was detected in any of the subsurface soil samples.

In summary, organic compounds were detected only in the subsurface soil samples from MW-5D and consisted of the three chlorinated aliphatics of primary concern at this site. In terms of inorganic substances, no sample contained more than three metals above the 90th percentile for typical eastern U.S. soils, including cobalt, which appears to be naturally abundant. Of those metals above the 90th percentile, none exceeded the common range detected in eastern U.S. soils (Shacklette and Boerngen 1984).

4.4.3 Groundwater Samples

As discussed in Section 3.5.4, groundwater samples were collected from the 17 newly installed monitoring wells and the four pre-existing wells. All samples were unfiltered and were analyzed for full TCL organic substances and inorganic substances according to NYSDEC CLP methods, with the exception of GW-2S, GW-9S, and GW-12S, which, due to insufficient sample volume, were analyzed for TCL VOCs and inorganic substances only. Tables 4-6 and 4-7 summarize the organic substances and inorganic substances detected in the groundwater samples, respectively. Table 4-8 summarizes the sampling parameters pertaining to the groundwater samples. All samples remained unfiltered; therefore, the suspended sediment in each well was allowed to settle out prior to sampling, as discussed in Section 3.5.4. By doing so, the metals portion of 10 samples had a turbidity below 50 NTU, and all but three samples

had turbidities below 250 NTU. The high turbidities of samples GW-2S and GW-9S were due to the small amount of water in these wells.

Several organic substances, including aromatic hydrocarbons and chlorinated aliphatic compounds, were detected in various groundwater samples. Acetone was detected in GW-3S at 33 µg/L. While acetone is a common laboratory contaminant, it is included in Table 4-6 because it was not detected in the method blank related to GW-3S. However, based on the low concentration and its presence in GW-3S alone, the acetone is assumed to result from laboratory contamination. One trihalomethane was detected in the groundwater samples--chloroform in GW-9S--but at a concentration below the NYSDEC Class GA standard.

Several chlorinated aliphatic compounds were detected across the site. Chloroethane was detected above the Class GA standard in GW-11S at an estimated concentration of 8 µg/L. 1,1-DCA was detected above the Class GA standard in samples GW-5D and GW-5S at estimated concentrations of 6 and 11 µg/L, respectively. 1,1-DCE was detected above the standard in samples GW-5D, GW-5S, GW-11S, and GW-11SDD at estimated concentrations ranging from 9 to 12 µg/L. 1,1-DCE was also detected below the standard in GW-2D. Total 1,2-DCE was detected at or above the standard in samples GW-2D, GW-5D, GW-5S, GW-6D, GW-6S, GW-11S, GW-11SDD, and GW-12D at estimated concentrations of 5 to 5,600 µg/L. In addition, total 1,2-DCE was detected below the standard in GW-10D, GW-12S, and GW-13D. MC was detected only in GW-12D, below the Class GA standard. This compound is a common laboratory contaminant but is included in Table 4-6 because it was not detected in the method blank associated with GW-12D. 1,1,1-Trichloroethane (1,1,1-TCA) was detected only in GW-2D and GW-5S, both at levels below the Class GA standard. TCE was detected above the standard in GW-2D, GW-5D, GW-5S, GW-6D, GW-11S, GW-11SDD, and GW-12S at concentrations ranging from 38 to 1,200 µg/L. TCE was also detected below the standard in GW-3D, GW-4D, and GW-10D. VC was detected above the Class GA standard in samples GW-2D, GW-5D, GW-5S, GW-6D, GW-11S, GW-11SDD, and GW-12D at concentrations ranging from an estimated 45 to 2,100 µg/L.

Two aromatic hydrocarbons were also detected at the site. Ethylbenzene was detected below the standard in GW-5D, and toluene was detected at or above the standard in GW-5D, GW-5S, and GW-12S at concentrations ranging from 5 to an estimated 9 µg/L.

No semivolatile substances, PCBs, or pesticides were detected in any of the groundwater samples analyzed.

Of the 24 inorganic substances analyzed for, 17 were detected in the groundwater samples. Aluminum, arsenic, barium, beryllium, calcium, cobalt, copper, nickel, potassium, vanadium, and zinc were detected in various samples across the site, as detailed in Table 4-7, but all at concentrations below Class GA standards. Chromium, detected only in seven samples including the background, exceeded the standard only in GW-2S at 110 µg/L. Iron

was detected and exceeded the standard in all samples, including the background, at concentrations ranging from 316 to an estimated 110,000 µg/L. Lead was detected in all but eight samples and exceeded the standard in GW-2S and GW-12S at an estimated 38.1 and 125 µg/L, respectively. Magnesium was detected in all samples but exceeded the Class GA guidance value only in GW-2S and GW-8S at 50,500 and 56,000 µg/L, respectively. Manganese was detected in all samples, exceeding the standard in 15 samples at concentrations ranging from 387 to 8,530 µg/L. Sodium was also detected in all the samples and exceeded the standard in 12 samples at concentrations ranging from 20,400 to 516,000 µg/L. No cyanide was detected in any sample.

The high inorganic content in many of the wells, especially GW-2S, is most likely a result of the high turbidity of those samples. In terms of organic substances, the two most contaminated wells are MW-5D and MW-5S, with total VOC concentrations of approximately 6,300 and 8,100 µg/L, respectively.

4.4.4 Residential Well and Spring Samples

As discussed in Section 3.6, water samples were collected from five residential wells and two springs. All samples were analyzed for TCL semivolatile substances, PCBs, pesticides, metals, and cyanide according to NYSDEC CLP methods, as well as volatiles by EPA Method 524.2. Tables 4-9 and 4-10 summarize the organic and inorganic analytes detected, respectively. At the time of sampling, conductivity, temperature, and turbidity data were collected for each of the samples. These data are presented in Table 4-11.

The only volatile substance detected in the samples collected, other than those attributable to laboratory contamination, was TCE. This chlorinated aliphatic compound was detected only in water from the LaDue spring (DW-5) at 2.6 µg/L. TCE was also detected in the field duplicate collected at the LaDue spring (DW-5D) at 2.9 µg/L. No semivolatile substances, PCBs, or pesticides were detected in any of the samples.

Of the 24 inorganic analytes tested for, 14 were detected in the residential water samples. Aluminum, barium, calcium, magnesium, and potassium were detected in all the samples at concentrations below NYSDEC Class GA standards and guidance values and New York State Department of Health (NYSDOH) Maximum Contaminant Levels (MCLs). Chromium, copper, lead, mercury, and cyanide were detected in some of the samples, but none was detected at concentrations exceeding NYSDEC Class GA standards or NYSDOH MCLs.

Iron, present in all but DW-2, exceeded the Class GA standard and MCL in DW-1, DW-3, DW-4, DW-5, and DW-6 at concentrations ranging from 534 to 1,300 µg/L. Manganese, present in all samples, exceeded the Class GA standard and MCL in DW-1 only, at 510 µg/L. Iron and manganese are both considered secondary contaminants by NYSDOH, with MCLs based on aesthetic quality. Both are also commonly high in unfiltered groundwater samples.

Sodium, present in all samples, exceeded the NYSDEC Class GA standard in samples DW-1, DW-3, DW-4, and DW-7 at concentrations ranging from 31,600 to 58,000 µg/L. No MCL for this secondary contaminant exists; however, the sodium content in the above four samples exceeds the guideline for people on severely restricted sodium diets. No sodium concentrations exceeded guidelines for people on moderately restricted sodium diets (10 NYCRR 5-1.52).

Zinc, detected in all samples, exceeded the NYSDEC Class GA standard in DW-4 only, at a concentration of 338 µg/L. However, this concentration is below the MCL for this secondary contaminant.

4.4.5 Surface Water Samples

As discussed in Section 3.7, six surface water samples plus one field duplicate were collected from Duffy Creek and its unnamed tributary. Two samples were collected from Duffy Creek (SW-2 and SW-4), two were collected from its tributary (SW-1 and SW-3) upstream of their confluence, and two were collected downstream of the confluence (SW-5 and SW-6). All samples were analyzed for full TCL organic substances and inorganic substances. Tables 4-12 and 4-13 summarize the organic substances and inorganic substances detected in the surface water samples, respectively.

No VOCs other than common laboratory contaminants were detected in the surface water samples. Two semivolatile compounds were detected in the samples. Di-n-butylphthalate was detected at low concentrations in SW-1, SW-2, SW-4, and SW-6. In addition, di-n-octylphthalate was detected at a low concentration in SW-2. Phthalates are common laboratory contaminants but are included here because neither was detected in the method blank associated with these samples. Phthalates are also common field contaminants resulting from rubber-based protective clothing. The phthalates detected in the downstream samples are assumed not to be site-related because they were also detected upstream (SW-2).

No PCBs or pesticides were detected in any of the surface water samples.

Of the 24 inorganics analyzed for, 13 were detected in the samples. Barium, calcium, magnesium, manganese, potassium, sodium, vanadium, and zinc were present in most or all of the samples analyzed but at concentrations below NYSDEC Class C standards. Aluminum was present in all samples and exceeded the Class C standard in all samples except SW-6, collected the furthest downstream of the site. Aluminum concentrations ranged from 119 to 578 µg/L in the samples, exceeding the Class C standard, and was present at 307 µg/L in the background sample from Duffy Creek (SW-2). Copper and nickel were both detected only in the background sample (SW-2), and both were detected at concentrations below Class C standards. Iron was detected in all seven samples, exceeding the standard in all except SW-4 and SW-6. The highest concentration of iron was detected in SW-2, the background sample

(estimated to be 3,840 µg/L). Lead was detected in all seven samples, ranging from estimated concentrations of 1.1 to 4.9 µg/L. The Class C standard for lead was exceeded in samples SW-3, SW-4, SW-4D, and SW-5 but not in the sample closest to the site (SW-1) nor furthest downstream (SW-6).

The surface water samples were also analyzed for hardness, as indicated on Table 4-13. All seven samples fall near the border between soft and moderately hard water.

4.4.6 Sediment Samples

As discussed in Section 3.7, sediment samples were collected from six locations in Duffy Creek and its unnamed tributary. These samples were collected from the same locations as the surface water samples discussed in Section 4.4.5. Tables 4-14 and 4-15 summarize the organic and inorganic analytes detected in the sediment samples, respectively.

The only VOC detected in any of the sediment samples was acetone which was present in all samples except SED-6 at concentrations ranging from approximately 10 to 38 µg/kg. Acetone is a common laboratory contaminant but is discussed here because it was not detected in the associated method blank. However, due to the low concentrations detected, as well as its presence in the upstream sample (SED-2), the presence of acetone in these samples is assumed to be due to laboratory contamination.

The only semivolatile substances detected was butylbenzylphthalate in sample SED-3 at an estimated concentration of 24 µg/kg. Phthalates are common field and lab contaminants resulting from rubber-based protective clothing. No sediment criteria exist for either acetone or butylbenzyl phthalate (NYSDEC 1989).

No PCBs or pesticides were detected in any of the sediment samples.

In addition to the above analyses, the sediment samples were also analyzed for organic matter according to ASTM Designation D2974-87. The results, which are presented in Table 4-14, ranged from 3.2 to 7.3%.

Of the 24 inorganics analyzed for, 17 were detected in the sediment samples. Aluminum, barium, beryllium, calcium, chromium, cobalt, lead, magnesium, potassium, and vanadium were detected in all seven samples at concentrations below the sediment criteria. Sodium, detected only in SED-2, has no applicable criterion. Arsenic, detected in all samples at concentrations ranging from 8.1 to 14.3 µg/kg, exceeded the sediment criterion but not the limit of tolerance in all samples, including the background sample (SED-2). Copper was detected in all of the sediment samples at concentrations ranging from 15.7 to 23.0 µg/kg and exceeded the criteria, but not the limit of tolerance, in SED-1, SED-4, and SED-4D. Iron exceeded the sediment criterion in all samples, with concentrations ranging from 31,600 to 43,200 µg/kg. Iron also exceeded the limit of tolerance in SED-2, the background sample, and in SED-6. Manganese exceeded the sediment criterion in all samples, with concentrations

ranging from 705 to 2,440 µg/kg, and it exceeded the limit of tolerance in samples SED-1, SED-2, SED-3, and SED-5. The highest concentrations of iron and manganese were detected in the background sample SED-2, suggesting that the presence of these metals at high concentrations is not site-related.

Nickel exceeded the sediment criterion but not the tolerance limit in all of the samples, with concentrations ranging from 33.4 to 42.2 µg/kg. Zinc, detected in all samples, exceeded the criterion in SED-2, SED-3, and SED-4D, but not the tolerance limit. The background sample, SED-2, contained one of the highest concentrations of zinc.

4.4.7 Surface Soil Samples

As discussed in Section 3.8, two background (SS-1 and SS-2) and twelve biased (SS-3 through SS-14) surface soil samples were collected at and around the site. All 14 samples were analyzed for full TCL organic substances and inorganic substances according to NYSDEC CLP methods. Tables 4-16 and 4-17 summarize the organic and inorganic analytes detected in the surface soil samples, respectively.

Three VOCs were detected in the surface soil samples. Acetone was detected in one sample (SS-11) at a concentration that was not directly attributable to laboratory contamination. Chloromethane was detected in SS-7 at an estimated concentration of 40 µg/kg, and ethylbenzene was detected in SS-6 and SS-7 at estimated concentrations of 1 and 18 µg/kg, respectively. No other chlorinated aliphatic compounds were detected in any of the surface soil samples.

Several semivolatile compounds, including phthalates and PAHs, were detected in several soil samples. Two phthalate compounds were detected at concentrations not directly attributable to laboratory contamination, including bis(2-ethylhexyl)phthalate at 2,100 µg/kg in SS-3 and butylbenzylphthalate at estimated concentrations of 50 and 260 µg/kg in SS-10D and SS-13, respectively. Phthalates are common laboratory and field contaminants due to their presence in rubber gloves and other protective equipment.

As summarized in Table 4-15, several PAHs were detected in numerous samples. The total estimated PAH concentrations in these samples are 53 µg/kg in SS-3; 160 µg/kg in SS-7; 40 µg/kg in SS-9; 980 µg/kg in SS-10; 140 µg/kg in SS-12; and 410 µg/kg in SS-14. Individual PAHs found to exceed typical ranges detected in rural soils (ASTDR 1989) include benzo(b)fluoranthene in SS-10 and SS-14; chrysene in SS-10 and SS-14; fluoranthene in SS-7 and SS-10; indeno(1,2,3-cd)pyrene in SS-12; phenanthrene in SS-7, SS-10, and SS-14; and pyrene in SS-3, SS-7, SS-10, and SS-14.

No PCBs or pesticides were detected in any of the surface soil samples.

Of the 24 inorganic analytes tested for, 18 were detected in the surface soil samples. Concentrations of metals in the surface soil samples were compared to the common range

detected in eastern United States soils as well as to the upper limit of the 90th percentile (Shacklette and Boerngen 1984).

Aluminum, arsenic, barium, beryllium, chromium, copper, magnesium, potassium, sodium, and vanadium were detected in all or most samples but at concentrations within the observed range and 90th percentile.

The concentrations of calcium in SS-3 and SS-9 were found to exceed the 90th percentile but fell within the observed range. Cobalt was detected at concentrations exceeding the 90th percentile in all samples except background sample SS-2 (including background sample SS-1). However, all cobalt concentrations fell within the observed range except in SS-11, where it was detected at 87.3 mg/kg. Iron was found to exceed the upper limit of the 90th percentile in SS-3, SS-10, SS-10D, and SS-11 at concentrations ranging from 54,300 to 283,000 mg/kg. Lead was found to exceed the 90th percentile in SS-3 and SS-11 at 35.5 and 56.1 mg/kg, respectively, while manganese exceeded this limit in SS-3 and SS-13 at estimated concentrations of 4,540 and 1,940 mg/kg, respectively. Nickel exceeded the 90th percentile in SS-3, SS-6, SS-7, and SS-11 at concentrations ranging from 39.4 to 88.0 mg/kg. Zinc was detected above the 90th percentile in SS-3, SS-11, and SS-13 at concentrations ranging from 131 to 356 mg/kg. All of these metals, with the exception of iron in SS-3 and SS-11, fell within the observed range.

In addition to these metals, cyanide was detected in one sample, SS-11, at an estimated concentration of 3.5 mg/kg.

In summary, SS-3 contained seven metals at concentrations above the 90th percentile, and SS-11 contained five as well as cyanide. The remainder of the samples contained zero to three metals above the 90th percentile. The presence of cobalt in all of the surface samples at relatively similar concentrations suggests a natural local abundance of this metal. In terms of organic compounds, low concentrations of VOCs were detected in three samples. Additionally, phthalates and PAHs were detected at relatively low concentrations in numerous samples.

4.4.8 Leachate Samples

As discussed in Section 3.9, two leachate samples of liquid matrix were collected from the on-site leachate collection system. Sample L-1 was collected from Manhole 4 (MH-4), which is the next-to-last manhole before leachate from the northwest, northeast, and south-central fill areas enters the sump at Pump Station 1. Sample L-2 was collected from the sump at Pump Station 2, which contains leachate from the south fill area only. Both samples were analyzed for full TCL organic substances and inorganic substances according to NYSDEC CLP methods. Tables 4-18 and 4-19 summarize the organic and inorganic analytes detected in the leachate samples.

Leachate sample L-1, which consisted of a reddish-orange liquid of pH 7.02 and conductivity of 860 ppm, contained two VOCs: total 1,2-DCE at 8 µg/L and TCE at an estimated concentration of 2 µg/L. Sample L-2, a reddish-orange liquid of pH 6.63 and conductivity of 1,170 ppm, contained three VOCs: TCE at 14 µg/L, chlorobenzene at an estimated 3 µg/L, and total 1,2-DCE at an estimated concentration of 2 µg/L.

Sample L-1 contained no semivolatile substances, PCBs, or pesticides, while L-2 did not include any PCBs or pesticides. However, several semivolatile substances were detected in L-2 at estimated concentrations as follows: 4-chloro-3-methylphenol at 4 µg/L; 1,4-dichlorobenzene at 1 µg/L; di-n-butylphthalate at 2 µg/L; naphthalene at 1 µg/L; and n-nitrosodiphenylamine at 1 µg/L. Di-n-butylphthalate, a common laboratory and field contaminant, is included in this discussion because it was not detected in the laboratory method blank.

Since leachate on site has in the past flowed directly into the unnamed tributary to Duffy Creek and the potential still exists for this to occur, the leachate results were compared to NYSDEC Class C surface water standards in order to preliminarily assess the leachate's potential impact on the creek. The only organic substances found to exceed these standards and guidance values were TCE and 4-chloro-3-methylphenol in L-2.

Of the 24 inorganic analytes tested for, 17 were detected in the leachate samples, as detailed in Table 4-19. Arsenic, barium, beryllium, cadmium, chromium, copper, magnesium, manganese, nickel, potassium, and sodium were all detected in one or both leachate samples at concentrations below NYSDEC Class C standards. Aluminum, cobalt, iron, lead, and zinc were detected in concentrations above Class C standards in both samples. Vanadium exceeded the imposed standard in L-1 only.

In summary, the leachate from the south fill area contained more organic compounds than the leachate collected at MH-4. However, the concentration of VOCs in the leachate is much less than in the air above the leachate as discussed in Section 4.4.9. In terms of inorganic substances, several metals exceeded Class C standards; however, most appear ubiquitous at the site, with the exception of lead and vanadium.

4.4.9 Air Samples

As discussed in Section 3.10, the manholes and risers of the leachate collection system were surveyed with air monitoring equipment in order to locate "hot spots" and identify leachate and air sampling locations. Data were collected on September 30, 1991 prior to the leachate sampling. These data, along with data from the additional survey performed on December 17 and 18, 1991 prior to air sampling, are presented in Table 4-20. Since only two leachate samples could be collected (see Section 3.9), air samples were collected from the "hottest" manholes and risers from each fill area, as detailed on Table 3-6. Eight air samples

were collected, including one field duplicate and one field blank. All samples were analyzed for VOCs by EPA method TO-14, which utilizes SUMMA® canisters. The analytical results provided by Air Toxics, Ltd. are provided in Appendix F.

As detailed in Table 4-21, several VOCs were detected in the air samples, including aromatic hydrocarbons (including benzene, ethylbenzene, 1,2,4-trimethylbenzene, toluene, and o-, m-, and p-xylene), chlorinated aliphatic hydrocarbons (including chloroethane; 1,1-DCA; cDCE; MC; 1,1,1-TCA; TCE; and VC), and chlorofluorocarbons (CFCs) (including Freon® 11 [fluorotrichloromethane], Freon® 12 [dichlorodifluoromethane], Freon® 113 [1,1,2-trichloro-1,2,2-trifluoroethane], and Freon® 114 [dichlorotetrafluorethane]).

Sample A-1 (MH-10) contained 22,100 parts per billion by volume (ppbv) of aromatic hydrocarbons and 71,000 ppbv of chlorinated aliphatic compounds, totaling 93,100 ppbv VOCs. Sample A-2 (R-10) contained 12,500 ppbv aromatics, more than 100,000 ppbv chlorinated aliphatics, and 2,910 ppb CFCs, totaling 116,000 ppbv VOCs. Sample A-3 (MH-6) contained 29,600 ppbv aromatics and approximately 102,000 ppbv chlorinated aliphatic compounds, totaling 131,000 ppbv VOCs. Sample A-4 (MH-15) contained approximately 10,300 ppbv aromatics; 2,370 ppbv chlorinated aliphatics; and 2,660 ppbv CFCs, totaling 15,400 ppbv VOCs. Sample A-5 (R-2) contained 234 ppbv aromatics, 106 ppbv chlorinated aliphatics, 19.8 ppbv CFCs, and 3.8 ppbv chlorinated aromatics, totaling 360 ppbv VOCs. Duplicate sample A-6 contained similar compounds to A-5 but at about half the concentration, totaling 170 ppbv VOCs. Sample A-7 contained 8,090 ppbv aromatics and 18,600 ppbv chlorinated aliphatics, totaling 26,700 ppbv VOCs. Sample A-8, the field blank through which purified nitrogen was run, contained 3.6 ppbv 1,2-dichlorobenzene and 2.8 ppbv Freon® 113, neither of which was detected in any other sample. In addition, A-8 was found to contain 1.6 ppbv of MC, which was also detected in A-2, but at a significantly high enough concentration that it is not considered background contamination.

In summary, the samples containing the highest concentrations of VOCs were those collected nearest the northwest fill area. Manhole 6, located at the southern end of the northwest fill area before the junction with the line from the northeast fill area, contained the highest concentration of VOCs. The air samples contained much higher concentrations of VOCs than the liquid leachate samples. This indicates that the collection system is efficiently removing VOCs from the leachate or it is serving as a direct migratory pathway for VOCs from the fill areas, or both.

4.4.10 Leachate Collection System Evaluation

As discussed in Section 3.11, information regarding the leachate collection system was collected during the RI by means of visual inspection, surveying, and file review. Since these data pertain to the FS, results are not discussed in the RI report.

4.5 DATA ASSESSMENT SUMMARY

All analytical data generated for this remedial investigation have been reviewed by a third-party data validator for compliance, completeness, and data usability. QA/QC concerns that may have an effect on data usability are summarized below with the appropriate data qualifiers.

- Low levels of MC, acetone, di-n-butylphthalate, and bis(2-ethylhexyl)phthalate were attributable to laboratory background contamination because they were present in the method blanks at comparable levels. In some instances, the method blanks did not exhibit contamination by one or more of these common contaminants. However, because MC and acetone are widely used laboratory solvents and phthalate esters are present in the gloves used in handling samples, their presence is most likely due to laboratory/field contamination. Di-n-butylphthalate in TP-4 and TP-5 and bis(2-ethylhexyl)phthalate in TP-1, TP-2, TP-4, and TP-5 are at levels higher than those usually found for laboratory or field contamination.

- Volatile analysis holding time of seven days was exceeded by one day for the following samples: SB-2A, SB-3A, SB-3B, SS-10D-RE, and SS-13-RE. The holding time was exceeded by three to four days for samples TP-1 to TP-5, TP-1DL, and TP-2 MS/MSD. Sample TP-1DL was analyzed according to medium level protocol, so no qualification was necessary. Positive results and quantitation limits for aromatic volatiles in these samples were qualified "J" and "UJ" as estimated. However, samples SB-2A, SB-3A, and SB-3B were re-collected and analyzed within the holding time.

- Surrogate recovery for bromofluorobenzene was below QC limits for volatile analysis of the following samples: GW-5D, TB-1, SS-1, SS-2-RE, SS-13, and SS-13-RE. Matrix interference was substantiated for SS-13 because reanalysis gave similar results. Surrogate recoveries for toluene-d8 and bromofluorobenzene were below QC limits for sample TP-1DL. Positive results and limits for all volatile substances in these samples were qualified "J" and "UJ" as estimated.

- Several samples indicated one or more high surrogate recoveries for volatile analysis, including TB-1-RE, SS-1-RE, SS-2, SS-7, SS-7-RE, SB-7A, SB-7B, SB-10B, GW-5S, GW-6S, GW-11S, GW-12D, GW-12D-RE, GW-13D, and GW-13S. Matrix interferences were substantiated for SS-7 and GW-12D because reanalysis gave similar results. Positive results only in these samples were qualified "J" as estimated.

- Positive results for 2-butanone in TP-1 and TP-5 were qualified "J" as estimated due to a relative standard deviation result of greater than 35% for the initial calibration of 2-butanone.

- Low internal standard (IS) areas for volatile analysis of several samples were noted. Samples SS-1, SS-2-RE, SS-7, SS-7-RE, SS-10D, and SS-13 gave low IS areas for chlorobenzene-d5, and sample SS-7 also gave a low IS area for bromochloromethane. Positive results and limits for the

compounds quantitated using these ISs were qualified "J" and "UJ" as estimated in these samples.

- Base/neutral/acid extractable (BNA) extraction holding time of five days was exceeded by one day for samples SB-6A and SB-6B; by 23 days for samples GW-2D-RE, GW-8S, and GW-10S-RE; and by 28 days for sample GW-11-SDD-RE. Positive results and limits for BNAs in these samples were qualified "J" and "UJ" as estimated.

- Two or more acid phenol (AP) surrogates gave recoveries of less than 10% for BNA analysis in the following samples: GW-2D, GW-2D-RE, GW-10S, GW-10S-RE, GW-11-SDD, GW-13D, and GW-13D-RE. Reanalysis of GW-11-SDD gave one recovery below 10%. AP quantitation limits for GW-11SDD-RE were qualified "UJ" as estimated, while AP limits for the other samples were qualified "R" as rejected. Matrix interferences were substantiated by poor AP recoveries for the reanalysis of these samples.

- Low IS areas for BNA analysis of several samples were noted. The following samples had low IS areas for chrysene-d12 and perylene-d12: SS-12, SS-13, SS-14, and their reanalyses. In addition, samples SS-9 and SS-14 had low IS areas for perylene-d12 only. Four IS areas were low for sample TP-5: acenaphthene-d10, phenanthrene-d10, chrysene-d12, and perylene-d12. In most instances, matrix interferences were substantiated by similar results for reanalyses or MS/MSD analyses. Positive results and limits for the compounds quantitated using these ISs were qualified "J" and "UJ" as estimated in the associated samples.

- Pesticide/PCB extraction holding time of five days was exceeded by one day for samples SB-6A and SB-6B. Positive results and limits for pesticide/PCBs in these samples were qualified "J" and "UJ" as estimated.

- Several pesticides gave percent difference (%D) values greater than 20% for continuing calibration, including beta-BHC; dieldrin; 4,4'-DDE; 4,4'-DDD; and 4,4'-DDT. Positive results for these compounds in samples TP-1 and TP-2 were qualified "J" as estimated.

- Volatile analysis of residential well samples by Method 524.2 indicated zero percent recovery for 1,2-dibromo-3-chloropropane in both laboratory-fortified blank spikes. The quantitation limit for this compound was qualified "R" as rejected in all residential well samples.

- Cobalt results for SW-1 to SW-6 were qualified "U" as undetected because cobalt was detected at 6.1 μg/L in the associated preparation blank. Manganese results for SW-4, SW-4D, and SW-6 were qualified "U" because manganese was detected at 3.2 μg/L in the preparation blank. Manganese and zinc results for DW-1 were qualified "U" because of manganese detected at 2.6 μg/L and zinc at 4.9 μg/L in the preparation blank. The iron result for GW-7D was qualified "U" because of iron detected at 15.9 μg/L in the preparation blank.

- Field blank results for rinsate sample R-1 were used to qualify the associated soil samples. Cadmium results for SB-8AD, SB-8B, and SB-9B were qualified "U" as undetected because of cadmium detected at 6.5

µg/L in R-1. All other contaminants found in R-1 were either present at greater than five times the blank level or not detected in the associated samples.

- The cyanide holding time of 12 days was exceeded by six days for samples TP-1, TP-2, and TP-3. Quantitation limits for cyanide in these samples were qualified "UJ" as estimated.

- For samples TP-1 to TP-5, inorganic spike recoveries were zero percent for antimony and selenium; between 30% and 75% for arsenic, silver, thallium, and zinc; and greater than 125% for lead. Quantitation limits for antimony and selenium were qualified "R" as rejected; arsenic, lead, and zinc positive results were qualified "J" as estimated; and silver and thallium limits were qualified "UJ" as estimated.

- Inorganic spike recovery was less than 30% for antimony in four spike analyses. Quantitation limits for antimony were qualified "R" as rejected in the associated samples SB-1A to SB-6A, SB-1B to SB-6B, SB-5C, and SB-10A. Arsenic, selenium, and silver results and limits for these samples were qualified "J" and "UJ" as estimated, due to spike recoveries between 30% and 75%.

- For water samples L-1 (MH-4) and L-2 (PS#2), antimony and silver gave spike recoveries between 30% and 75%, while arsenic and selenium gave recoveries less than 30%. For soil samples SS-1 to SS-14, antimony and silver gave zero percent recoveries, while mercury and selenium gave recoveries between 30% and 75%. Antimony and silver quantitation limits were qualified "UJ" as estimated for the waters and "R" as rejected for the soils. Arsenic results were qualified "J" as estimated, while arsenic and selenium limits were qualified "R" as rejected for the waters. Mercury and selenium limits were qualified "UJ" as estimated for the soils.

- For soil samples SB-7A, SB-7B, and SED-1 to SED-6, antimony and silver gave spike recoveries less than 30%, and selenium gave a recovery between 30% and 75%. For water samples SW-1 to SW-6, selenium gave a recovery between 30% and 75%. Antimony and silver limits were qualified "R" as rejected for the soils, and selenium limits were qualified "UJ" as estimated for both soils and waters.

- Duplicate results gave relative percent difference (RPD) values greater than QC limits for the following: manganese for soil samples SB-1A to SB-6A, SB-1B to SB-6B, SB-5C, and SB-10A; lead for water samples L-1 (MH-4) and L-2 (PS#2); barium, manganese, and cyanide for soil samples SS-1 to SS-14; lead and iron for water samples SW-1 to SW-6; lead for water samples GW-1D to GW-4D, GW-2S, GW-3S, GW-8S to GW-10S, GW-9D, and GW-10D, and barium and zinc for soil samples TP-1 to TP-5. Positive results for these analytes in the associated samples were qualified "J" as estimated.

- Serial dilution results for water samples L-1 (MH-4) and L-2 (PS#2) gave %D values greater than 10% for aluminum and zinc. For soil samples SS-1 to SS-14, the %D for iron exceeded 10%. For water samples DW-1 to DW-7, GW-5D to GW-7D, GW-5S to GW-7S, GW-11S to GW-13S, GW-11-SDD, GW-12D, and GW-13D, the %D for aluminum exceeded

10%. Positive results for these analytes that exceeded 50 times the instrument detection limit (IDL) were qualified "J" as estimated in the associated samples.

Table 4-1

MONITORING WELL AND WATER LEVEL ELEVATION DATA[a]

	Elevation (feet)		Water Surface Elevation	
Well ID	Ground	Top of Inner Casing	10/22/91 through 10/24/91	11/20/91
MW-1D	277.63	280.27	213.40	213.19
MW-2D	208.30	211.01	158.41	158.31
MW-2S	204.59	207.29	197.54	198.60
MW-3D	174.80	178.05	164.10	163.91
MW-3S	175.10	177.56	162.16	170.39
MW-4D	176.49	178.95	166.69	167.38
MW-5D	151.52	153.55	150.25	150.27
MW-5S	151.55	154.12	150.48	150.49
MW-6D	132.81	134.83	116.69	116.79
MW-6S	132.15	134.79	122.44	123.10
MW-7D	96.48	98.99	65.13	65.40
MW-8S	109.78	112.23	102.96	103.11
MW-9D	156.26	158.93	130.76	129.15
MW-9S	156.71	159.12	138.83	141.77
MW-10D	184.40	186.65	163.18	161.24
MW-10S	184.65	187.20	172.90	172.39
MW-11S	88.32	90.32	82.61	83.71
CW-3A	98.26	100.43	94.77	85.95
CW-3B	99.43	100.59	90.29	87.81
CW-4A	91.66	92.81	88.37	89.18
CW-4B	91.65	92.53	88.39	88.50

[a] Elevation reference: Site benchmark, BM-1 = 296.150 feet.

Source: Ecology and Environment Engineering, P.C. 1991.

Table 4-2

ORGANIC COMPOUNDS DETECTED IN TRENCH SAMPLES
(all values reported in µg/kg)

Compound	TP-1	TP-2	TP-3	TP-4	TP-5
Volatiles					
Acetone	4,500 DJ	230 J	1,800 J	ND	370 J
Benzene	ND	ND	ND	ND	78 J
2-Butanone	490 J	ND	ND	ND	75 J
1,1-Dichloroethane	710	ND	ND	ND	ND
total 1,2-Dichloroethene	3,900 DJ	ND	2,200	2,900	21 J
Ethylbenzene	33,000 J	31 J	12,000 J	830 J	1,200 J
2-Hexanone	120	ND	ND	ND	44 J
Methylene chloride	U	U	U	U	110
4-Methyl-2-pentanone	260 J	ND	ND	ND	ND
Styrene	45	ND	ND	4,200	ND
Tetrachloroethene	ND	ND	ND	520 J	ND
Toluene	970 J	11 J	760 J	3,200 J	33 J
Trichloroethene	73	ND	ND	5,300	ND
Vinyl chloride	980 DJ	ND	ND	ND	ND
Total xylenes	1,700 J	51 J	ND	690 J	350 J
Semivolatiles					
Benzo(b)fluoranthene	ND	370 J	ND	ND	ND
Benzo(a)pyrene	ND	280 J	ND	ND	ND
Benzyl alcohol	ND	ND	ND	1,200 J	ND
Bis(2-ethylhexyl)phthalate	1,100 J	1,100 J	U	8,300	8,300 J
Butylbenzylphthalate	ND	16,000	ND	1,000 J	2,700 J
4-Chloro-3-methylphenol	ND	300 J	ND	ND	ND
Chrysene	ND	410 J	ND	ND	ND
Di-n-butylphthalate	ND	270 J	U	14,000	4,100 J
1,2-dichlorobenzene	ND	ND	ND	1,200 J	670 J
Diethylphthalate	110 J	ND	25 J	ND	ND
Dimethylphthalate	ND	ND	ND	910 J	530 J

Key at end of table.

Table 4-2

ORGANIC COMPOUNDS DETECTED IN TRENCH SAMPLES
(all values reported in µg/kg)

Compound	TP-1	TP-2	TP-3	TP-4	TP-5
Fluoranthene	280 J	720 J	ND	ND	300 J
2-Methylnaphthalene	ND	180 J	ND	ND	190 J
4-Methylphenol	1,600 J	820 J	870	ND	370 J
Naphthalene	ND	140 J	ND	ND	150 J
Pentachlorophenol	ND	ND	ND	ND	6,600 J
Phenanthrene	130 J	540 J	ND	ND	610 J
Pyrene	190 J	530 J	ND	ND	340 J
Pesticides					
beta-BHC	12 J	ND	ND	ND	ND
Dieldrin	ND	13 J	ND	ND	ND
4,4'-DDE	ND	15 J	ND	ND	ND
4,4'-DDD	ND	43 J	ND	ND	120
4,4'-DDT	ND	130 J	ND	ND	ND

Key:

D = Reported result is taken from diluted sample analysis.
J = Associated numerical value is considered estimated.
ND = Compound was not detected above the CRQL.
U = The compound was detected in the method blank at comparable level and is considered undetected.

Source: Ecology and Environment Engineering, P.C. 1991.

Table 4-3

INORGANIC ANALYTES DETECTED IN TRENCH SAMPLES
(all values reported in mg/kg)

Analyte	TP-1	TP-2	TP-3	TP-4	TP-5	Common Range in Eastern U.S. Soils[a]	
						Observed Range	Upper Limit of 90th Percentile
Aluminum	13,200	9,450	13,900	12,000	14,600	7,000 - 100,000	128,000
Arsenic	20.9 J	14.3 J	12.2 J	11.5 J	12.7 J	<0.1 - 73	16.0
Barium	132 J	121 J	121 J	85.7 J	215 J	10 - 1,500	867
Beryllium	0.74 B	0.47 B	0.71 B	0.60 B	0.64 B	<1 - 7	1.81
Calcium	4,350	9,890	1,610	1,850	2,710	100 - 280,000	14,400
Chromium	28.8	18.2	23.2	24.3	26.9	1 - 1,000	112
Cobalt	28.1	20.8	24.9	26.0	24.5	<0.3 - 70	19.8
Copper	29.0	28.4	194	25.4	34.6	<1 - 700	48.7
Iron	36,400	23,900	31,700	35,100	38,300	100 - >100,000	54,100
Lead	33.4 J	53.5 J	15.3 J	86.9 J	62.5 J	<10 - 300	33.0
Magnesium	5,070	4,470	4,240	4,130	3,330	50 - 50,000	10,700
Manganese	760	422	661	784	709	<2 - 7,000	1,450
Nickel	43.2	25.8	33.5	35.0	31.9	<5 - 700	38.2
Potassium	2,160	1,970	2,230	1,570	1,670	50 - 37,000	23,500
Sodium	509 B	289 B	323 B	71.2 B	276 B	<500 - 50,000	17,400

Key at end of table.

Table 4-3

INORGANIC ANALYTES DETECTED IN TRENCH SAMPLES
(all values reported in mg/kg)

						Common Range in Eastern U.S. Soils[a]	
Analyte	TP-1	TP-2	TP-3	TP-4	TP-5	Observed Range	Upper Limit of 90th Percentile
Vanadium	17.8	15.1	22.0	18.6	26.2	<7 - 300	140
Zinc	173 J	258 J	269 J	87.4 J	263 J	<5 - 2,900	104

[a]Shacklette and Boerngen 1984.

Key:

B = Result is greater than IDL but less than CRDL.
J = Reported value is estimated due to variance from QC limits.

Source: Ecology and Environment Engineering, P.C. 1991.

Table 4-4

ORGANIC COMPOUNDS DETECTED IN SUBSURFACE SOIL SAMPLES FROM BORINGS
(all values reported in µg/kg)

Compound	SB-1A[a] (12-14')	SB-1B[a] (1-2')	SB-2A (6.5-7.5')	SB-3A (1-2')	SB-3B (10-12')	SB-4A (2-4')	SB-4B (7-9')	SB-5B (8-9')	SB-5C (18-19')
Volatiles									
total 1,2-Dichloroethene	ND	ND	ND	ND	ND	ND	ND	87	61
Trichloroethene	ND	ND	ND	ND	ND	ND	ND	22	13
Vinyl chloride	ND	ND	ND	ND	ND	ND	ND	21	7 J
Semivolatiles									
None Detected			NA	NA	NA	NA	NA	NA	NA

Key at end of table.

Table 4-4

ORGANIC COMPOUNDS DETECTED IN SUBSURFACE SOIL SAMPLES FROM BORINGS
(all values reported in µg/kg)

Compound	SB-6A (6-10')	SB-6B (12-14')	SB-7A (8-10')	SB-7B (20-21' and 22-23')	SB-8A (7-9')	SB-8AD[b] (7-9')	SB-8B (21-23')	SB-9A (4-6')	SB-9B (26-27.5')	SB-10A (5-7')	SB-10b (18-19')
Volatiles											
total 1,2-Dichloroethene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Trichloroethene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Vinyl chloride	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Semivolatiles											
None Detected								NA	NA	NA	NA

[a]Background samples from well MW-1D.
[b]Field duplicate of sample SB-8A.

Key:

J = The reported value is estimated.
NA = Not analyzed for.
ND = Not detected.

Source: Ecology and Environment Engineering, P.C. 1991.

Table 4-5

INORGANIC ANALYTES DETECTED IN SUBSURFACE SOIL SAMPLES FROM BORINGS
(all values reported mg/kg)

Analyte	SB-1A[a] (12-14')	SB-1B[a] (1-2')	SB-2A (6.5-7.5')	Common Range in Eastern U.S. Soils[c]	
				Observed Range	Upper Limit of 90th Percentile
Aluminum	18,100	16,200	15,600	7,000 - 100,000	128,000
Arsenic	2.9 J	6.8 J	12.7 J	<0.1 - 73	16.0
Barium	31.2 B	72.3	109	10 - 1,500	867
Beryllium	0.64 B	0.50 B	1.1 B	<1 - 7	1.81
Cadmium	ND	ND	1.3	NA	NA
Calcium	1,180	1,050 B	850 B	100 - 280,000	14,400
Chromium	27.6	21.1	20.8	1 - 1,000	112
Cobalt	33.2	25.8	30.2	<0.3 - 70	19.8
Copper	37.0	7.7	29.3	<1 - 700	48.7
Iron	43,700	32,900	45,200	100 - >100,000	54,100
Lead	6.6 J	18.4 J	11.6 J	<10 - 300	33.0
Magnesium	6,680	3,650	6,710	50 - 50,000	10,700
Manganese	431 J	1,750 J	686 J	<2 - 7,000	1,450
Mercury	ND	ND	ND	0.01 - 3.4	0.265
Nickel	53.4	25.8	42.1	<5 - 700	38.2
Potassium	1,870	1,520	2,430	50 - 37,000	23,500
Sodium	54.6 B	34.2 B	99.5 B	<500 - 50,000	17,400
Vanadium	21.9	24.8	19.0	<7 - 300	140
Zinc	96.5 J	75.2 J	87.3 J	<5 - 2,900	104

Key at end of table.

Table 4-5

INORGANIC ANALYTES DETECTED IN SUBSURFACE SOIL SAMPLES FROM BORINGS
(all values reported mg/kg)

Analyte	SB-3A (1-2')	SB-3B (10-12')	SB-4A (2-4')	Common Range in Eastern U.S. Soils[c]	
				Observed Range	Upper Limit of 90th Percentile
Aluminum	15,500	12,800	13,600	7,000 - 100,000	128,000
Arsenic	16.4 J	7.1 J	1.3 J	<0.1 - 73	16.0
Barium	71.3	137	281	10 - 1,500	867
Beryllium	0.69 B	0.59 B	0.63 B	<1 - 7	1.81
Cadmium	ND	ND	ND	NA	NA
Calcium	360 B	1,150	1,640	100 - 280,000	14,400
Chromium	18.6	18.2	22.2	1 - 1,000	112
Cobalt	29.2	22.5	30.1	<0.3 - 70	19.8
Copper	9.8	12.8	21.1	<1 - 700	48.7
Iron	35,100	30,600	32,500	100 - >100,000	54,100
Lead	32.8 J	20.1 J	ND	<10 - 300	33.0
Magnesium	3,590	4,570	5,820	50 - 50,000	10,700
Manganese	1,140 J	668 J	1,670 J	<2 - 7,000	1,450
Mercury	ND	ND	ND	0.01 - 3.4	0.265
Nickel	25.7	30.4	41.9	<5 - 700	38.2
Potassium	1,510	1,840	1,780	50 - 37,000	23,500
Sodium	35.5 B	71.7 B	ND	<500 - 50,000	17,400
Vanadium	21.4	16.9	18.9	<7 - 300	140
Zinc	56.9 J	65.7 J	74.6 J	<5 - 2,900	104

Key at end of table.

Table 4-5

INORGANIC ANALYTES DETECTED IN SUBSURFACE SOIL SAMPLES FROM BORINGS
(all values reported mg/kg)

Analyte	SB-4B (7-9')	SB-5B (8-9')	SB-5C (18-19')	Common Range in Eastern U.S. Soils[c]	
				Observed Range	Upper Limit of 90th Percentile
Aluminum	14,500	13,800	11,100	7,000 - 100,000	128,000
Arsenic	12.7 J	9.0 J	5.0 J	<0.1 - 73	16.0
Barium	42.8 B	132	80.7	10 - 1,500	867
Beryllium	0.86 B	0.77 B	0.49 B	<1 - 7	1.81
Cadmium	ND	ND	ND	NA	NA
Calcium	1,440	1,230	1,370	100 - 280,000	14,400
Chromium	21.1	20.1	15.4	1 - 1,000	112
Cobalt	32.7	25.6	21.3	<0.3 - 70	19.8
Copper	18.3	15.7	26.3	<1 - 700	48.7
Iron	41,400	33,700	26,000	100 - >100,000	54,100
Lead	8.0 J	13.0 J	12.7 J	<10 - 300	33.0
Magnesium	6,020	5,030	4,260	50 - 50,000	10,700
Manganese	1,010 J	694 J	551 J	<2 - 7,000	1,450
Mercury	ND	ND	ND	0.01 - 3.4	0.265
Nickel	48.0	36.4	30.1	<5 - 700	38.2
Potassium	1,990	1,710	1,110 B	50 - 37,000	23,500
Sodium	ND	ND	ND	<500 - 50,000	17,400
Vanadium	20.6	18.7	15.8	<7 - 300	140
Zinc	78.0 J	72.1 J	64.6 J	<5 - 2,900	104

Key at end of table.

Table 4-5

INORGANIC ANALYTES DETECTED IN SUBSURFACE SOIL SAMPLES FROM BORINGS
(all values reported mg/kg)

Analyte	SB-6A (6-10')	SB-6B (12-14')	SB-7A (8-10')	Common Range in Eastern U.S. Soils[c]	
				Observed Range	Upper Limit of 90th Percentile
Aluminum	13,500	13,100	13,000	7,000 - 100,000	128,000
Arsenic	10.6 J	15.7 J	11.7	<0.1 - 73	16.0
Barium	64.9	67.2	129	10 - 1,500	867
Beryllium	0.58 B	0.65 B	0.80 B	<1 - 7	1.81
Cadmium	ND	ND	ND	NA	NA
Calcium	742 B	777 B	1,600	100 - 280,000	14,400
Chromium	18.7	17.5	22.0	1 - 1,000	112
Cobalt	26.5	21.7	27.7	<0.3 - 70	19.8
Copper	15.5	12.5	23.6	<1 - 700	48.7
Iron	36,700	32,800	33,500	100 - >100,000	54,100
Lead	27.7 J	35.6 J	20.3 J	<10 - 300	33.0
Magnesium	4,660	4,720	5,130	50 - 50,000	10,700
Manganese	1,040 J	461 J	849	<2 - 7,000	1,450
Mercury	ND	ND	ND	0.01 - 3.4	0.265
Nickel	38.5	31.5	39.0	<5 - 700	38.2
Potassium	1,520	1,720	1,680	50 - 37,000	23,500
Sodium	54.3 B	67.0 B	44.4 B	<500 - 50,000	17,400
Vanadium	15.9	14.8	19.0	<7 - 300	140
Zinc	71.6 J	66.7 J	72.0	<5 - 2,900	104

Key at end of table.

Table 4-5

INORGANIC ANALYTES DETECTED IN SUBSURFACE SOIL SAMPLES FROM BORINGS
(all values reported mg/kg)

Analyte	SB-7B (20-21' and 22-23')	SB-8A (7-9')	SB-8AD[b] (7-9')	Common Range in Eastern U.S. Soils[c]	
				Observed Range	Upper Limit of 90th Percentile
Aluminum	12,500	12,100	13,200	7,000 - 100,000	128,000
Arsenic	14.5	14.1	10.4	<0.1 - 73	16.0
Barium	43.0	111	111	10 - 1,500	867
Beryllium	0.94 B	0.51 B	0.61 B	<1 - 7	1.81
Cadmium	ND	ND	U	NA	NA
Calcium	1,420	1,180	1,320	100 - 280,000	14,400
Chromium	21.7	15.1	18.8	1 - 1,000	112
Cobalt	27.0	21.8	24.9	<0.3 - 70	19.8
Copper	16.7	17.3	16.9	<1 - 700	48.7
Iron	35,800	29,400	32,700	100 - >100,000	54,100
Lead	13.3 J	13.9	12.3	<10 - 300	33.0
Magnesium	4,600	4,130	4,890	50 - 50,000	10,700
Manganese	909	996	828	<2 - 7,000	1,450
Mercury	ND	ND	ND	0.01 - 3.4	0.265
Nickel	40.1	32.2	34.7	<5 - 700	38.2
Potassium	2,710	1,470	1,790	50 - 37,000	23,500
Sodium	54.1 B	52.4 B	56.6 B	<500 - 50,000	17,400
Vanadium	21.0	14.0	16.2	<7 - 300	140
Zinc	71.3	60.1	66.2	<5 - 2,900	104

Key at end of table.

Table 4-5

INORGANIC ANALYTES DETECTED IN SUBSURFACE SOIL SAMPLES FROM BORINGS
(all values reported mg/kg)

Analyte	SB-8B (21-23')	SB-9A (4-6')	SB-9B (26-27.5')	Common Range in Eastern U.S. Soils[c]	
				Observed Range	Upper Limit of 90th Percentile
Aluminum	11,500	13,800	13,900	7,000 - 100,000	128,000
Arsenic	10.6	17.4	17.9	<0.1 - 73	16.0
Barium	90.2	122	87.7	10 - 1,500	867
Beryllium	0.59 B	0.65 B	0.92 B	<1 - 7	1.81
Cadmium	U	ND	U	NA	NA
Calcium	1,540	1,700	1,800	100 - 280,000	14,400
Chromium	14.8	18.9	15.1	1 - 1,000	112
Cobalt	23.2	25.4	30.1	<0.3 - 70	19.8
Copper	12.6	17.9	22.9	<1 - 700	48.7
Iron	33,900	33,300	35,100	100 - >100,000	54,100
Lead	11.8	22.4	8.0	<10 - 300	33.0
Magnesium	4,900	5,450	5,200	50 - 50,000	10,700
Manganese	1,420	771	894	<2 - 7,000	1,450
Mercury	0.12	ND	ND	0.01 - 3.4	0.265
Nickel	31.1	35.6	37.9	<5 - 700	38.2
Potassium	1,560	1,840	2,100	50 - 37,000	23,500
Sodium	61.6 B	64.2 B	80.1 B	<500 - 50,000	17,400
Vanadium	14.2	16.1	16.6	<7 - 300	140
Zinc	62.1	69.3	75.2	<5 - 2,900	104

Key at end of table.

Table 4-5

INORGANIC ANALYTES DETECTED IN SUBSURFACE SOIL SAMPLES FROM BORINGS
(all values reported mg/kg)

Analyte	SB-10A (5-7')	SB-10B (18-19')	Common Range in Eastern U.S. Soils[c]	
			Observed Range	Upper Limit of 90th Percentile
Aluminum	13,400	5,550	7,000 - 100,000	128,000
Arsenic	14.1 J	3.1	<0.1 - 73	16.0
Barium	182	40.5 B	10 - 1,500	867
Beryllium	0.67 B	ND	<1 - 7	1.81
Cadmium	1.8	ND	NA	NA
Calcium	1,150	77,500	100 - 280,000	14,400
Chromium	18.6	9.3	1 - 1,000	112
Cobalt	27.0	14.5	<0.3 - 70	19.8
Copper	15.1	9.5	<1 - 700	48.7
Iron	32,100	14,700	100 - >100,000	54,100
Lead	45.3 J	7.3	<10 - 300	33.0
Magnesium	4,250	17,100	50 - 50,000	10,700
Manganese	1,430 J	290	<2 - 7,000	1,450
Mercury	ND	ND	0.01 - 3.4	0.265
Nickel	31.7	16.9	<5 - 700	38.2
Potassium	1,340	630 B	50 - 37,000	23,500
Sodium	38.3 B	103	<500 - 50,000	17,400
Vanadium	19.1	11.0	<7 - 300	140
Zinc	64.8 J	56.3	<5 - 2,900	104

[a] Background samples from well MW-1D.
[b] Field duplicate of sample SB-8A.
[c] Shacklette and Boerngen 1984.

Key:

B = Result is greater than IDL, but less than CRDL.
J = Reported value is estimated due to variance from quality control limits.
NA = Not applicable.
ND = Not detected.
U = Analyte was detected in preparation blank at comparable level and is considered undetected.

Source: Ecology and Environment Engineering, P.C. 1991.

Table 4-6

ORGANIC COMPOUNDS DETECTED IN GROUNDWATER SAMPLES
(all values reported in µg/L)

Compound	GW-1D	GW-2D	GW-2S	GW-3D	GW-3S	GW-4D	GW-5D	GW-5S	GW-6D	GW-6S	GW-7D	GW-8S	GW-9D
Volatiles													
Acetone	ND	ND	ND	ND	33	ND	ND	ND	ND	ND	ND	ND	ND
Chloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chloroform	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1-Dichloroethane	ND	ND	ND	ND	ND	ND	6 J	11 J	ND	ND	ND	ND	ND
1,1-Dichloroethene	ND	3 J	ND	ND	ND	ND	11 J	12 J	ND	ND	ND	ND	ND
total 1,2-Dichloroethene	ND	520 D	ND	ND	ND	ND	4,600 DE	5,600 DE	200 D	5 J	ND	ND	ND
Ethylbenzene	ND	ND	ND	ND	ND	ND	3 J	ND	ND	ND	ND	ND	ND
Methylene chloride	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Toluene	ND	ND	ND	ND	ND	ND	9 J	8 J	ND	ND	ND	ND	ND
1,1,1-Trichlorethane	ND	1 J	ND	ND	ND	ND	ND	4 J	ND	ND	ND	ND	ND
Trichloroethene	ND	230 D	ND	2 J	ND	1 J	310 D	370 D	7	ND	ND	ND	ND
Vinyl chloride	ND	160 D	ND	ND	ND	ND	1,400 D	2,100 D	63	ND	ND	ND	ND
Semivolatiles													
None detected			NA										

Key at end of table.

Table 4-6

ORGANIC COMPOUNDS DETECTED IN GROUNDWATER SAMPLES
(all values reported in µg/L)

Compound	GW-9S	GW-10D	GW-10S	GW-11S	GW-11SDD[a]	GW-12D[b]	GW-12S	GW-13D	GW-13S	NYSDEC Class GA Groundwater Standard
Volatiles										
Acetone	ND	ND	ND	ND	ND	ND	ND	ND	ND	50 G
Chloroethane	ND	ND	ND	8 J	ND	ND	ND	ND	ND	5
Chloroform	2 J	ND	ND	ND	ND	ND	ND	ND	ND	7
1,1-Dichloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	5
1,1-Dichloroethene	ND	ND	ND	9 J	9	ND	ND	ND	ND	5
total 1,2-Dichloroethene	ND	3 J	ND	390 D	390 D	9 J	3 J	4 J	ND	5
Ethylbenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	5
Methylene chloride	ND	ND	ND	ND	ND	4 J	ND	ND	ND	5
Toluene	ND	ND	ND	ND	ND	ND	5	ND	2 J	5
1,1,1-Trichlorethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	5
Trichloroethene	ND	3 J	ND	1,200 D	1,200 D	ND	38	ND	ND	5
Vinyl chloride	ND	ND	ND	110 J	110	45 J	ND	ND	ND	2

Key at end of table.

Table 4-6

ORGANIC COMPOUNDS DETECTED IN GROUNDWATER SAMPLES
(all values reported in µg/L)

Compound	GW-9S	GW-10D	GW-10S	GW-11S	GW-11SDD[a]	GW-12D[b]	GW-12S	GW-13D	GW-13S	NYSDEC Class GA Groundwater Standard
Semivolatiles										
None detected	NA						NA			

[a] Field duplicate of sample G11S.
[b] Reported results from reanalysis of sample GW-12D.

Key:

ND = Not detected.
G = General organic guidance value (NYSDEC 1990).
J = The reported value is estimated.
D = Reported result is taken from diluted sample analysis.
E = Reported value is estimated because it exceeds the calibration limit.
NA = Sample not analyzed for semi-volatiles due to insufficient volume.

Source: Ecology and Environment Engineering, P.C. 1991.

Table 4-7

INORGANIC ANALYTES DETECTED IN GROUNDWATER SAMPLES
(all values reported in µg/L)

Analyte	GW-1D	GW-2D	GW-2S	GW-3D	GW-3S	GW-4D	GW-5D	GW-5S	GW-6D	GW-6S	GW-7D	GW-8S	GW-9D
Aluminum	364	742	42,700	252	3,040	393	3,140 J	531	131 B	8,990 J	29.5 B	217	3,850
Arsenic	2.9 B	9.1 B	17.8	ND	2.4 B	ND	3.5 B	2.5 B	ND	6.4 B	ND	ND	4.3 B
Barium	273	49.0 B	342	101 B	53.4 B	13.9 B	110 B	12.8 B	20.0 B	40.2 B	10.2 B	61.4 B	43.4 B
Beryllium	ND	ND	2.2 B	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Calcium	21,800	30,600	53,600	49,700	31,900	13,100	9,160	16,300	16,000	12,800	30,200	85,200	26,400
Chromium	11.6	ND	110	ND	ND	ND	49.6	ND	ND	14.2	ND	ND	ND
Cobalt	ND	8.1 B	102	ND	14.7 B	ND	ND	ND	ND	11.3 B	ND	11.5 B	13.4 B
Copper	ND	3.3 B	115	ND	7.7 B	ND	46.2	3.2 B	ND	15.3 B	ND	ND	9.7 B
Iron	972 J	1,910 J	110,000 J	524 J	6,270 J	634 J	2,480	650	316	15,700	U	542 J	8,290 J
Lead	ND	4.1 J	38.1 J	ND	6.0 J	ND	2.4 B	ND	ND	10.8	ND	11.0 J	5.7 J
Magnesium	8,600	15,600	50,500	21,400	19,100	12,100	5,400	12,300	11,000	12,200	21,700	56,000	13,100
Manganese	227	1,820	8,530	41.2	1,300	72.3	1,060	583	828	514	18.4	2,200	179
Nickel	ND	ND	155	ND	ND	ND	ND	ND	ND	22.3 B	ND	ND	ND
Potassium	2,090 B	14,900	17,500	18,800	5,960	1,990 B	8,800	1,750 B	1,230 B	5,020	2,520 B	4,940 B	18,300
Sodium	4,690 B	19,700	20,900	29,800	20,400	9,730	516,000	9,920	6,080	7,450	19,000	35,500	32,600
Vanadium	ND	7.3 B	67.1	6.4 B	10.2 B	7.0 B	ND	ND	ND	10.1 B	ND	8.7 B	12.7 B
Zinc	ND	16.0 B	230	ND	24.1	ND	154	63.5	6.7 B	64.3	12.4 B	7.1 B	62.4

Key at end of table.

Table 4-7

INORGANIC ANALYTES DETECTED IN GROUNDWATER SAMPLES
(all values reported in µg/L)

Analyte	GW-9S	GW-10D	GW-10S	GW-11S	GW-11SDD[a]	GW-12D	GW-12S	GW-13D	GW-13S	NYSDEC Class GA Groundwater Standard
Aluminum	342	1,250	1,760	2,230 J	2,480 J	910 J	2,760 J	2,640 J	286	NA
Arsenic	ND	5.6 B	4.1 B	ND	ND	ND	3.1 B	3.5 B	ND	25
Barium	36.8 B	262	208	69.5 B	71.3 B	36.4 B	91.9 B	211	85.7 B	1,000
Beryllium	ND	ND	ND	ND	ND	ND	ND	ND	ND	3 G
Calcium	67,900	25,300	15,700	43,800	44,000	71,300	31,000	47,500	54,600	NA
Chromium	ND	ND	ND	ND	10.0	11.0	22.2	ND	ND	50
Cobalt	9.0 B	9.5 B	10.5 B	ND	ND	ND	ND	ND	ND	NA
Copper	ND	8.0 B	ND	3.7 B	9.1 B	11.6 B	9.0 B	4.7 B	ND	200
Iron	1,630 J	3,270 J	4,620 J	4,280	4,440	736	5,780	5,130	414	300[b]
Lead	1.2 J	7.6 J	3.3 J	3.5	4.6	ND	125	3.6	ND	25
Magnesium	30,800	8,090	6,300	22,100	22,200	37,300	3,100 B	21,500	24,600	35,000 G
Manganese	1,490	387	4,110	2,030	2,040	24.6	123	2,370	2,770	300[b]
Nickel	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA
Potassium	11,300	27,100	4,380 B	2,140 B	1,970 B	2,540 B	38,000	4,340 B	2,320 B	NA
Sodium	33,200	20,200	5,720	14,800	18,700	33,300	41,700	21,200	24,800	20,000
Vanadium	7.2 B	8.4 B	7.8 B	ND	ND	ND	27.9 B	ND	ND	NA
Zinc	5.7 B	27.2	11.0 B	26.4	39.8	41.0	83.4	54.6	5.6 B	300

Key at end of table.

[a] Field duplicate of sample G11S.
[b] Total concentration of iron and manganese shall not exceed 500 µg/L.

Key:

J = Reported value is estimated due to variance for quality control limits.
B = Result is greater than IDL, but less than CRDL.
NA = No applicable NYS SCG.
ND = Not detected.
G = Guidance value (NYSDEC 1990).
D = Reported result is taken from diluted sample analysis.
U = Analyte was detected in preparation blank at comparable level and is considered undetected.

Source: Ecology and Environment Engineering, P.C. 1991.

Table 4-8

GROUNDWATER SAMPLE PARAMETERS

Sample Number	Well Number	Organic Sample Portion[a]				Inorganic Portion[b]	
		Conductivity (ppm)	Temperature (°C)	Turbidity (NTU)	Date/Time	Turbidity[c] (NTU)	Date/Time
GW-1D	MW-1D	123	11.0	146	10-22-91/1740	14	10-23-91/0910
GW-2D	MW-2D	218	11.5	210	10-22-91/1525	38	10-23-91/0925
GW-2S[d]	MW-2S	416	11.0	>4,000	10-22-91/1728	>4,000	10-23-91/0929
GW-3D	MW-3D	315	13.0	600	10-22-91/1555	20	10-23-91/0855
GW-3S	MW-3S	248	13.5	2,800	10-22-91/1618	160/>1,000	10-23-91/0858
GW-4D	MW-4D	124	13.0	141	10-22-91/1613	18	10-23-91/0835
GW-5D	MW-5D	182	14.0	660	10-24-91/1100	18	10-25-91/0845
GW-5S	MW-5S	166	14.5	585	10-24-91/1110	19	10-25-91/0850
GW-6D	MW-6D	138	12.5	770	10-24-91/1120	7	10-25-91/0900
GW-6S	MW-6S	121	14.0	2,000	10-24-91/1125	440	10-25-91/0903
GW-7D	MW-7D	265	11.0	361	10-23-91/1625	17	10-24-91/1035
GW-8S	MW-8S	586	14.0	>4,000	10-22-91/1654	15/960	10-23-91/1010
GW-9D	MW-9D	222	11.5	190	10-22-91/1634	240	10-23-91/1000
GW-9S[d]	MW-9S	NA	NA	>4,000	10-22-91/1634	>4,000	10-23-91/1002
GW-10D	MW-10D	145	11.0	1,600	10-22-91/1715	110/200	10-23-91/0940
GW-10S	MW-10S	116	13.0	2,700	10-22-91/1710	140/540	10-23-91/0937
GW-11S	MW-11S	322	12.0	309	10-23-91/1625	125	10-24-91/1025
GW-12D	CW-3A	449	14.0	182	10-23-91/1640	31	10-24-91/1043
GW-12S[d]	CW-3B	NA	14.0	270	10-23-91/1640	173	10-24-91/1042

Table 4-8

GROUNDWATER SAMPLE PARAMETERS

Sample Number	Well Number	Organic Sample Portion[a]				Inorganic Portion[b]	
		Conductivity (ppm)	Temperature (°C)	Turbidity (NTU)	Date/Time	Turbidity[c] (NTU)	Date/Time
GW-13D	CW-4A	391	15.0	>4,000	10-23-91/1655	114	10-24-91/1055
GW-13S	CW-4B	386	14.0	1,600	10-23-91/1655	75	10-24-91/1053

a Organic portion refers to VOC, BNA, PCB, and pesticides analyses except where noted.
b Inorganic portion refers to metals and total cyanide except where noted.
c Where two turbidities are listed, the first is for the metals portion and the second is for the cyanide portion.
d Due to low well volume, water was collected for VOC and metals analyses only.

Key:

NA = Data not acquired.

Source: Ecology and Environment Engineering, P.C. 1991.

Table 4-9

ORGANIC COMPOUNDS DETECTED IN RESIDENTIAL WELL AND SPRING SAMPLES
(all values reported in µg/L)

Compound	DW-1 Rosini	DW-2 Teller	DW-3 Kelly	DW-4 Bauer	DW-5 LaDue	DW-5D LaDue	DW-6 Miller	DW-7 Vacarro	NYSDOH MCL[a]	NYSDEC Class GA Groundwater Standard
Volatiles										
Trichloroethene	ND	ND	ND	ND	2.6	2.9	ND	ND	5	5
Semivolatiles	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

[a] Maximum contaminant level per 10 NYCRR 5-1.5.2.

Key:

ND = Not detected.

Source: Ecology and Environment Engineering, P.C. 1991.

Table 4-10

INORGANIC ANALYTES DETECTED IN RESIDENTIAL WELL AND SPRING SAMPLES
(all values reported in µg/L)

Analyte	DW-1 Rosini	DW-2 Teller	DW-3 Kelly	DW-4 Bauer	DW-5 LaDue
Aluminum	107 B	25.6 B	741	200 B	645
Barium	32.8 B	72.8 B	67.0 B	54.7 B	26.4 B
Calcium	40,100	37,400	21,300	33,300	44,900
Chromium	ND	ND	11.1	ND	ND
Copper	4.5 B	ND	29.8	3.6 B	7.3 B
Iron	534	U	693	730	535
Lead	ND	1.8 B	ND	ND	ND
Magnesium	13,300	13,400	6,070	12,100	19,600
Manganese	510	148	17.7	150	54.6
Mercury	ND	ND	ND	0.46	ND
Potassium	1,450 B	1,240 B	1,150 B	1,400 B	1,810 B
Sodium	50,400	8,200	31,600	58,000	17,000
Zinc	8.8 B	134	39.4	338	26.7
Cyanide	ND	ND	ND	ND	ND

Key at end of table.

Table 4-10

INORGANIC ANALYTES DETECTED IN RESIDENTIAL WELL AND SPRING SAMPLES
(all values reported in µg/L)

Analyte	DW-5D[a] LaDue	DW-6 Miller	DW-7 Vacarro	NYSDOH MCL[b]	NYSDEC Class GA Groundwater Standard
Aluminum	134 B	400	16.9 B	NA	NA
Barium	24.3 B	31.5 B	34.7 B	1,000 P	1,000
Calcium	44,800	13,400	21,800	NA	NA
Chromium	ND	ND	ND	50 P	50
Copper	ND	ND	33.8	1,000 S	200
Iron	193	1,300	107	300[c] S	300[c]
Lead	ND	ND	ND	50 P	25
Magnesium	19,600	8,160	8,230	NA	35,000 G
Manganese	41.1	166	76.9	300[c] S	300[c]
Mercury	ND	ND	ND	2 P	2
Potassium	1,680 B	1,100 B	1,450 B	NA	NA
Sodium	8,540	4,110 B	55,100	NA[d]	20,000
Zinc	7.9 B	9.7 B	5.3 B	5,000 S	300
Cyanide	ND	19.0	ND	NA	100

a Field duplicate of sample DW-5.
b Maximum contaminant level per 10 NYCRR 5-1.5.2.
c Total concentration of iron and manganese shall not exceed 500 µg/L.
d Water containing 20,000 µg/L should not be used for drinking by people on severely restricted sodium diets.
Water containing >270,000 µg/L should not be used for drinking by people on moderately restricted sodium diets.

Key:

B = Result is greater than IDL, but less than CRDL.
G = Guidance value (NYSDEC 1990).
NA = No applicable NYS SCG.
ND = Not detected.
P = NYSDOH Primary Contaminant.
S = NYSDOH Secondary Contaminant.
U = Analyte was detected on preparation blank at comparable level and is considered undetected.

Source: Ecology and Environment Engineering, P.C. 1991.

Table 4-11

RESIDENTIAL WELL AND SPRING SAMPLE PARAMETERS

Sample	Owner	Type	Conductivity (ppm)	Temperature (°C)	Turbidity (NTU)
DW-1	Rosini	150-foot well	329	14.0	4.2
DW-2	Teller	120-foot well	218	14.0	5.0
DW-3	Kelly	56-foot well	162	13.5	1.2
DW-4	Bauer	130-foot well	319	15.0	9.0
DW-5	LaDue	Spring	269	15.0	18
DW-6	Miller	Spring	126	15.5	8.0/51[a]
DW-7	Vacarro	Well	260	19.0	1.5

[a] First value pertains to VOA, metals, and cyanide portions, which were filled first. Second value pertains to BNA and PCB/Pesticide portions that caused disturbance in spring when sampled.

Source: Ecology and Environment Engineering, P.C., 1991.

Table 4-12

ORGANIC COMPOUNDS DETECTED IN SURFACE WATER SAMPLES
(all values reported in µg/L)

Compound	SW-1	SW-2	SW-3	SW-4	SW-4D	SW-5	SW-6	NYSDEC Class C Surface Water Standard
Volatiles								
None detected.								
Semivolatiles								
Di-n-butylphthalate	2 J	1 J	ND	2 J	ND	ND	1 J	NA
Di-n-octylphthalate	ND	2 J	ND	ND	ND	ND	ND	NA

Key:

J = The reported value is estimated.
NA = No applicable NYS SCG.
ND = Not detected.

Source: Ecology and Environment Engineering, P.C., 1991.

Table 4-13

INORGANIC ANALYTES DETECTED IN SURFACE WATER SAMPLES
(all values reported in µg/L)

Analyte	SW-1	SW-2	SW-3	SW-4	SW-4D[a]	SW-5	SW-6	NYSDEC Class C Surface Water Standard
Aluminum	578	307	496	119 B	274	874	96.0 B	100
Barium	35.4 B	43.6 B	99.3 B	49.5 B	50.8 B	57.7 B	49.2 B	NA
Calcium	15,400	15,900	19,800	18,000	17,900	18,300	17,200	NA
Copper	ND	5.8 B	ND	ND	ND	ND	ND	7.75[b]
Iron	1,110 J	3,840 J	778 J	150 J	387 J	1,610 J	130 J	300
Lead	2.2 J	1.7 J	4.8 J	4.9 J	2.5 J	2.7 J	1.1 J	1.48 - 1.90[c]
Magnesium	4,490 B	7,200	7,010	6,600	6,600	6,800	6,360	NA
Manganese	533	3,090	143	U	U	68.5	U	NA
Nickel	ND	30.6 B	ND	ND	ND	ND	ND	65.6[d]
Potassium	2,980 B	1,770 B	1,480 B	1,430 B	1,490 B	1,790 B	1,250 B	NA
Sodium	4,170 B	22,100	8,980	14,800	14,700	15,000	13,800	NA
Vanadium	6.5 B	6.3 B	6.1 B	ND	5.5 B	5.8 B	7.3 B	14
Zinc	8.5 B	19.4 B	10.7 B	4.1 B	7.3 B	6.8 B	ND	30

Key at end of table.

Table 4-13

INORGANIC ANALYTES DETECTED IN SURFACE WATER SAMPLES
(all values reported in µg/L)

Analyte	SW-1	SW-2	SW-3	SW-4	SW-4D[a]	SW-5	SW-6	NYSDEC Class C Surface Water Standard
Hardness (mg/L)	54	61	62	62	61	66	65	NA

[a] Duplicate sample of SW-4.
[b] Standard is a function of hardness. For SW-2 only, standard is 7.75 µg/L.
[c] Standard is a function of hardness as follows: SW-1 (1.48 µg/L); SW-2 (1.72); SW-3 (1.75); SW-4 (1.75); SW-4D (1.72); SW-5 (1.90); and SW-6 (1.87 µg/L).
[d] Standard is a function of harndess. For SW-2 only, standard is 65.6 µg/L.

Key:

B = Result is greater than IDL, but less than CRDL.
J = Reported value is estimated due to variance from quality control limits.
NA = No applicable NYS SCG.
ND = Not detected.
U = Analyte was detected in preparation blank at comparable level and is considered undetected.

Source: Ecology and Environment Engineering, P.C. 1991.

Table 4-14

ORGANIC COMPOUNDS DETECTED IN SEDIMENT SAMPLES
(all values reported in µg/kg except as noted)

Compound	SED-1	SED-2	SED-3	SED-4	SED-4D[a]	SED-5	SED-6	Sediment Criteria[b]	Limit of Tolerance[c]
Volatiles									
Acetone	20	30	10 J	31	38	11 J	ND	NA	NA
Semivolatiles									
Butylbenzylphthalate	ND	ND	24 J	ND	ND	ND	ND	NA	NA
Organic matter (%)	7.3	6.6	3.4	5.3	5.2	3.2	3.2		

[a] Field duplicate of sample SED-4.
[b] Geometric mean of "no-effect" and "lowest-effect" levels based on toxicity studies in benthic organisms (NYSDEC 1989).
[c] Concentration which would be detrimental to the majority of species (NYSDEC 1989).

Key:

J = The reported value is estimated.
NA = No applicable NYS SCG.
ND = Not detected.

Source: Ecology and Environment Engineering, P.C. 1991.

Table 4-15

INORGANIC ANALYTES DETECTED IN SEDIMENT SAMPLES
(all values reported in mg/kg)

Analyte	SED-1	SED-2	SED-3	SED-4	SED-4D[a]	SED-5	SED-6	Sediment Criteria[b]	Limit of Tolerance[c]
Aluminum	12,800	13,000	12,400	14,500	16,900	11,200	11,000	NA	NA
Arsenic	12.7	10.9	11.0	9.6	14.3	8.1	13.5	5	33
Barium	123	97.4	175	169	202	192	129	NA	NA
Beryllium	0.81 B	0.96 B	0.89 B	0.91 B	1.1 B	0.85 B	0.85 B	NA	NA
Calcium	2,010	1,320 B	1,290	1,470 B	1,760 B	1,150 B	999 B	NA	NA
Chromium	22.5	21.3	18.5	20.9	24.4	18.5	18.3	26	111
Cobalt	26.9	27.8	26.1	24.8	29.7	27.9	25.4	NA	NA
Copper	20.5	16.0	16.0	19.8	23.0	16.7	15.7	19	114
Iron	32,400	43,200	36,000	31,600	38,400	39,000	40,200	24,000	40,000
Lead	26.1 J	20.8 J	20.7 J	20.2 J	26.7 J	3.2 J	18.9 J	27	250
Magnesium	3,900	3,630	3,720	4,270	5,010	3,660	3,510	NA	NA
Manganese	1,180	2,440	1,200	705	891	1,480	808	428	1,110
Nickel	40.1	33.4	37.7	36.2	42.2	38.1	36.0	22	90
Potassium	1,200 B	1,310 B	1,230 B	1,790 B	2,140 B	1,110 B	1,060 B	NA	NA
Sodium	ND	108 B	ND	ND	ND	ND	ND	NA	NA

Key at end of table.

Table 4-15

INORGANIC ANALYTES DETECTED IN SEDIMENT SAMPLES
(all values reported in mg/kg)

Analyte	SED-1	SED-2	SED-3	SED-4	SED-4D[a]	SED-5	SED-6	Sediment Criteria[b]	Limit of Tolerance[c]
Vanadium	22.8	22.1	19.7	21.4	25.3	17.5	18.2	NA	NA
Zinc	84.7	96.3	107	81.0	96.9	78.7	76.1	85	800

[a] Field duplicate of sample SED-4.
[b] Geometric mean of "no-effect" and "lowest-effect" levels based on toxicity studies in benthic organisms (NYSDEC 1989).
[c] Concentration which would be detrimental to the majority of species (NYSDEC 1989).

Key:

B = Result is greater than IDL, but less than CRDL.
J = Reported value is estimated due to variance from quality control limits
NA = No applicable NYS SCG.
ND = Not detected.

Source: Ecology and Environment Engineering, P.C. 1991.

Key at end of table.

Table 4-16

ORGANIC COMPOUNDS DETECTED IN SURFACE SOIL SAMPLES
(all values reported in µg/kg)

Compound	Background		SS-3	SS-4	SS-5	SS-6	SS-7	SS-8	Background PAH Concentrations in Rural soils[b]
	SS-1	SS-2							
Volatiles									
Acetone	U	U	U	U	ND	U	U	U	
Chloromethane	ND	ND	ND	ND	ND	ND	40 J	ND	
Ethylbenzene	ND	ND	ND	ND	ND	1 J	18 J	ND	
Semivolatiles									
Anthracene	ND	ND	ND	ND	ND	ND	ND	ND	NA
Benzo(b)fluoranthene	ND	ND	ND	ND	ND	ND	ND	ND	20 - 30
Benzo(k)fluoranthene	ND	ND	ND	ND	ND	ND	ND	ND	10 - 110
Benzo(g,h,i)perylene	ND	ND	ND	ND	ND	ND	ND	ND	10 -70
Benzo(a)pyrene	ND	ND	ND	ND	ND	ND	ND	ND	2 - 1,300
Bis(2-ethylhexyl)phthalate	U	U	2,100	U	U	U	U	U	NA
Butylbenzylphthalate	ND	ND	ND	ND	ND	ND	ND	ND	NA
Chrysene	ND	ND	ND	ND	ND	ND	ND	ND	38
Dibenz(a,h)anthracene	ND	ND	ND	ND	ND	ND	ND	ND	NA
Fluoranthene	ND	ND	ND	ND	ND	ND	55 J	ND	0.3 - 40
Ideno(1,2,3-cd)pyrene	ND	ND	ND	ND	ND	ND	ND	ND	10 - 15
Phenanthrene	ND	ND	ND	ND	ND	ND	46 J	ND	30
Pyrene	ND	ND	53 J	ND	ND	ND	59 J	ND	1 - 19.7

Key at end of table.

Table 4-16

ORGANIC COMPOUNDS DETECTED IN SURFACE SOIL SAMPLES
(all values reported in µg/kg)

Compound	SS-9	SS-10	SS-10D	SS-11	SS-12[a]	SS-13[a]	SS-14	Background PAH Concentrations in Rural soils[b]
Volatiles								
Acetone	ND	U	ND	240	ND	ND	U	
Chloromethane	ND	ND	ND	ND	ND	ND	ND	
Ethylbenzene	ND	ND	ND	ND	ND	ND	ND	
Semivolatiles								
Anthracene	ND	27 J	ND	ND	ND	ND	ND	NA
Benzo(b)fluoranthene	ND	67 J	ND	ND	ND	ND	140 J	20 - 30
Benzo(k)fluoranthene	ND	44 J	ND	ND	ND	ND	ND	10 - 110
Benzo(g,h,i)perylene	ND	ND	ND	ND	47 J	ND	ND	10 -70
Benzo(a)pyrene	ND	ND	ND	ND	ND	ND	88 J	2 - 1,300
Bis(2-ethylhexyl)phthalate	U	U	U	U	U	U	U	NA
Butylbenzylphthalate	ND	ND	50 J	ND	ND	260 J	ND	NA
Chrysene	40 J	100 J	ND	ND	ND	ND	48 J	38
Dibenz(a,h)anthracene	ND	ND	ND	ND	44 J	ND	ND	NA
Fluoranthene	ND	370 J	ND	ND	ND	ND	42 J	0.3 - 40
Ideno(1,2,3-cd)pyrene	ND	ND	ND	ND	45 J	ND	ND	10 - 15
Phenanthrene	ND	94 J	ND	ND	ND	ND	41 J	30
Pyrene	ND	280 J	ND	ND	ND	ND	49 J	1 - 19.7

Key at end of table.