OB3901 D4432

FEASIBILITY STUDY REPORT
WELLSVILLE-ANDOVER LANDFILL
(Site No. 9-02-004)

January 1994

Prepared for:

NEW YORK STATE DEPARTMENT OF
ENVIRONMENTAL CONSERVATION
Division of Hazardous Waste Remediation
50 Wolf Road
Albany, New York 12223

ecology and environment engineering, p.c.

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1. INTRODUCTION

Ecology and Environment Engineering, P.C. (E & E), under contract to the New York State Department of Environmental Conservation (NYSDEC), was tasked to perform a Remedial Investigation/Feasibility Study (RI/FS) at the Wellsville-Andover Landfill (NYSDEC Site No. 9-02-004), an inactive municipal landfill located in the townships of Wellsville and Andover, Allegany County, New York (see Figure 1-1). The RI/FS activities are being performed under Work Assignment No. D002625-8 of E & E's State Superfund Standby Contract.

This FS report updates and incorporates information presented in E & E's Phase I FS report (E & E 1992), combining the first, second, and third phases of the FS for the Wellsville-Andover Landfill site. This FS report is a companion document to the *Remedial Investigation Report* completed by E & E in December 1993.

1.1 PURPOSE AND ORGANIZATION OF REPORT

This FS report was prepared following the guidelines presented in NYSDEC's Technical and Administrative Guidance Memoranda, *Selection of Remedial Actions at Inactive Hazardous Waste Sites* (NYSDEC 1989) and *Strategic Plan: Accelerated Remedial Actions at Class 2, Non-RCRA Regulated Landfills* (NYSDEC 1990), the United States Environmental Protection Agency's (EPA's) *Conducting Remedial Investigations/Feasibility Studies for CERCLA Municipal Landfill Sites*, EPA/540/P-91-001 (EPA 1991), and *Streamlining the RI/FS for CERCLA Municipal Landfill Sites*, OSWER, 9355.3-11FS (EPA 1990).

In Phase I, remedial action objectives (RAOs) to protect human health and the environment were identified, general response actions were developed, and remedial technologies were evaluated to identify potential technologies for meeting the RAOs for the

Wellsville-Andover site. These potential technologies include the treatment, containment, and/or disposal of contaminated media. In Phase II, these technologies are developed into alternatives and evaluated based on the following criteria: short- and long-term effectiveness, implementability, and, to a lesser extent, cost. The third phase will further refine and analyze in detail the alternatives that are retained after the second phase evaluation. The selected alternatives will be evaluated using the following criteria:

- Compliance with New York State Standards, Criteria, and Guidelines (SCGs);
- Overall protection of human health and the environment;
- Short-term effectiveness;
- Long-term effectiveness and permanence;
- Reduction of toxicity, mobility, or volume;
- Implementability; and
- Cost.

Upon completion of the Phase III FS, an appropriate remedial action (along with the rationale for choosing this action) will be recommended for NYSDEC's consideration.

1.2 BACKGROUND INFORMATION

1.2.1 Site Description

The Wellsville-Andover Landfill site, which is listed as a Class 2 site in the Registry of Inactive Hazardous Waste Disposal Sites, 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 therefore was not included in the site investigation.

This area is currently used by a local community group, the Wellsville Area Small Plane Society (WASPS), for recreational purposes. Access to this portion of the site is gained only by a central dirt road that runs north-south between the filled areas.

The landfill, which has a fill area of approximately 40 acres, 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 (MSL). 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 is 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. 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 from this point, eventually joining Dyke Creek 1.8 miles south-southeast of the site. Dyke Creek, also a Class C stream, is a direct tributary to the Genesee River.

Numerous man-made ditches exist at the site for the purpose of diverting surface runoff away 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 to drain almost completely and has an overflow control. Water from this pond discharges to on-site ditches, which convey the water 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 diverts this water into the unnamed tributary west of the site.

1.2.2 Site History

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 and industrial waste between 1964 and 1978. The northeast fill area accepted municipal and industrial waste from 1978 to 1983. According to a 1983 Phase I Investigation Report prepared for NYSDEC, Rochester Button Company disposed of unknown quantities of methylene chloride (MC) and possibly trichloroethene (TCE) between 1968 and 1973. Note that these wastes are now classified as listed hazardous wastes under the Resource Conservation and Recovery Act (RCRA), which was promulgated on November 19, 1980. Other wastes disposed of at the landfill included polyester scraps, pumice, talc, detergent, lead carbonate, plastics, sodium cyanide salt, cutting oils, chromium and zinc chromate paints, solvents, coolants, and lubricating oils (NYSDEC 1983).

Only the northeast fill 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.

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 assumed 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. 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 underground holding tanks adjacent to Pump Station 1. A pond located on site near the southern access gate stores leachate that overflows from the two holding tanks. This unlined pond, which has an estimated capacity of 80,000 gallons, is rarely dry and overflows during wet weather periods. Leachate has also been observed overflowing from Pump Station 2 and migrating south on the adjacent property. Further discussion on the leachate collection system may be found in the Leachate Investigation Report completed by E & E in July 1992.

A Phase I study was performed for NYSDEC in 1983 by Engineering-Science, Inc. in association with Dames and Moore, and a Phase II study was performed in 1986 by Malcolm Pirnie for the Village of Wellsville. Factors of concern indicated by these studies were the potential impact of contaminated groundwater on local residents and the generation of leachate contaminated with volatile organic compounds (VOCs).

E & E performed a Phase I RI of the Wellsville-Andover Landfill for NYSDEC between August 1991 and February 1992. The Phase I RI report, completed in March 1992, contains data tables from the sampling programs conducted during Phase I field work.

From June 1993 through September 1993, E & E performed a Phase II RI for NYSDEC, focusing on the collection of additional data needed to define and evaluate remedial alternatives. The Phase II RI report has been presented under separate cover.

A Phased/Interim Remedial Alternatives report was also prepared by E & E in April 1992 to evaluate interim remedial alternatives. The report concluded that the impact of leachate on the groundwater is a concern, but the most effective solutions for mitigating this impact are not easily implemented as an interim action. It was therefore recommended that site access be limited in the meantime, and that the leachate problem be addressed in the final, comprehensive remedial action plan.

1.2.3 Nature and Extent of Contamination

The RI site investigation focused on characterizing the nature and extent of contamination associated with the site. During Phase I, samples were collected from various media and site locations, including:

- Landfill gas (LFG);
- Surface soils from drainage ditches and seep areas on and around the landfill;
- Subsurface soils and waste materials from the landfill; and
- Subsurface soils from borings around the landfill.

In addition, samples were collected from the following media during both Phase I and Phase II.

- Surface water from streams draining the site;
- Stream sediments;
- Groundwater from monitoring wells on and around the site;
- Groundwater samples from nearby residential wells and springs used for drinking water supply; and
- Landfill leachate and seeps.

A summary of contaminants detected at the site is presented in Tables 1-1 through 1-14. Figure 1-3 contains monitoring well and sampling locations. Figure 1-4 shows Phases I and II residential well and spring, surface water, and sediment sampling locations.

Preliminary Field Activities

Preliminary field activities performed prior to sampling of environmental media during the Phase I RI site characterization included a ground-based survey, the development of a base map, and the performance of three geophysical surveys. The geophysical investigation included a total earth field magnetics survey, a ground conductivity survey, and a seismic refraction survey.

Subsurface Soil and Waste

The boundaries of the fill areas were identified by the geophysical investigation and depicted on a site base map. Based on the contour patterns shown on the geophysical investigation maps generated as part of the RI, waste disposal appears to have been performed in a cellular fashion in the northeast fill area, while in the other areas, filling appears to have occurred in a more haphazard manner. Trench excavation conducted during the Phase I RI further supported the idea that mixed fill types are present throughout the landfill. That is, wastes do not appear to have been segregated based on type, and municipal, industrial, and what is now considered hazardous wastes are likely mixed. The geophysical investigation did not reveal a contaminant plume outside the fill areas; however, the depth to groundwater and high natural metal content of the area soils may have interfered with detection of a plume. Seismic profiles for the site were generated depicting subsurface stratigraphy; these profiles were then used to aid in the selection of monitoring well locations.

The results of the geophysical investigation allowed E & E to identify five highly anomalous locations within the fill areas. Each area was excavated and the cause of the anomaly determined. Steel 55-gallon drums were discovered in three of the five locations excavated. Of these drums, an empty, crushed oil drum was located in the south fill area, and five rusted drums were located in the northeast corner of the south-central fill area. These drums contained a solid, plastic-like material and were surrounded by plastic buttons and scraps. Two rusted, liquid-filled drums with no identifiable markings were discovered in the northwest corner of the northwest fill area.

Soil and waste samples collected from the five trenches indicated the presence of numerous contaminants, including chlorinated aliphatic compounds (1,2-dichloroethene [DCE], TCE, vinyl chloride [VC], etc.), aromatic hydrocarbons (benzene, ethylbenzene, toluene, xylene, and styrene), polynuclear aromatic hydrocarbons (PAHs), phthalates, phenols, and pesticides. Sample TP-2 from the northeast fill area contained relatively low amounts of the above contaminants, except for PAHs, phthalates, and pesticides, which were found at comparatively higher concentrations. The PAHs detected may have resulted from incomplete combustion of waste prior to disposal, while the phthalates most likely resulted from the relatively large amount of plastic in this disposal area compared to other areas. Sample TP-1 from the northwest fill area contained relatively high concentrations of most of the above contaminants, including approximately 5,700 micrograms per liter (μg/L) of chlorinated aliphatic compounds and approximately 36,000 μg/L of aromatic hydrocarbons. TP-4 from the south-central fill area contained the highest concentration of total chlorinated aliphatics (approximately 9,800 μg/L) and phthalates (approximately 24,000 μg/L).

When compared to observed ranges in eastern United States soils, concentrations of cobalt, lead, and zinc were found to be slightly elevated across the site, while arsenic, copper, and nickel were slightly elevated only in the northwest fill area. Based on available data, the concentrations of these metals suggest that all are fairly ubiquitous in the area.

Among the subsurface soil samples collected from each of the deep well borings, only the two samples from MW-5D contained organic substances (1,2-DCE, TCE, and VC). A total of 130 micrograms per kilogram (μg/kg) were detected at 8 to 9 feet, and approximately 81 μg/kg were detected at 18 to 19 feet. Several inorganic substances exceeded the 90th percentile of the observed range in eastern United States soils, but only lead appears not to be attributable to background conditions.

The boundaries of the individual fill areas were defined using topographic clues and the geophysical survey results. These boundaries were later verified by Phase II test pit excavation. During Phase I RI trenching and Phase II RI piezometer installation, existing landfill cover and fill depths were found to vary. In the northeast fill area, fill was encountered to a depth of 15.5 feet and the cover ranged from 1.5 to 2.5 feet thick. In the northwest area, fill extended to depths of 8 to 12 feet and the cover was between 3 and 7 feet thick. In the south-central fill area, fill was found at maximum depths of 9 to 20 feet with 2.5 to 4 feet of cover. In the south fill area, fill was encountered to a depth of 9 feet with 2 to 3 feet of cover. Variations in cover thickness are likely due to settling and the subsequent addition of more soil. With the exception of encountering fill from 4 to 20 feet below ground surface (BGS) in PZ-11 in the south-central fill area, the remaining fill depths are consistent with the Phase II investigation report, which stated that the maximum depth of fill was approximately 9 to 14 feet (Village of Wellsville 1986).

Groundwater

During the Phase I RI, E & E collected groundwater samples from 21 overburden and bedrock monitoring wells on site. Organic compounds detected in the groundwater samples included several chlorinated aliphatic compounds (chloroethane, 1,1-dichloroethane [DCA], 1,1-DCE, 1,2-DCE, 1,1,1-trichloroethane [TCA], TCE, and VC) and the aromatic hydrocarbons ethylbenzene and toluene. The monitoring wells containing these compounds above NYSDEC Class GA standards included MW-2D, MW-5D, MW-5S, MW-6D, MW-11S, CW-3A, and CW-3B. All of these wells are on the east or south side of the site. Concentrations of total chlorinated aliphatic compounds ranged up to a maximum of approximately 8,100 μg/L in GW-5S.

Inorganic substances detected above Class GA standards in the Phase I RI groundwater samples--with the exception of iron, manganese, magnesium, and sodium, which are commonly high in unfiltered samples--were chromium in GW-2D and lead in GW-12S and GW-2D.

During the Phase II RI, five additional monitoring well pairs were installed further east and south of the site than the existing wells, and one very deep well was installed. Groundwater samples were then collected from all possible wells (excluding three dry wells) totaling 31 samples. The same VOCs found in the Phase I RI samples were detected in the Phase II RI groundwater samples, except that benzene was detected off site in well MW-15DA.

Fourteen monitoring wells were found to contain chlorinated aliphatics and/or aromatic hydrocarbons. All but one well (CW-4A) contained at least one compound above NYSDEC Class GA groundwater standards. All of the 14 wells were on the east and south sides of the site, with the exception of MW-10D (which had a total VOC concentration of approximately 7 μg/L) on the west side of the site. Concentrations of total chlorinated aliphatic compounds in Phase II RI groundwater samples ranged up to a maximum of approximately 6,200 μg/L in MW-5S. VOCs were also detected in three of the new off-site wells (MW-14D, MW-15DA, and MW-15S). Deep monitoring well MW-5VD contained no organic contamination, indicating a lack of vertical contaminant migration to the depth range screened by this well (90 to 110 feet BGS).

Thirteen inorganic analytes were detected above NYSDEC Class GA standards in the Phase II RI groundwater samples. Of these 13 analytes, arsenic, barium, beryllium, cadmium, and zinc exceeded standards in only one highly turbid sample, MW-8D. The remaining inorganics detected above standards include chromium in MW-2S and MW-8S; copper in MW-8D and MW-16S; lead in MW-2S, MW-8D, and CW-3A; magnesium in MW-2S, MW-3D, MW-8D, MW-8S, and CW-3B; and cyanide in CW-4B. Every Phase II RI groundwater sample contained at least one inorganic analyte above NYSDEC Class GA standards, including iron in the background well, MW-1D. The high turbidities of samples MW-2S, MW-8D, MW-8S, and CW-3B are likely part of the reason for the high metals content in these samples.

Wells and Springs

Seven residential wells and springs in the area were sampled during the Phase I RI (the closest public water supply is approximately 4 miles away). The only organic compound detected was TCE, which was found below the Class GA standard in the LaDue spring south-southeast of the site. Inorganic substances above Class GA standards include iron and sodium in more than half the samples, manganese in the Rosini well, and zinc in the Bauer well. All four of these metals are considered secondary contaminants by the New York State Department of Health (NYSDOH). That is, their standards are based on aesthetics, not the protection of human health.

During the Phase II RI, domestic water samples were collected from 19 residences in Duffy Hollow. As in the Phase I RI, site-related organics were detected in the LaDue spring. TCE was detected at a concentration above the NYSDEC Class GA groundwater standard in samples collected from both the outdoor spigot and the spring overflow. These concentrations, 6.2 μg/L and 5.1 μg/L, respectively, are approximately double those detected during the Phase I RI.

In the Phase II RI domestic water samples, at least one inorganic was detected above NYSDEC Class GA standards at 15 homes. Concentrations of inorganic analytes were very similar in those locations sampled during both phases of the RI, with few exceptions. None of the changes were of a large magnitude, suggesting that the changes represent natural fluctuations to what may be natural or site-related preexisting concentrations, with the exception of cyanide, which does not appear to be site related.

Surface Water

A total of seven surface water and seven sediment samples were collected from Duffy Creek and its unnamed tributary during both phases of the RI. No organic or inorganic analytes in either medium were found to significantly exceed (by more than approximately 50%) the concentrations detected in the background sample, except for manganese in surface water sample SW-2, which was six times the background value, and potassium in sediment sample SED-4, which was two times the background value.

Surface Soils

Twelve biased and two background surface soil samples were collected at the site during the Phase I RI. Analysis indicated the presence of chloromethane and/or ethylbenzene in samples collected near seeps in the northwest fill area. In addition, several PAHs were detected at various concentrations in leachate seeps and ditches on and off the site. Inorganic analysis of these surface soil samples indicated concentrations of calcium, cobalt, iron, lead, manganese, nickel, and zinc above those expected based on a literature review; however, based on the background samples and other on-site data, all of these substances appear to be naturally ubiquitous at the concentrations detected.

Air

Six air (LFG) samples were collected at various points along the leachate collection system during the Phase I RI. Analysis indicated the presence of relatively high concentrations of chlorinated aliphatic compounds and aromatic hydrocarbons, with the majority of the VOCs in the collection system emanating from the northwest fill area. Samples collected from manholes MH-6 and MH-10 and riser R-10 contained one to two orders of magnitude in VOCs above the other samples analyzed.

The relatively high concentrations of VOCs in the air samples suggest that the leachate may not be the only source of the VOCs. Risers and lateral lines may allow VOCs in the fill to migrate directly to the main line of the leachate collection system. To help determine whether VOCs are also migrating away from the fill areas via soil gas, a perimeter soil gas survey was performed during the Phase II RI. No samples were collected; rather, air monitoring instruments were used to quantify the VOCs present in the soil gas around each fill area. Several locations very near the fill showed high concentrations of VOCs in the soil gas; however, most of the locations exhibited little or no VOCs.

To obtain suitable benchmarks for evaluating the significance of the LFG concentrations, NYSDEC annual guidance concentrations (AGCs), which apply to ambient air, were multiplied by 1,000. Investigations at another landfill with a mixture of wastes (Strasburg Landfill in Pennsylvania) that had substantial LFG generation showed that VOC concentrations in ambient air around the top of the landfill were about 1,000 times lower than concentrations in the soil gas. This empirical relationship observed between contaminant concentrations in the soil gas and ambient air was in excellent agreement with the relationship predicted by an EPA model for the pressure-driven migration of vapors through soil.

Leachate

Leachate samples were collected during the Phase I RI from two locations along the leachate collection system (L-1 from Manhole 4 [MH-4] and L-2 from the sump at Pump Station 2). Inorganic substances exceeding NYSDEC Class C standards in the leachate are aluminum, lead, and zinc in both samples and vanadium only in L-1. Volatile and semivolatile compounds were also detected at concentrations exceeding NYSDEC Class C standards.

Four leachate samples were collected during the Phase II RI sampling. The analytical results indicated that aluminum, cobalt, copper, iron, lead, vanadium, and zinc were present above the NYSDEC Class C standard. Chlorobenzene, chloroethane, 1,1-DCA, 1,2-DCA, ethylbenzene, and total xylenes were also detected at concentrations above the NYSDEC Class C standard. Maximum concentrations of chemicals detected in Phase II RI samples were generally higher than the maximum concentrations detected in the Phase I RI samples.

Aquifer Characterization

Aquifer testing was conducted in many of the on-site wells during the Phase II RI. Results indicated that the hydraulic conductivity range in the vicinity of the overburden wells is 10^{-6} to 10^{-4} centimeters per second (cm/s), and 10^{-5} to 10^{-2} cm/s for the bedrock wells.

Groundwater flow in both the overburden and bedrock is strongly influenced by topography (see Figures 1-5 and 1-6). A groundwater flow divide is present along the east side of the site. On the east side of the divide, flow is to the southeast toward Duffy Creek. On the west side of the divide, flow is to the southwest toward the unnamed tributary.

Several isolated aquifers appear to exist in many areas at and around the site. However, based on site geology and the extent of fracturing, these aquifers likely merge in several places. The bedrock and overburden potentiometric surfaces are expected to converge at common discharge points such as Duffy Creek and its tributary.

1.2.4 Contaminant Fate and Transport

The primary migratory pathway for contaminants on site is from the fill to the groundwater via infiltration and leaching. Because the fill areas have a much higher (two or three orders of magnitude) permeability than the surrounding native soils and the landfill cover is also expected to be more permeable than the surrounding soils (but less permeable than the fill), the fill areas are assumed to be acting as primary groundwater recharge units in the immediate vicinity of the site. The infiltrating rainwater leaches the contaminants out of the fill and is either intercepted in the leachate collection system or enters into the groundwater.

The findings of the RI showed that the surface groundwater probably intercepts the northwest fill area, and that groundwater most likely does not intercept the other fill areas (see Figures 1-7, 1-8, and 1-9).

A primary migratory pathway for site-related contaminants to move off site is groundwater. Organics were detected off site to the east in monitoring well MW-14D. Organics were also detected south and southeast of the site in the LaDue spring and in numerous monitoring wells. To the southeast, TCE was detected as far as 1,500 feet away from the site. Immediately south of the site, organic contaminants were detected 300 feet from the landfill in MW-11S, but not in MW-16D/16S, which is approximately 1,200 feet from the site. Based on this information, a groundwater contaminant plume in the overburden and shallow bedrock appears to be emanating from the site and moving hydraulically (and topographically) downgradient to the south and southeast. TCE appears to be at the leading edge of this plume. TCE has traveled at least as far as the LaDue spring and probably traveled farther during the landfill's period of use (15 to 30 years).

Organics were detected on site in the bedrock to a maximum depth of 50 to 60 feet BGS in MW-2D. However, no VOCs were present at 60 to 70 feet BGS in MW-8D or at 90 to 110 feet BGS in MW-5VD, indicating that 60 feet may be the approximate maximum depth of VOCs.

No significantly elevated levels of inorganics were detected in MW-5VD. However, the presence of inorganics at depth cannot easily be determined because two of the deep wells with the highest total metals content (MW-2D and MW-8D) also had relatively high turbidities.

The lack of organics on the west side of the site, especially in wells MW-9S and MW-10S, suggests that the leachate collection system is intercepting and/or removing VOCs from the groundwater in these areas. Air monitoring and LFG sampling along the leachate collection system indicated that the northwest fill area is contributing the highest concentrations of VOCs to the leachate collection system. However, the wells installed near this fill area at depths similar to the leachate collection system contained no VOCs in the well samples.

Leachate is a potential migratory pathway for site-related contaminants. Numerous organic and inorganic constituents of the leachate were present at elevated levels and leachate has been observed flowing off site, thus providing a mechanism by which off-site environmental media could become contaminated.

Based on the perimeter explosive gas survey, soil gas does not appear to be a major contaminant migration pathway. However, based on the detection limits of the survey equipment (parts per million [ppm] range) and the lack of downgradient ambient air and soil gas samples, the volatilization of site-related VOCs from contaminated groundwater cannot conclusively be eliminated as a migratory pathway.

1.2.5 Human Health Risk Evaluation

In the preliminary risk evaluation conducted as part of the RI for the Wellsville-Andover Landfill site, the analytical results of site samples were compared to background contaminant levels and applicable NYSDEC, NYSDOH, and EPA criteria. Contaminants of potential concern (COPCs) were chosen based on this comparison process. These contaminants include 1,1-DCA, 1,1-DCE, 1,2-DCE, toluene, TCE, and VC. According to EPA classification, 1,1-DCA and 1,1-DCE are Group C (possible) human carcinogens; 1,2-DCE and toluene are not considered carcinogenic; TCE is a Group B2 (probable) carcinogen; and VC is a Group A (known human) carcinogen.

Potential exposure pathways are shown schematically in Figure 1-10, the conceptual site model. Under existing conditions at the site, the most significant potential exposure pathway appears to be the use of contaminated groundwater downgradient from the site as a source of drinking water. Other potential pathways include inhalation of vapors emanating directly from the landfill or from contaminated groundwater, and contact with landfill leachate at seeps and the leachate holding pond.

In the future, residences that may be built closer to the landfill would probably also use groundwater as a drinking water source. If this were to occur, the exposure pathways would be the same as those described for existing conditions; however, exposure levels could be much higher because the levels of groundwater contamination are much higher closer to the landfill. This would result in higher ingestion and inhalation exposures from use of the groundwater and would increase the possibility of vapors infiltrating the residences directly from the contaminated groundwater.

1.2.6 Habitat-Based Assessment

In addition to the human health risk evaluation, a habitat-based assessment was performed to characterize the ecological resources associated with this site. The scope of work performed addressed items in Steps 1, 2A, and 2B of Fish and Wildlife Impact Analysis for Inactive Hazardous Waste Sites (NYSDEC 1991c). Analytical data collected during the RI were compared to site background and applicable criteria for the protection of fish and wildlife. Based on this comparison, several contaminants of potential ecological concern (CPECs) were identified for each applicable medium, including surface water (and leachate), sediment, and surface soil.

CPECs were then evaluated with respect to toxicity benchmark criteria. No organics appeared to pose a threat to fish and wildlife in any of the three media. On-site leachate and seeps pose a moderate risk to fish and wildlife because of the presence of the inorganic CPECs aluminum, cobalt, copper, iron, lead, and zinc. Manganese in the sediment and five CPECs (cadmium, cobalt, lead, nickel, and zinc) in the surface soil are possible threats to fish and wildlife; however, additional evaluation is necessary to conclusively determine the risk posed by these contaminants.

Table 1-1

PHASE I
SUMMARY OF CONTAMINANTS DETECTED IN LANDFILL GAS SAMPLES

Chemical	Detection Frequency	Range of Detected Concentrations (ppb)		1,000x NYSDEC AGC (ppb)[a]	Exceedance Frequency
		Minimum	Maximum		
Volatile Organic Compounds					
Benzene	2/6	113	240	38	2/6
Chloroethane	2/6	60	820	NA	NA
1,1-Dichloroethane	4/6	4	1,700	124,000	0/6
cis-1,2-Dichloroethene	6/6	2	87,000	479,000	0/6
Ethylbenzene	6/6	19	21,000	230,000	0/6
Freon®11	2/6	180	210	125,000	0/6
Freon®12	3/6	12	27	NA	NA
Freon®114	2/6	2	980	NA	NA
Methylene chloride	1/6	—	860	7,770	0/6
1,2,4-Trichlorobenzene	1/6	—	2	1,210	0/6
1,1,1-Trichloroethane	2/6	800	2,300	183,000	0/6
Trichloroethene	2/6	2	390	80	1/6
1,2,4-Trimethylbenzene	1/6	—	34	59,000	0/6
Toluene	6/6	3	8,600	531,000	0/6
Vinyl chloride	6/6	11	12,000	8	6/6
m,p-Xylene	5/6	34	1,800	69,000	0/6
o-Xylene	2/6	5	290	161,000	0/6

[a] Annual Guidance Concentration (NYSDEC 1991b) converted from $\mu g/m^3$ to ppb and multiplied by 1,000 (see text for explanation).

Key:

NA = Not available.

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

Table 1-2

PHASE I
SUMMARY OF CONTAMINANTS DETECTED IN LEACHATE SAMPLES

Chemical	Detection Frequency	Range of Detected Concentrations (μg/L)		NYSDEC Class C Surface Water Standard (μg/L)[a]	Exceedance Frequency
		Minimum	Maximum		
INORGANIC SUBSTANCES					
Aluminum	2/2	774	27,600	100	2/2
Arsenic	1/2	—	12.5	190	0/2
Barium	2/2	406	577	NA	NA
Calcium	2/2	123,000	191,000	NA	NA
Chromium	2/2	15.2	39.9	962 / 791[b]	0/2
Cobalt	2/2	55.4	58.4	5	2/2
Copper	1/2	—	35.2	58.8 / 47.9[b]	0/2
Iron	2/2	71,900	165,000	300	2/2
Lead	2/2	27.2	47.9	34.6 / 25.6[b]	2/2
Magnesium	2/2	42,800	50,300	NA	NA
Manganese	2/2	1,880	3,670	NA	NA
Nickel	1/2	—	54.5	398 / 332[b]	0/2
Potassium	2/2	33,400	50,700	NA	NA
Sodium	2/2	33,600	71,500	NA	NA
Vanadium	1/2	—	52.2	14	1/2
Zinc	2/2	151	227	30	2/2
ORGANIC SUBSTANCES					
Volatiles					
Chlorobenzene	1/2	—	3	5	0/2
total 1,2-Dichloroethene	2/2	2	8	NA	NA
Trichloroethene	2/2	2	14	11	1/2

Key at end of table.

Table 1-2

PHASE I
SUMMARY OF CONTAMINANTS DETECTED IN LEACHATE SAMPLES

Chemical	Detection Frequency	Range of Detected Concentrations (μg/L)		NYSDEC Class C Surface Water Standard (μg/L)[a]	Exceedance Frequency
		Minimum	Maximum		
ORGANIC SUBSTANCES (CONT.)					
Semivolatiles					
4-Chloro-3-methyl phenol	1/2	—	4	1[c]	1/2
1,4-Dichlorobenzene	1/2	—	1	5[d]	0/2
Di-n-butyl phthalate	1/2	—	2	NA	NA
Naphthalene	1/2	—	1	NA	NA
n-Nitrosodiphenylamine	1/2	—	1	NA	NA

a NYSDEC 1991a.
b Standard is a function of hardness; first value is for sample L-1, and second value is for sample L-2.
c Standard applies to total chlorinated phenols.
d Standard applies to the sum of ortho, meta, and para isomers.

Key:

NA = Not available.

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

Table 1-3

PHASE II
SUMMARY OF CONTAMINANTS DETECTED IN LEACHATE SAMPLES

Chemical	Detection Frequency	Range of Detected Concentrations (μg/L)		NYSDEC Class C Surface Water Standard (μg/L)[a]	Exceedance Frequency
		Minimum	Maximum		
INORGANIC SUBSTANCES					
Aluminum	4/4	1,020	35,900	100	4/4
Arsenic	4/4	5.9	28.0	190	0/4
Barium	4/4	47.5	511	NA	NA
Beryllium	1/3	—	1.7	11 - 1,100[f]	0/4
Calcium	4/4	9,060	153,000	NA	NA
Chromium	3/4	18.4	36.3	87.6 - 1,140[b]	0/4
Cobalt	4/4	5.9	66.2	5	4/4
Copper	4/4	5.3	49.4	4.8 - 70[b]	4/4
Iron	4/4	8,850	100,350[e]	300	4/4
Lead	4/4	7.2	67.9	0.9 - 45[b]	1/4
Magnesium	4/4	3,010	102,000	NA	NA
Manganese	4/4	1,130	15,100	NA	NA
Nickel	3/4	23.5	73.0	43 - 465[b]	0/4
Potassium	4/4	1,800	65,500[e]	NA	NA
Sodium	4/4	1,050	168,000[e]	NA	NA
Vanadium	3/4	7.2[e]	53.7	14	2/4
Zinc	4/4	40.5	181	30	4/4
ORGANIC SUBSTANCES					
Volatiles					
Chlorobenzene	1/4	—	6.5[e]	5	1/4
Chloroethane	1/4	—	44.5[e]	5	1/4
1,1-Dichloroethane	1/4	—	8.5[e]	5	1/4
1,2-Dichloroethane	4/4	7[e]	10	5	4/4
Ethylbenzene	4/4	—	145[e]	5	1/4

Key at end of table.

Table 1-3

PHASE II
SUMMARY OF CONTAMINANTS DETECTED IN LEACHATE SAMPLES

Chemical	Detection Frequency	Range of Detected Concentrations (μg/L)		NYSDEC Class C Surface Water Standard (μg/L)[a]	Exceedance Frequency
		Minimum	Maximum		
Total xylenes	1/4	—	445[e]	5	1/4
Toluene	2/4	—	2	5	0/4

[a] NYSDEC 1991a.
[b] Standard is a function of hardness. This information was unavailable for Phase II data.
[c] Standard applies to total chlorinated phenols.
[d] Standard applies to the sum of ortho, meta, and para isomers.
[e] Value is average of sample and duplicate.
[f] Standard is a function of hardness as follows: 11 μg/L when hardness is <75 mg/L and 1,100 μg/L when hardness is >75 mg/L.

Key:

NA = Not available.

Source: Compiled by Ecology and Environment Engineering, P.C. 1993.

Table 1-4

PHASE I
SUMMARY OF CONTAMINANTS DETECTED IN SUBSURFACE SOIL/WASTE MATERIALS FROM TRENCHES

Chemical	Detection Frequency	Range of Detected Concentrations (mg/kg)		Benchmark Background Concentration (mg/kg)[b]	Exceedance Frequency	Benchmark Health Risk Value (mg/kg)[a]	Exceedance Frequency
		Minimum	Maximum				
INORGANIC SUBSTANCES							
Aluminum	5/5	9,450	14,600	128,000	0/5	NA	NA
Arsenic	5/5	11.5	20.9	16	1/5	80	0/5
Barium	5/5	85.7	215	867	0/5	4,000	0/5
Calcium	5/5	1,610	9,890	14,400	0/5	NA	NA
Chromium	5/5	18.2	28.8	112	0/5	80,000	0/5
Cobalt	5/5	20.8	28.1	19.8	5/5	NA	NA
Copper	5/5	25.4	194	48.7	1/5	3,000[c]	0/5
Iron	5/5	23,900	38,300	54,100	0/5	NA	NA
Lead	5/5	15.3	86.9	33	4/5	250	0/5
Magnesium	5/5	3,330	5,070	10,700	0/5	NA	NA
Manganese	5/5	422	784	1,450	0/5	20,000	0/5
Nickel	5/5	31.9	43.2	38.2	1/5	2,000	0/5
Potassium	5/5	1,570	2,160	23,500	0/5	NA[d]	NA
Vanadium	5/5	15.1	26.2	140	0/5	600	0/5
Zinc	5/5	87.4	269	104	4/5	20,000	0/5

Key at end of table.

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Table 1-4

PHASE I
SUMMARY OF CONTAMINANTS DETECTED IN SUBSURFACE SOIL/WASTE MATERIALS FROM TRENCHES

Chemical	Detection Frequency	Range of Detected Concentrations (mg/kg)		Benchmark Health Risk Value (mg/kg)[a]	Exceedance Frequency
		Minimum	Maximum		
ORGANIC SUBSTANCES					
Volatiles					
Acetone	4/5	0.23	4.5	6,000	0/5
Benzene	1/5	—	0.078	24	0/5
2-Butanone	2/5	0.075	0.49	NA	NA
1,1-Dichloroethane	1/5	—	0.71	8,000	0/5
total 1,2-Dichloroethene	4/5	0.021	3.9	800[e] (as cis-)	0/5
Ethylbenzene	5/5	0.031	33	8,000	0/5
2-Hexanone	2/5	0.044	0.12	NA	NA
Methylene chloride	1/5	—	0.11	93	0/5
4-Methyl-2-pentanone	1/5	—	0.26	NA	NA
Styrene	2/5	0.045	4.2	23	0/5
Tetrachloroethene	1/5	—	0.52	14	0/5
Toluene	5/5	0.011	3.2	20,000	0/5
Trichloroethene	2/5	0.073	5.3	64	0/5

Key at end of table.

02:OB3901_D4432-11/17/93-D1

Table 1-4

PHASE I
SUMMARY OF CONTAMINANTS DETECTED IN SUBSURFACE SOIL/WASTE MATERIALS FROM TRENCHES

Chemical	Detection Frequency	Range of Detected Concentrations (mg/kg)		Benchmark Health Risk Value (mg/kg)[a]	Exceedance Frequency
		Minimum	Maximum		
ORGANIC SUBSTANCES (CONT.)					
Volatiles (Cont.)					
Vinyl chloride	1/5	—	0.98	0.36	1/5
Total xylenes	4/5	0.051	1.7	200,000	0/5
Semivolatiles					
Benzo(a)fluoranthene	1/5	—	0.37	0.22	1/5
Benzo(a)pyrene	1/5	—	0.28	0.061	1/5
Benzyl alcohol	1/5	—	1.2	20,000	0/5
Bis(2-ethylhexyl)phthalate	5/5	0.13	8.3	50	0/5
Butylbenzylphthalate	3/5	1.0	16	20,000	0/5
4-Chloro-3-methylphenol	1/5	—	0.30	NA	NA
Chrysene	1/5	—	0.41	NA	NA
Di-n-butylphthalate	4/5	0.049	14	8,000	0/5
1,2-Dichlorobenzene	2/5	0.67	1.2	7,000	0/5
Diethylphthalate	2/5	0.025	0.11	60,000	0/5
Dimethylphthalate	2/5	0.53	0.91	80,000	0/5

Key at end of table.

Table 1-4

PHASE I
SUMMARY OF CONTAMINANTS DETECTED IN SUBSURFACE SOIL/WASTE MATERIALS FROM TRENCHES

Chemical	Detection Frequency	Range of Detected Concentrations (mg/kg)		Benchmark Health Risk Value (mg/kg)[a]	Exceedance Frequency
		Minimum	Maximum		
ORGANIC SUBSTANCES (CONT.)					
Semivolatiles (Cont.)					
Fluoranthene	3/5	0.28	0.72	3,000	0/5
2-Methylnaphthalene	2/5	0.18	0.19	NA	NA
4-Methylphenol	4/5	0.37	1.6	NA	NA
Naphthalene	2/5	0.14	0.15	300	0/5
Pentachlorophenol	1/5	—	6.6	2,000	0/5
Phenanthrene	3/5	0.13	0.61	NA	NA
Pyrene	3/5	0.19	0.53	2,000	0/5
Pesticides					
beta-BHC	1/5	—	0.012	3.9	0/5
Dieldrin	1/5	—	0.013	0.044	0/5
4,4'-DDD	2/5	0.043	0.12	2.9	0/5
4,4'-DDE	1/5	—	0.015	2.1	0/5
4,4'-DDT	1/5	—	0.13	2.1	0/5

Key at end of table.

Table 1-4 (Cont.)

[a] Guidance derived from direct ingestion pathway (NYSDEC 1991b).
[b] Upper 90th percentile of concentrations in eastern U.S. soils (Shacklette and Boerngen 1984);
[c] RCRA CMS action level for soil (USEPA 1990a).
[d] NYSDEC value was derived from potassium cyanide and is inappropriate for this use.
[e] Derived from cis-1,2-Dichloroethene.

Key:

NA = Not available.

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

Table 1-5

PHASE I
SUMMARY OF CONTAMINANTS DETECTED IN SURFACE WATER

Chemical	Detection Frequency	Range of Detected Concentrations (μg/L)		Class C Surface Water Standard (μg/L)[a]	Exceedance Frequency
		Minimum	Maximum		
INORGANIC SUBSTANCES					
Aluminum	5/6	137	874	100	5/6
Calcium	6/6	15,400	19,800	NA	NA
Iron	6/6	130	3,840	300	4/6
Lead	6/6	1.1	4.8	1.48 - 1.90[b]	3/6
Magnesium	5/6	6,360	7,200	NA	NA
Manganese	4/6	68.5	3,090	NA	NA
Sodium	5/6	8.980	22,100	NA	NA
ORGANIC SUBSTANCES					
Semivolatiles					
Di-n-butyl phthalate	4/6	1	2	NA	NA
Di-n-octyl phthalate	1/6	—	2	NA	NA

[a] NYSDEC 1991a.
[b] Standard is a function of hardness.

Key:

NA = Not available.

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

Table 1-6

PHASE II
SUMMARY OF CONTAMINANTS DETECTED IN SURFACE WATER

Chemical	Detection Frequency	Detected Concentration (μg/L)		Class C Surface Water Standard (μg/L)[a]	Exceedance Frequency
		Minimum	Maximum		
INORGANIC SUBSTANCES					
Aluminum	1/1	—	4,670	100	1/1
Arsenic	1/1	—	3.6	190	0/1
Barium	1/1	—	172	NA	NA
Calcium	1/1	—	18,800	NA	NA
Chromium	1/1	—	9.5	11[b]	0/1
Copper	1/1	—	7.3	8.5[b]	0/1
Iron	1/1	—	7,500	300	1/1
Lead	1/1	—	7.5	2.0[b]	1/1
Magnesium	1/1	—	7,210	NA	NA
Manganese	1/1	—	437	NA	NA
Nickel	1/1	—	14.3	71[b]	0/1
Potassium	1/1	—	3,070	NA	NA
Sodium	1/1	—	8,090	NA	NA
Vanadium	1/1	—	6.1	14	0/1
Zinc	1/1	—	53.7	30	1/1

a NYSDEC 1991a.
b Standard is a function of hardness.

Key:

NA = Not available.

Source: Compiled by Ecology and Environment Engineering, P.C. 1993.

Table 1-7

PHASE I
SUMMARY OF CONTAMINANTS DETECTED IN SEDIMENT SAMPLES

Chemical	Detection Frequency	Range of Detected Concentrations (mg/kg)		Benchmark Background Concentrations (mg/kg)[b]	Exceedance Frequency	NYSDEC Aquatic Sediment Criteria (mg/kg)[a]	Exceedance Frequency
		Minimum	Maximum				
INORGANIC SUBSTANCES							
Aluminum	6/6	1,000	15,700	128,000	0/6	NA	NA
Arsenic	6/6	8.1	13.5	16	0/6	5	6/6
Barium	6/6	97.4	192	867	0/6	NA	NA
Calcium	2/6	1,290	2,010	14,400	0/6	NA	NA
Chromium	6/6	18.3	22.7	112	0/6	26	0/6
Cobalt	6/6	25.4	27.9	19.8	6/6	NA	NA
Copper	6/6	15.7	21.4	48.7	0/6	19	2/6
Iron	6/6	32,400	43,200	54,100	0/6	24,000	6/6
Lead	6/6	3.2	26.1	33	0/6	27	0/6
Magnesium	6/6	3,510	4,640	10,700	0/6	NA	NA
Manganese	6/6	798	2,440	1,450	2/6	428	6/6
Nickel	6/6	33.4	40.1	38.2	2/6	22	6/6
Potassium	1/6	--	1,070	23,500	1/6	NA	NA
Vanadium	6/6	17.5	23.4	140	0/6	NA	NA
Zinc	6/6	76.1	107	104	1/6	85	3/6

Key at end of table.

Table 1-7

PHASE I
SUMMARY OF CONTAMINANTS DETECTED IN SEDIMENT SAMPLES

Chemical	Detection Frequency	Range of Detected Concentrations (mg/kg)		Benchmark Background Concentrations (mg/kg)[b]	Exceedance Frequency	NYSDEC Aquatic Sediment Criteria (mg/kg)[a]	Exceedance Frequency
		Minimum	Maximum				
ORGANIC SUBSTANCES							
Volatiles							
Acetone	5/6	0.01	0.035	NA	NA	NA	NA
Semivolatiles							
Butylbenzylphthalate	1/6	--	0.024	NA	NA	NA	NA

a Geometric mean of "no-effect" and "lowest effect" levels based on studies in benthic organisms (NYSDEC 1991b).
b Upper 90th percentile of concentrations in eastern U.S. soils (Shacklette and Boerngen 1984).

Key:

NA = Not available.

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

Table 1-8

PHASE II
SUMMARY OF CONTAMINANTS DETECTED IN SEDIMENT SAMPLES

Chemical	Detection Frequency	Detected Concentration (mg/kg)		Benchmark Background Concentrations (mg/kg)[b]	Exceedance Frequency	NYSDEC Aquatic Sediment Criteria (mg/kg)[a]	Exceedance Frequency
		Minimum	Maximum				
INORGANIC SUBSTANCES							
Aluminum	1/1	—	9,890	128,000	0/1	NA	NA
Arsenic	1/1	—	12.3	16	0/1	5	1/1
Barium	1/1	—	236	867	0/1	NA	NA
Beryllium	1/1	—	0.94	1.81	0/1	NA	NA
Calcium	1/1	—	2,810	14,400	0/1	NA	NA
Chromium	1/1	—	16.0	112	0/1	26	0/1
Cobalt	1/1	—	19.4	19.8	0/1	NA	NA
Copper	1/1	—	19.0	48.7	0/1	19	0/1
Iron	1/1	—	25,500	54,100	0/1	24,000	1/1
Lead	1/1	—	24.1	33	0/1	27	0/1
Magnesium	1/1	—	2,880	10,700	0/1	NA	NA
Manganese	1/1	—	2,040	1,450	1/1	428	1/1
Nickel	1/1	—	31.4	38.2	0/1	22	1/1
Potassium	1/1	—	879	23,500	0/1	NA	NA
Sodium	1/1	—	235	17,400	0/1	NA	NA

Key at end of table.

Table 1-8

PHASE II
SUMMARY OF CONTAMINANTS DETECTED IN SEDIMENT SAMPLES

Chemical	Detection Frequency	Detected Concentration (mg/kg)		Benchmark Background Concentrations (mg/kg)[b]	Exceedance Frequency	NYSDEC Aquatic Sediment Criteria (mg/kg)[a]	Exceedance Frequency
		Minimum	Maximum				
Vanadium	1/1	—	19.9	140	0/1	NA	NA
Zinc	1/1	—	112	104	1/1	85	1/1

a Geometric mean of "no-effect" and "lowest effect" levels based on studies in benthic organisms (NYSDEC 1991b).
b Upper 90th percentile of concentrations in eastern U.S. soils (Shacklette and Boerngen 1984).

Key:

NA = Not available.

Source: Compiled by Ecology and Environment Engineering, P.C. 1993.

Table 1-9

PHASE I
SUMMARY OF CONTAMINANTS DETECTED IN SURFACE SOIL SAMPLES

Chemical	Detection Frequency	Range of Detected Concentrations (mg/kg)		Benchmark Background Concentrations (mg/kg)[b]	Exceedance Frequency	Benchmark Health Risk Value (mg/kg)[a]	Exceedance Frequency
		Minimum	Maximum				
INORGANIC SUBSTANCES							
Aluminum	14/14	1,030	14,300	128,000	0/14	NA	NA
Arsenic	14/14	4.0	13.5	16	0/14	80	0/14
Barium	14/14	43.9	741	867	0/14	4,000	0/14
Calcium	8/14	1,680	173,000	14,400	2/14	NA	NA
Chromium	14/14	12.9	40.4	112	0/14	80,000	0/14
Cobalt	14/14	17.7	87.3	19.8	13/14	NA	NA
Copper	13/14	6.6	28.2	48.7	0/14	3,000[c]	0/14
Iron	14/14	23,800	283,000	54,100	3/14	NA	NA
Lead	14/14	13.2	56.1	33	2/14	250	0/14
Magnesium	14/14	1,710	9,060	10,700	0/14	NA	NA
Manganese	14/14	235	4,540	1,450	2/14	20,000	0/14
Nickel	14/14	15.8	88	38.2	4/14	2,000	0/14
Potassium	10/14	1,300	2,250	23,500	0/14	NA[d]	0/14
Vanadium	13/14	14.4	25.6	140	0/14	600	0/14
Zinc	14/14	43	356	104	3/14	20,000	0/14
Cyanide	1/14	—	3.5	NA	NA	2,000	0/14

Key at end of table.

Table 1-9

PHASE I
SUMMARY OF CONTAMINANTS DETECTED IN SURFACE SOIL SAMPLES

Chemical	Detection Frequency	Range of Detected Concentrations (mg/kg)		Benchmark Background Concentrations (mg/kg)[b]	Exceedance Frequency	Benchmark Health Risk Value (mg/kg)[a]	Exceedance Frequency
		Minimum	Maximum				
ORGANIC SUBSTANCES							
Volatiles							
Acetone	1/14	—	0.240	NA	NA	6,000	0/14
Chloromethane	1/14	—	0.040	NA	NA	NA	NA
Ethylbenzene	2/14	0.001	0.018	NA	NA	8,000	0/14
Semivolatiles							
Anthracene	1/14	—	0.014	NA	NA	20,000	0/14
Benzo(b)fluoranthene	2/14	0.034	0.140	0.020 - 0.030	2/14	0.22	0/14
Benzo(k)fluoranthene	1/14	—	0.022	0.010 - 0.110	0/14	0.22	0/14
Benzo(g,h,i)perylene	1/14	—	0.047	0.010 - 0.070	0/14	NA	NA
Benzo(a)pyrene	1/14	—	0.088	0.002 - 1.3	0/14	0.061	1/14
Bis(2-ethylhexyl)phthalate	1/14	—	2.1	NA	NA	50	0/14
Butylbenzylphthalate	2/14	0.025	0.260	NA	NA	20,000	0/14
Chrysene	3/14	0.040	0.050	0.038	3/14	NA	NA
Dibenz(a,h)anthracene	1/14	—	0.044	NA	NA	0.014	1/14
Fluoranthene	3/14	0.042	0.185	0.003 - 0.040	3/14	3,000	0/14
Indeno(1,2,3-cd)pyrene	1/14	—	0.045	0.010 - 0.015	1/14	NA	NA

Key at end of table.

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Table 1-9

PHASE I
SUMMARY OF CONTAMINANTS DETECTED IN SURFACE SOIL SAMPLES

Chemical	Detection Frequency	Range of Detected Concentrations (mg/kg)		Benchmark Background Concentrations (mg/kg)[b]	Exceedance Frequency	Benchmark Health Risk Value (mg/kg)[a]	Exceedance Frequency
		Minimum	Maximum				
Phenanthrene	3/14	0.041	0.047	0.030	3/14	NA	NA
Pyrene	4/14	0.049	0.140	0.001 - 0.197	0/14	2,000	

[a] Guidance derived from human direct ingestion pathway (NYSDEC 1991b).
[b] For inorganics, benchmark value is the upper 90th percentile of concentrations in eastern U.S. soils (Shacklette and Boerngen 1984); for PAHs, benchmark value is the background value found in rural soils (ATSDR 1989).
[c] RCRA CMS action level for copper in soil (EPA 1990).
[d] NYSDEC value was derived from potassium cyanide and is inappropriate for this use.

Key:

NA = Not available.

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

Table 1-10

PHASE I
SUMMARY OF CONTAMINANTS DETECTED IN SUBSURFACE SOIL FROM BORINGS

Chemical	Detection Frequency	Range of Detected Concentrations (mg/kg)		Benchmark Value (mg/kg)[b]	Exceedance Frequency	Benchmark Health Risk Value (mg/kg)[a]	Exceedance Frequency
		Minimum	Maximum				
INORGANIC SUBSTANCES							
Aluminum	19/19	5,550	18,100	128,000	0/19	NA	NA
Arsenic	19/19	1.3	17.9	16	3/19	80	0/19
Barium	16/19	43	281	867	0/19	4,000	0/19
Cadmium	2/19	1.3	1.8	NA	NA	80	0/19
Calcium	14/19	1,150	77,550	14,400	1/19	NA	NA
Chromium	19/19	9.3	27.6	112	0/19	80,000	0/19
Cobalt	19/19	14.5	33.2	19.8	18/19	NA	NA
Copper	19/19	7.7	37	48.7	0/19	3,000[c]	0/19
Iron	19/19	14,700	45,200	54,100	0/19	NA	NA
Lead	18/19	6.6	45.3	33	2/19	250	0/19
Magnesium	19/19	3,590	17,100	10,700	1/19	NA	NA
Manganese	19/19	431	1,750	1,450	2/19	20,000	0/19
Mercury	1/19	—	0.12	0.265	0/19	20	0/19
Nickel	19/19	16.9	53.4	38.2	7/19	2,000	0/19
Potassium	17/19	1,340	1,990	23,500	0/19	NA[d]	0/19

Key at end of table.

02:OB3901_D4432-11/17/93-D1

Table 1-10

PHASE I
SUMMARY OF CONTAMINANTS DETECTED IN SUBSURFACE SOIL FROM BORINGS

Chemical	Detection Frequency	Range of Detected Concentrations (mg/kg)		Benchmark Value (mg/kg)[b]	Exceedance Frequency	Benchmark Health Risk Value (mg/kg)[a]	Exceedance Frequency
		Minimum	Maximum				
Vanadium	18/19	14.2	24.8	140	0/19	600	0/19
Zinc	19/19	56.3	96.5	104	0/19	20,000	0/19
ORGANIC SUBSTANCES							
Volatiles							
total 1,2-Dichloroethene	2/19	0.061	0.087	NA	NA	800[e]	0/19
Trichloroethene	2/19	0.013	0.022	NA	NA	64	0/19
Vinyl chloride	2/19	0.007	0.021	NA	NA	0.36	0/19

a Guidance derived from human direct ingestion pathway (NYSDEC 1991b).
b Upper 90th percentile of concentrations in eastern U.S. soils (Shacklette and Boerngen 1984).
c RCRA CMS action level for soils (EPA 1990).
d NYSDEC value was derived from potassium cyanide and is inappropriate for this use.
e Derived from cis-1,2-dichloroethene.

Key:

NA = Not available.

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

DRAFT

Table 1-11

PHASE I
SUMMARY OF CONTAMINANTS DETECTED IN GROUNDWATER SAMPLES FROM MONITORING WELLS

Chemical	Detection Frequency	Range of Detected Concentrations (μg/L)		NYSDOH MCL (μg/L)[a]	Exceedance Frequency	NYSDEC Class GA Groundwater Standard (μg/L)[b]	Exceedance Frequency
		Minimum	Maximum				
INORGANIC SUBSTANCES							
Aluminum	19/21	217	42,700	NA	NA	NA	NA
Arsenic	1/21	—	17.8	50 P	0/21	25	0/21
Barium	5/21	208	342	1,000 P	0/21	1,000	0/21
Calcium	21/21	9,160	85,200	NA	NA	NA	NA
Chromium	7/21	5	110	~~50~~ 100 P	1/21	50	1/21
Cobalt	1/21	—	102	NA	NA	NA	NA
Copper	2/21	46.2	115	1,000 S	0/21	200	0/21
Iron	20/21	316	110,000	300 S[c]	20/21	300[c]	20/21
Lead	12/21	1.2	125	~~50~~ 15 AL P	1/21	25	2/21
Magnesium	20/21	5,400	56,000	NA	NA	35,000 G	3/21
Manganese	21/21	16.4	8,530	300 S[c]	14/21	300[c]	14/21
Potassium	10/21	5,020	38,000	NA	NA	NA	NA
Sodium	20/21	7,450	51,600	NA	NA	20,000	12/21
Vanadium	1/21	—	67.1	NA	NA	NA	NA
Zinc	11/21	24.1	230	5,000 S	0/21	300	0/21

Key at end of table.

02:OB3901_D4432-11/17/93-D1

DRAFT

Table 1-11

PHASE I
SUMMARY OF CONTAMINANTS DETECTED IN GROUNDWATER SAMPLES FROM MONITORING WELLS

Chemical	Detection Frequency	Range of Detected Concentrations (μg/L)		NYSDOH MCL (μg/L)[a]	Exceedance Frequency	NYSDEC Class GA Groundwater Standard (μg/L)[b]	Exceedance Frequency
		Minimum	Maximum				
ORGANIC SUBSTANCES							
Volatiles							
Acetone	1/21	—	33	50	0/21	5	1/21
Chloroethane	1/21	—	4	5	0/21	5	0/21
Chloroform	1/21	—	2	7	0/21	7	0/21
1,1-Dichloroethane	2/21	6	11	5	2/21	5	2/21
1,1-Dichloroethene	4/21	3	12	5	3/21	5	3/21
total 1,2-Dichloroethene	10/21	3	5,600	5	7/21	5	7/21
Ethylbenzene	1/21	—	3	5	0/21	5	0/21
Methylene chloride	1/21	—	4	5	0/21	5	0/21
Toluene	4/21	2	9	5	3/21	5	3/21
1,1,1-Trichloroethane	2/21	1	4	5	0/21	5	0/21
Trichloroethene	9/21	1	1,200	5	6/21	5	6/21
Vinyl chloride	6/21	45	2,100	2	6/21	2	6/21

Key at end of table.

Table 1-11 (Cont.)

[a] Maximum Contaminant Level (10 NYCRR 5-1.52).
[b] NYSDEC 1991a.
[c] Total concentration of iron and manganese is not to exceed 500 μg/L.

Key:

G = Guidance value (NYSDEC 1991).
NA = Not available.
P = NYSDOH primary contaminant.
S = NYSDOH secondary contaminant.

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

Table 1-12

PHASE II
SUMMARY OF CONTAMINANTS DETECTED IN GROUNDWATER SAMPLES FROM MONITORING WELLS

Chemical	Detection Frequency	Range of Detected Concentrations (μg/L)		NYSDOH MCL (μg/L)[a]	Exceedance Frequency	NYSDEC Class GA Groundwater Standard (μg/L)[b]	Exceedance Frequency
		Minimum	Maximum				
INORGANIC SUBSTANCES							
Aluminum	27/27	30.8	51,300	NA	NA	NA	NA
Arsenic	23/27	1.0	45.5	50 P	0/27	25	2/27
Barium	27/27	14.0	1,470	1,000 P	1/27	1,000	1/27
Beryllium	4/27	1.2	3.2	NA	NA	NA	NA
Cadmium	5/27	3.4	10.8	50	0/27	10	1/27
Calcium	27/27	9,430	173,000	NA	NA	NA	NA
Chromium	9/27	5.2	291	50 P	3/27	50	3/27
Cobalt	9/27	4.4	109	NA	NA	NA	NA
Copper	23/27	2.5	208	1,000 S	0/27	200	2/27
Cyanide	5/27	21.0	160	NA	NA	100	1/27
Iron	27/27	143	131,000	300 S[c]	25/27	300[c]	25/27
Lead	21/27	1.3	484	50 P	2/27	25	3/27
Magnesium	27/27	1,510	71,500	NA	NA	35,000 G	6/27
Manganese	27/27	29.4	7,570	300 S[c]	13/27	300[c]	13/27
Nickel	8/27	11.6	366	NA	NA	NA	NA
Potassium	27/27	832	42,100	NA	NA	NA	NA

Key at end of table.

Table 1-12

PHASE II
SUMMARY OF CONTAMINANTS DETECTED IN GROUNDWATER SAMPLES FROM MONITORING WELLS

Chemical	Detection Frequency	Range of Detected Concentrations (µg/L)		NYSDOH MCL (µg/L)[a]	Exceedance Frequency	NYSDEC Class GA Groundwater Standard (µg/L)[b]	Exceedance Frequency
		Minimum	Maximum				
Selenium	7/27	1.1	1.7	10	0/27	10	0/27
Sodium	27/27	3,250	49,200	NA	NA	20,000	9/27
Vanadium	9/27	4.2	57.8	NA	NA	NA	NA
Zinc	27/27	4.1	549	5,000 S	0/27	300	1/27
ORGANIC SUBSTANCES							
Volatiles							
Benzene	1/30	—	14	5	1/30	0.7	1/30
Chloroethane	1/30	—	13	5	1/30	5	1/30
1,1-Dichloroethane	2/30	3	9	5	1/30	5	1/30
1,1-Dichloroethene	4/30	2	9	5	2/30	5	2/30
total 1,2-Dichloroethene	18/30	3	3,300[d]	5	10/30	5	11/30
Ethylbenzene	2/30	4.5[d]	11	5	1/30	5	1/30
Toluene	3/30	1	10[d]	5	2/27	5	2/30
1,1,1-Trichloroethane	3/30	2	6	5	1/30	5	1/30
1,1,2-Trichloroethane	1/30		1.5[d]	5	0/30	5	0/30
Trichloroethene	9/30	5	1,800[d]	5	10/30	5	10/30
Vinyl chloride	7/30	8	1,750[d]	5	7/30	2	7/30

Key at end of table.

Table 1-12 (Cont.)

[a] Maximum Contaminant Level (10 NYCRR 5-1.52).
[b] NYSDEC 1991a.
[c] Total concentration of iron and manganese is not to exceed 500 μg/L.
[d] Average of duplicate samples.

Key:

G = Guidance value (NYSDEC 1991).
NA = Not available.
P = NYSDOH primary contaminant.
S = NYSDOH secondary contaminant.

Source: Compiled by Ecology and Environment Engineering, P.C. 1993.

Table 1-13

PHASE I
SUMMARY OF CONTAMINANTS DETECTED IN RESIDENTIAL WELL AND SPRING SAMPLES

Chemical	Detection Frequency	Range of Detected Concentrations (μg/L)		NYSDOH MCL (μg/L)[a]	Exceedance Frequency	NYSDEC Class GA Groundwater Standard (μg/L)[b]	Exceedance Frequency
		Minimum	Maximum				
INORGANIC SUBSTANCES							
Aluminum	3/7	323	741	NA	NA	NA	NA
Barium	0/7	NA	NA	1,000 P	0/7	1,000	0/7
Calcium	7/7	13,400	44,850	NA	NA	NA	NA
Chromium	1/7	—	11.1	50 P	0/7	50	0/7
Copper	1/7	—	33.8	1,000 S	0/7	200	0/7
Iron	6/7	107	1,300	300 S[c]	5/7	300[c]	5/7
Lead	0/7	NA	NA	50 P	0/7	25	0/7
Magnesium	7/7	6,070	19,600	NA	NA	35,000 G	0/7
Manganese	7/7	17.7	510	300 S[c]	1/7	300[c]	1/7
Mercury	1/8	—	0.46	2 P	0/7	2	0/7
Potassium	0/7	NA	NA	NA	NA	NA	NA
Sodium	6/7	8,200	58,000	NA	NA	20,000	4/7
Zinc	4/7	13.4	338	5,000 S	0/7	300	1/7
Cyanide	1/7	—	19	NA	0/7	100	0/7

Key at end of table.

02:OB3901_D4432-01/18/94-D1

Table 1-13

PHASE I
SUMMARY OF CONTAMINANTS DETECTED IN RESIDENTIAL WELL AND SPRING SAMPLES

Chemical	Detection Frequency	Range of Detected Concentrations (μg/L)		NYSDOH MCL (μg/L)[a]	Exceedance Frequency	NYSDEC Class GA Groundwater Standard (μg/L)[b]	Exceedance Frequency
		Minimum	Maximum				
ORGANIC SUBSTANCES							
Volatiles							
Trichloroethene	1/7	—	2.9	5	0/7	5	0/7

[a] Maximum Contaminant Level (10 NYCRR 5-1.52).
[b] NYSDEC 1991a.
[c] Total concentration of iron and manganese is not to exceed 500 μg/L.

Key:

G = Guidance value (NYSDEC 1991).
NA = Not available.
P = NYSDOH primary contaminant.
S = NYSDOH secondary contaminant.

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

Table 1-14

PHASE II
SUMMARY OF CONTAMINANTS DETECTED IN RESIDENTIAL WELL AND SPRING SAMPLES

Chemical	Detection Frequency	Range of Detected Concentrations (μg/L)		NYSDOH MCL (μg/L)[a]	Exceedance Frequency	NYSDEC Class GA Groundwater Standard (μg/L)[b]	Exceedance Frequency
		Minimum	Maximum				
INORGANIC SUBSTANCES							
Aluminum	13/19	21.1	925	NA	NA	NA	NA
Antimony	2/19	35.6	39.7			NA	NA
Arsenic	4/19	1.5	7.5	50 P	0/19	25	0/19
Barium	18/19	21.3	135	1,000 P	0/19	1,000	0/19
Calcium	18/19	5,890	46,200[d]	NA	NA	NA	NA
Copper	16/19	2.2	2,070	~~1,000~~ 1300 S	1/19	200	2/19
Iron	18/19	16.4	10,600	300 S[c]	7/19	300[c]	7/19
Lead	15/19	1.0	20.1	~~50~~ 15 P	0/19	25	0/19
Magnesium	18/19	3,060	20,900[d]	NA	NA	35,000 G	0/19
Manganese	18/19	3.2[d]	2,050	300 S[c]	3/19	300[c]	3/19
Mercury	1/19	—	0.29	2 P	0/19	2	0/19
Potassium	18/19	556	1,910	NA	NA	NA	NA
Selenium	1/19	—	1.7	10	0/19	10	0/19
Sodium	18/19	1,620	110,000	NA	NA	20,000	10/19

Key at end of table.

02:OB3901_D4432-11/17/93-D1

DRAFT

Table 1-14

PHASE II
SUMMARY OF CONTAMINANTS DETECTED IN RESIDENTIAL WELL AND SPRING SAMPLES

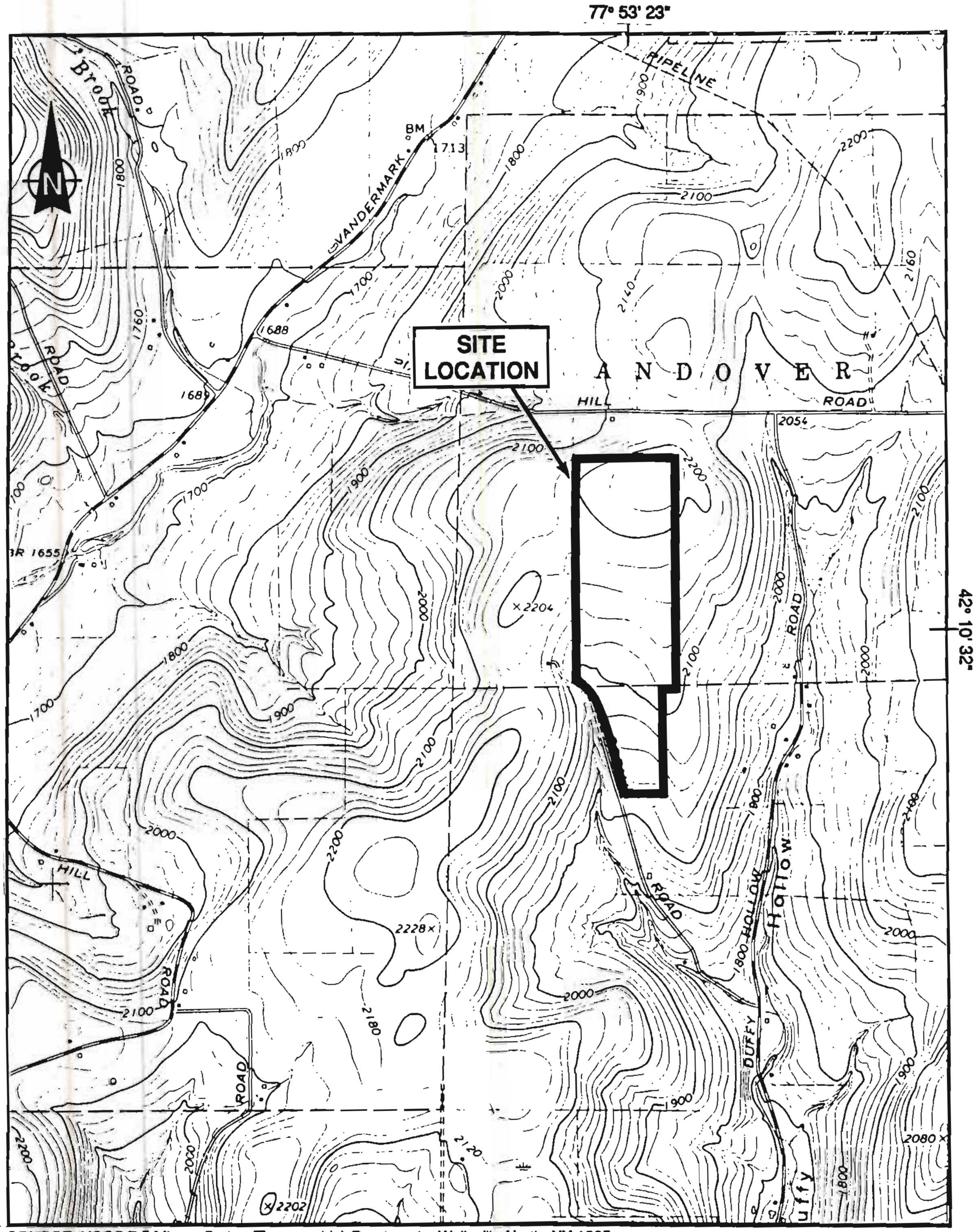
Chemical	Detection Frequency	Range of Detected Concentrations (μg/L)		NYSDOH MCL (μg/L)[a]	Exceedance Frequency	NYSDEC Class GA Groundwater Standard (μg/L)[b]	Exceedance Frequency
		Minimum	Maximum				
Zinc	17/19	5.4	471	5,000 S	0/19	300	2/19
Cyanide	2/19	10.0	84.0	NA	NA	100	0/19
ORGANIC SUBSTANCES							
Volatiles							
Acetone	1/17	—	19	50	1/17	5	1/17
1,2-Dichloroethane	1/17	—	1.0	5	0/17	5	0/17
Carbon disulfide	1/17	—	0.4	NA	NA	NA	NA
Trichloroethene	1/17	—	5.1	5	1/17	5	1/17

a Maximum Contaminant Level (10 NYCRR 5-1.52).
b NYSDEC 1991a.
c Total concentration of iron and manganese is not to exceed 500 μg/L.
d Value represents average of sample and duplicate.

Key:

G = Guidance value (NYSDEC 1991).
NA = Not available.
P = NYSDOH primary contaminant.
S = NYSDOH secondary contaminant.

Source: Compiled by Ecology and Environment Engineering, P.C. 1993.



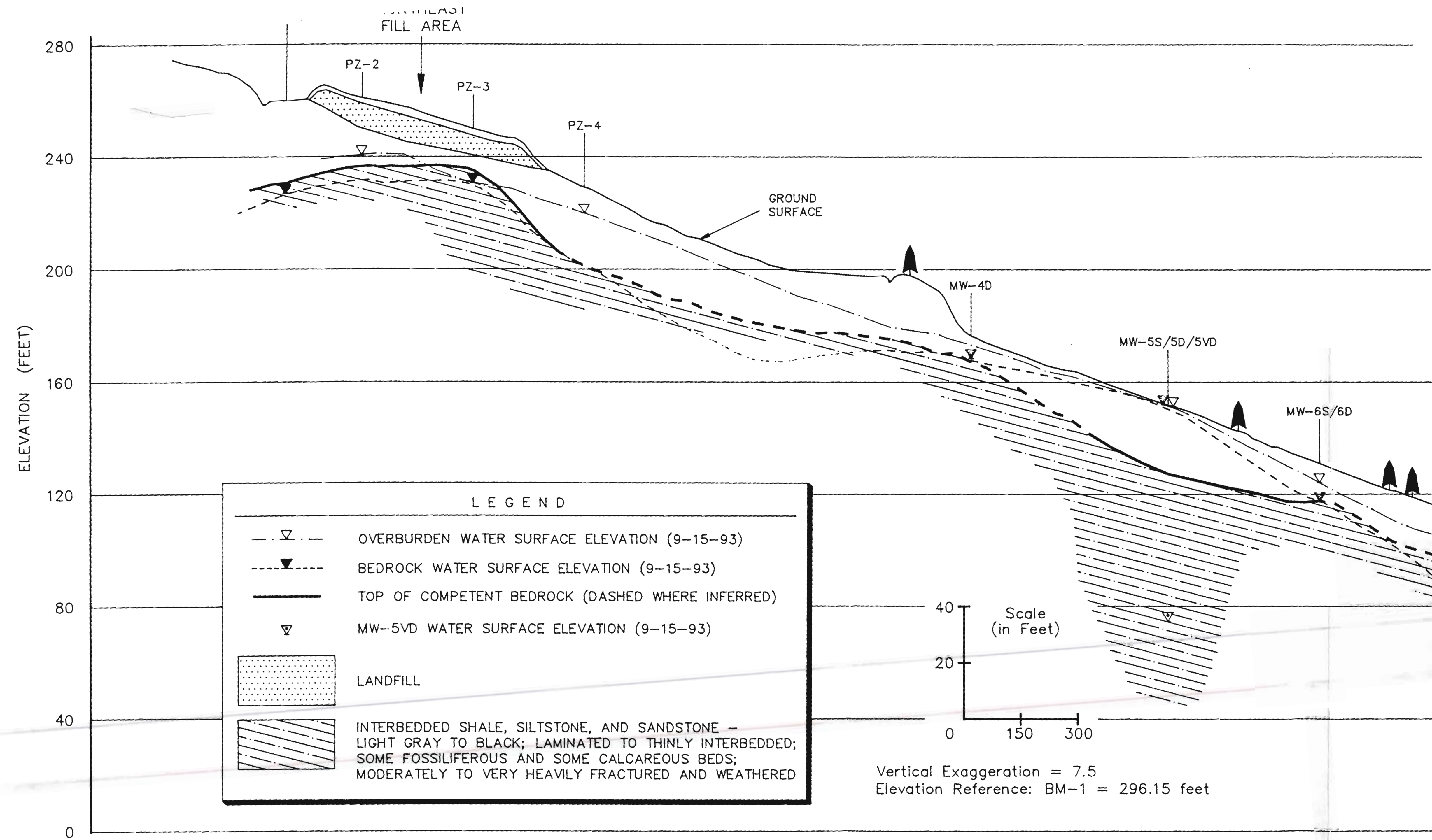
SOURCE: USGS 7.5 Minute Series (Topographic) Quadrangle, Wellsville North, NY 1965.

SCALE 1:24,000

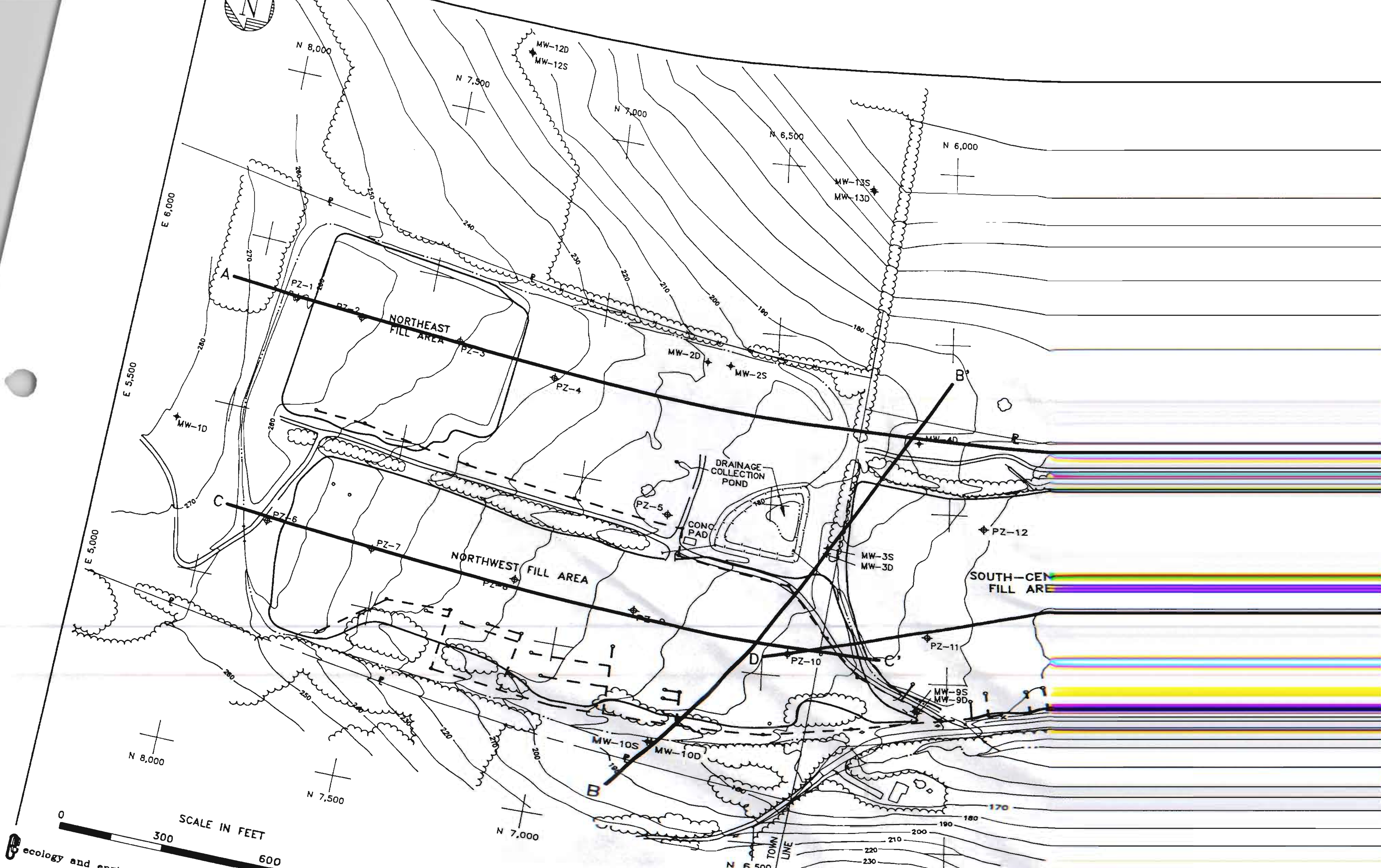
0 ½ 1 Mile

0 .5 1 Kilometer

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



FILL AREA
PZ-2
PZ-3
PZ-4
GROUND SURFACE
MW-4D
MW-5S/5D/5VD
MW-6S/6D
ELEVATION (FEET)
280
240
200
160
120
80
40
0
LEGEND
OVERBURDEN WATER SURFACE ELEVATION (9-15-93)
BEDROCK WATER SURFACE ELEVATION (9-15-93)
TOP OF COMPETENT BEDROCK (DASHED WHERE INFERRED)
MW-5VD WATER SURFACE ELEVATION (9-15-93)
LANDFILL
INTERBEDDED SHALE, SILTSTONE, AND SANDSTONE – LIGHT GRAY TO BLACK; LAMINATED TO THINLY INTERBEDDED; SOME FOSSILIFEROUS AND SOME CALCAREOUS BEDS; MODERATELY TO VERY HEAVILY FRACTURED AND WEATHERED
Scale (in Feet)
40
20
0
150
300
Vertical Exaggeration = 7.5
Elevation Reference: BM-1 = 296.15 feet



SCALE IN FEET
0
300
600
E 5,000
E 5,500
E 6,000
N 8,000
N 7,500
N 7,000
N 6,500
N 6,000
NORTHEAST FILL AREA
NORTHWEST FILL AREA
DRAINAGE COLLECTION POND
CONC PAD
TOWN LINE
MW-1D
MW-2D
MW-2S
MW-3S
MW-3D
MW-9S
MW-9D
MW-10S
MW-10D
MW-12D
MW-12S
MW-13S
MW-13D
PZ-1
PZ-4
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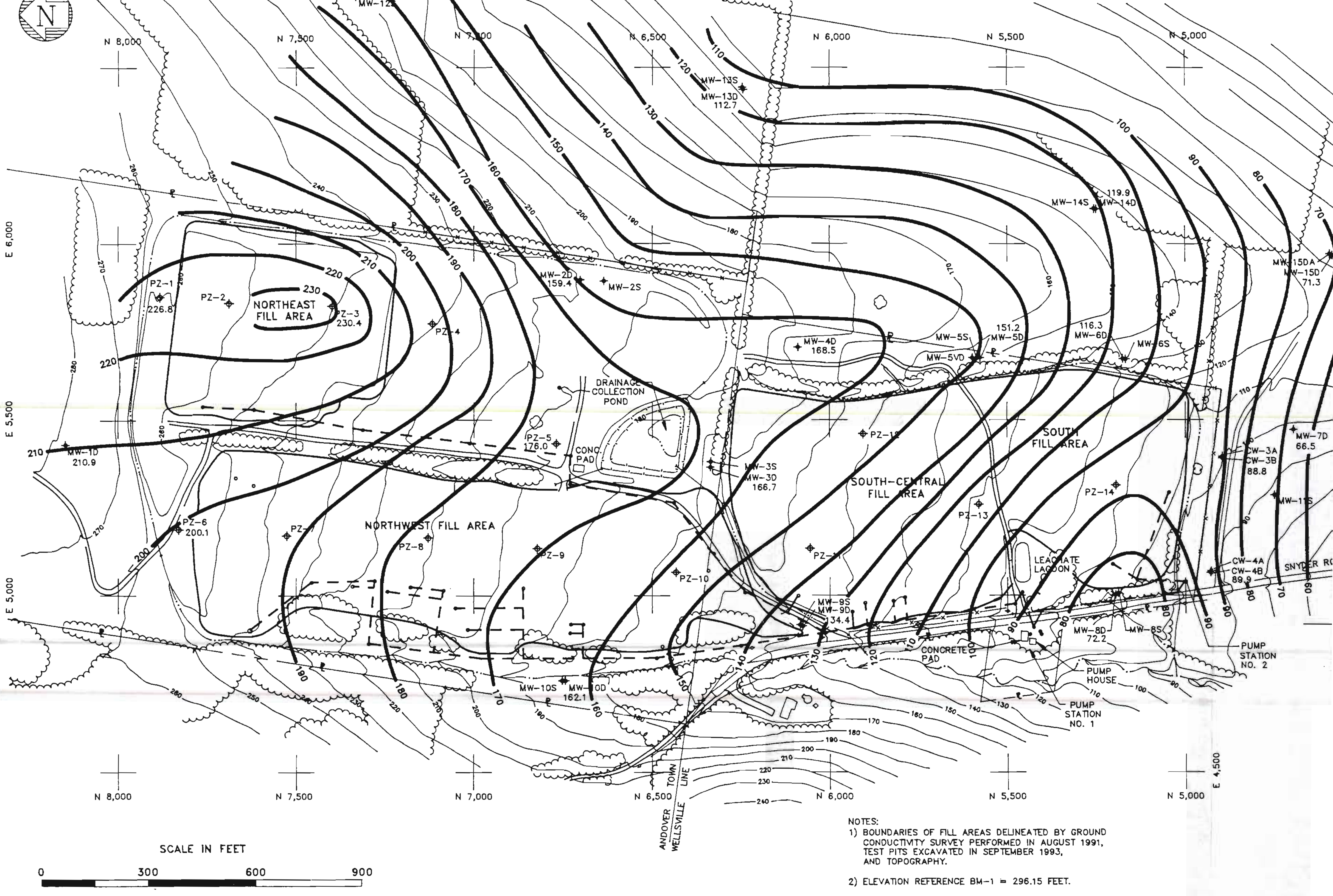
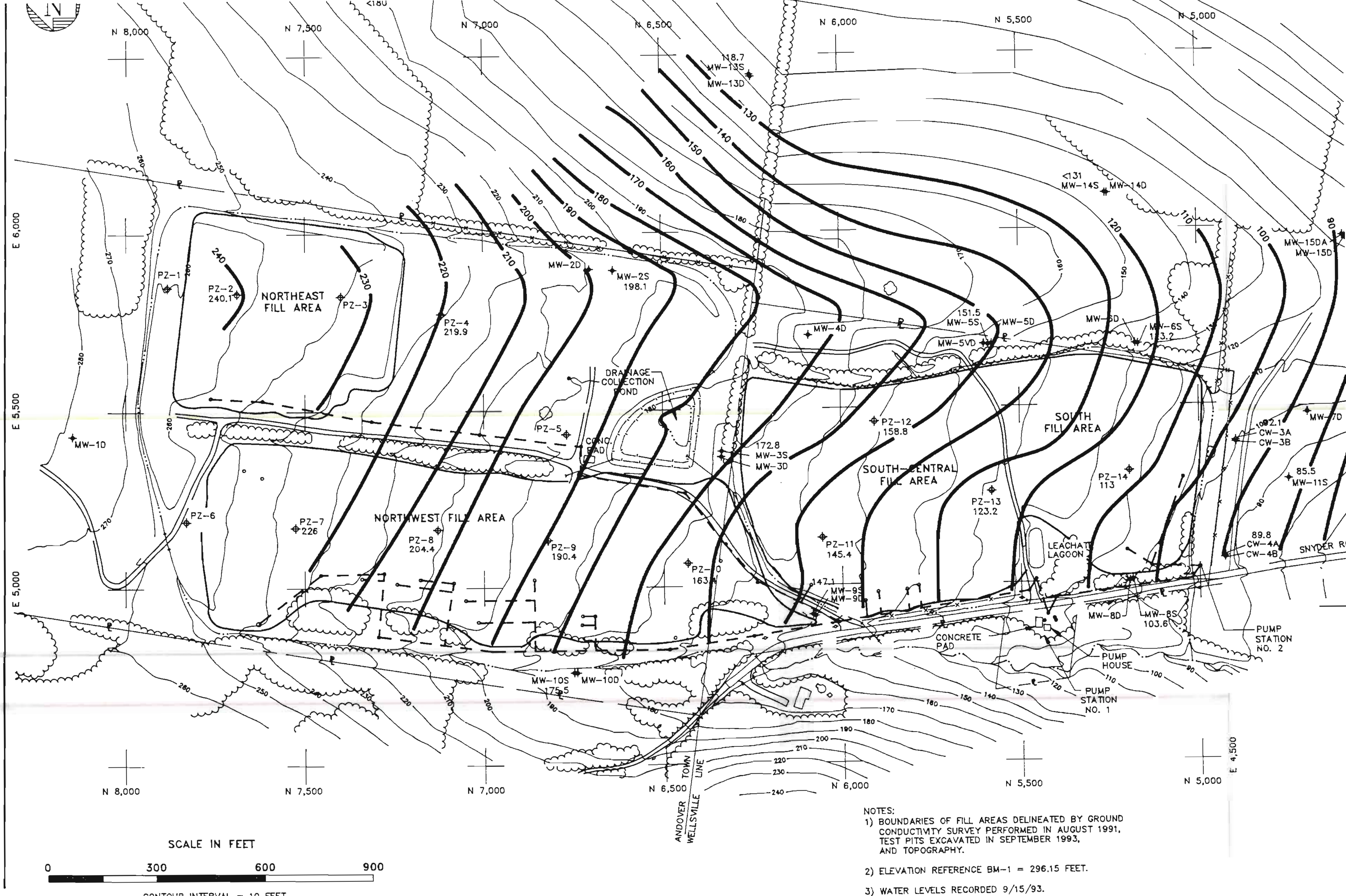
PZ-11
PZ-12
A
B
B'
C
C'
D



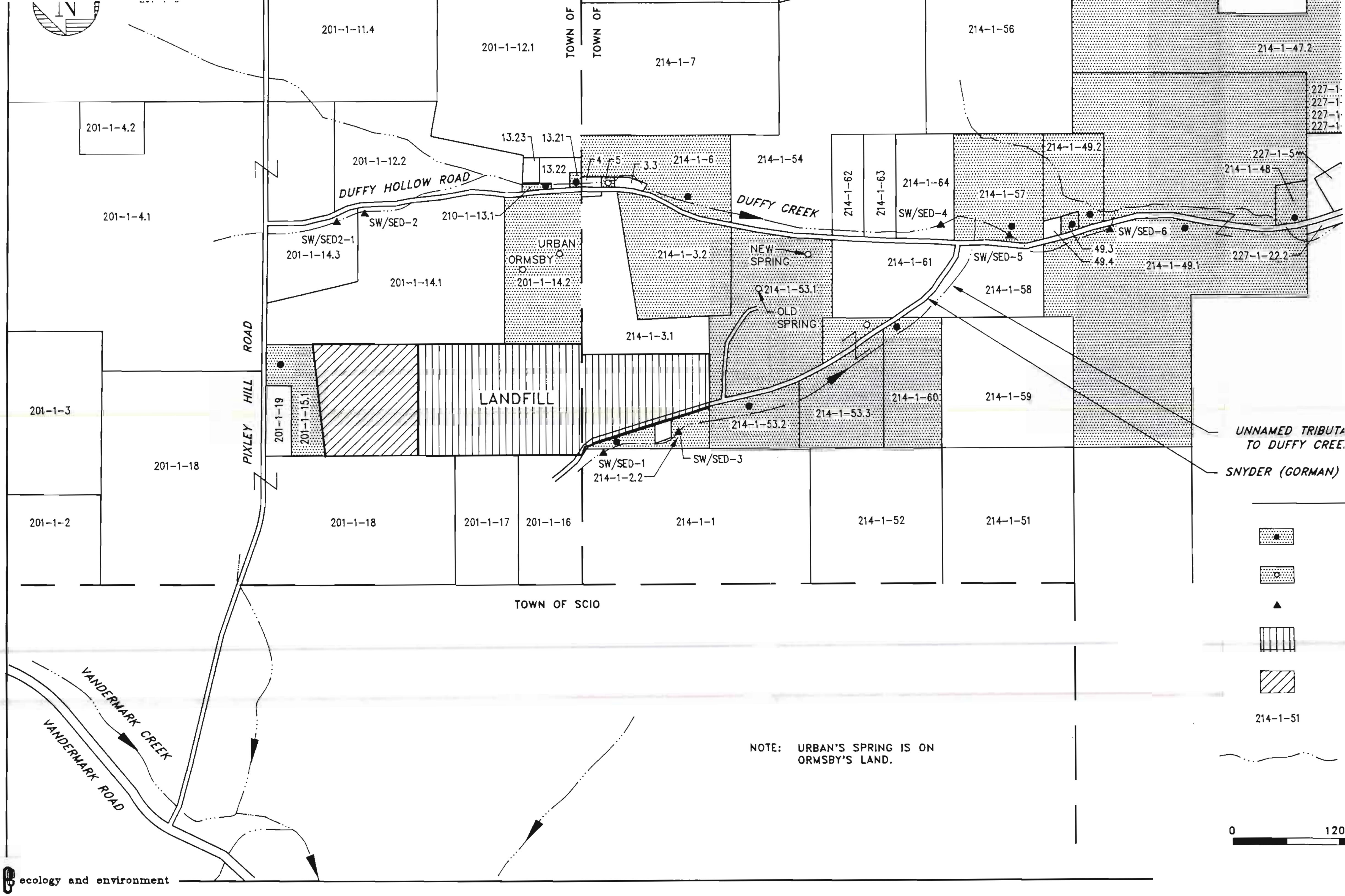
NOTES:
1) BOUNDARIES OF FILL AREAS DELINEATED BY GROUND CONDUCTIVITY SURVEY PERFORMED IN AUGUST 1991, TEST PITS EXCAVATED IN SEPTEMBER 1993, AND TOPOGRAPHY.

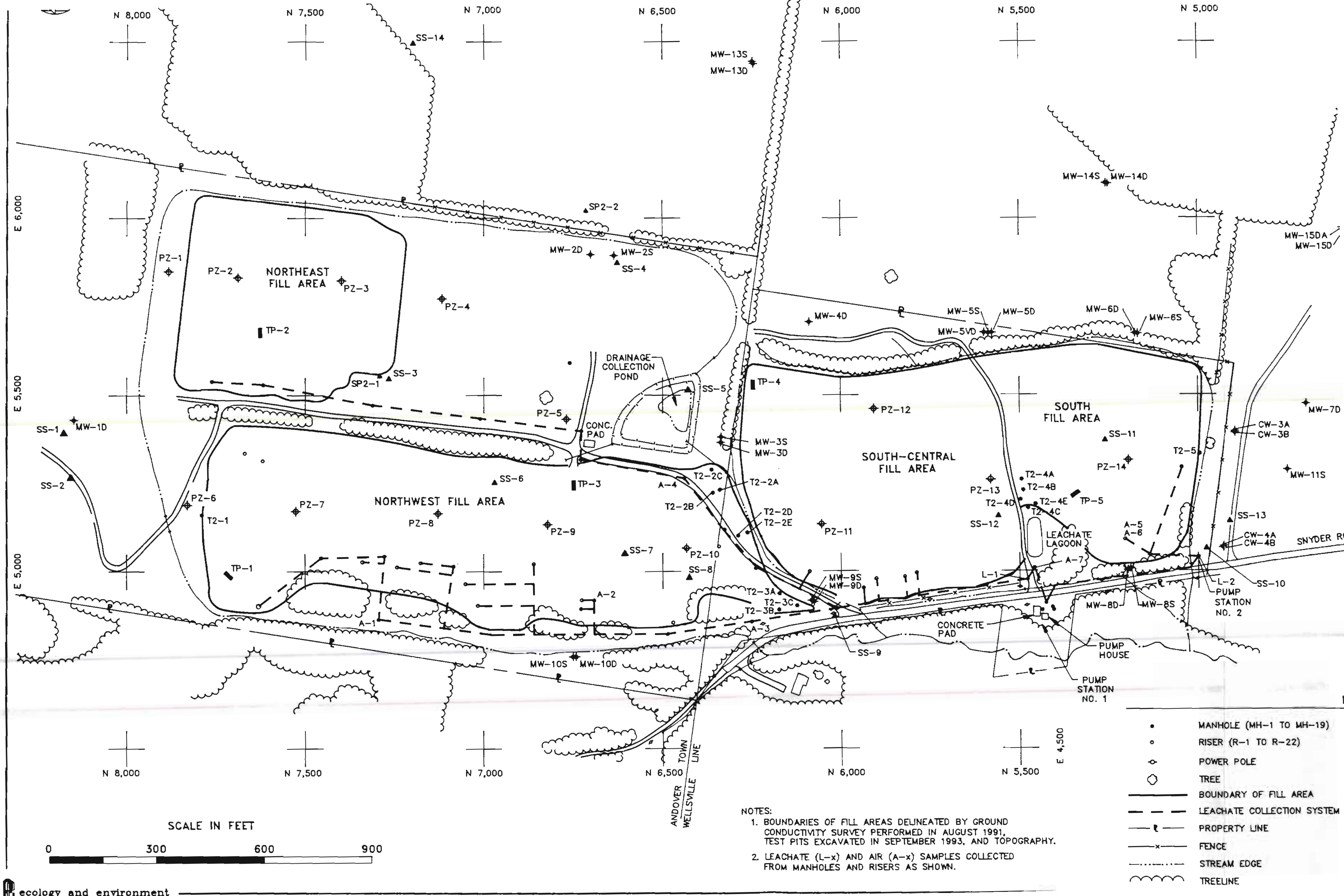
2) ELEVATION REFERENCE BM-1 = 296.15 FEET.

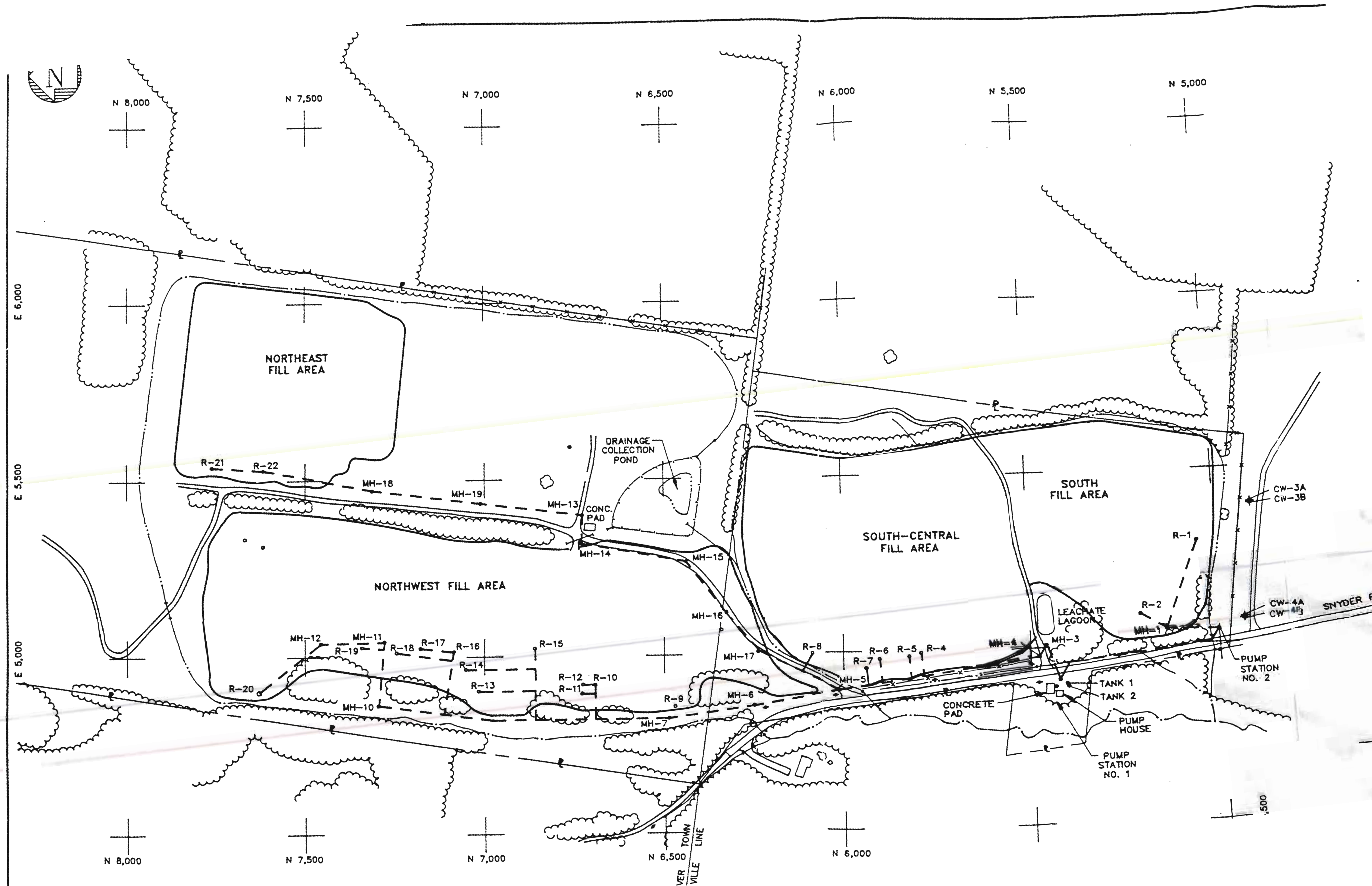


NOTES:

1) BOUNDARIES OF FILL AREAS DELINEATED BY GROUND CONDUCTIVITY SURVEY PERFORMED IN AUGUST 1991, TEST PITS EXCAVATED IN SEPTEMBER 1993, AND TOPOGRAPHY.
2) ELEVATION REFERENCE BM-1 = 296.15 FEET.
3) WATER LEVELS RECORDED 9/15/93.


PIXLEY HILL ROAD
DUFFY HOLLOW ROAD
DUFFY CREEK
VANDERMARK CREEK
VANDERMARK ROAD
TOWN OF
TOWN OF
TOWN OF SCIO
LANDFILL
URBAN
ORMSBY
NEW SPRING
OLD SPRING
SW/SED2-1
SW/SED-1
SW/SED-2
SW/SED-3
SW/SED-4
SW/SED-5
SW/SED-6
201-1-2
201-1-3
201-1-4.1
201-1-4.2
201-1-11.4
201-1-12.1
201-1-12.2
201-1-14.1
201-1-14.2
201-1-14.3
201-1-15.1
201-1-16
201-1-17
201-1-18
201-1-19
210-1-13.1
13.21
13.22
13.23
4
5
3.3
214-1-1
214-1-2.2
214-1-3.1
214-1-3.2
214-1-6
214-1-7
214-1-47.2
214-1-48
214-1-49.1
214-1-49.2
49.3
49.4
214-1-51
214-1-52
214-1-53.1
214-1-53.2
214-1-53.3
214-1-54
214-1-56
214-1-57
214-1-58
214-1-59
214-1-60
214-1-61
214-1-62
214-1-63
214-1-64
227-1-5
227-1-22.2
UNNAMED TRIBUTA
TO DUFFY CREE
SNYDER (GORMAN)
NOTE: URBAN'S SPRING IS ON ORMSBY'S LAND.
214-1-51
0
120
ecology and environment


NORTHEAST FILL AREA
NORTHWEST FILL AREA
SOUTH-CENTRAL FILL AREA
SOUTH FILL AREA
DRAINAGE COLLECTION POND
CONC. PAD
LEACHATE LAGOON
CONCRETE PAD
PUMP HOUSE
PUMP STATION NO. 1
PUMP STATION NO. 2
ANDOVER TOWN
WELLSVILLE LINE
SNYDER R
N 8,000
N 7,500
N 7,000
N 6,500
N 6,000
N 5,500
N 5,000
E 6,000
E 5,500
E 5,000
E 4,500
PZ-1
PZ-2
PZ-3
PZ-4
PZ-5
PZ-6
PZ-7
PZ-8
PZ-9
PZ-10
PZ-11
PZ-12
PZ-13
PZ-14
TP-1
TP-2
TP-3
TP-4
TP-5
SS-1
SS-2
SS-3
SS-4
SS-5
SS-6
SS-7
SS-8
SS-9
SS-10
SS-11
SS-12
SS-13
SS-14
SP2-1
SP2-2
MW-1D
MW-2D
MW-2S
MW-3S
MW-3D
MW-4D
MW-5S
MW-5VD
MW-5D
MW-6D
MW-6S
MW-7D
MW-8D
MW-8S
MW-9S
MW-9D
MW-10S
MW-10D
MW-11S
MW-13S
MW-13D
MW-14S
MW-14D
MW-15DA
MW-15D
CW-3A
CW-3B
CW-4A
CW-4B
T2-1
T2-2A
T2-2B
T2-2C
T2-2D
T2-2E
T2-3A
T2-3B
T2-3C
T2-4A
T2-4B
T2-4C
T2-4D
T2-4E
T2-5
A-1
A-2
A-3
A-4
A-5
A-6
A-7
L-1
L-2
MANHOLE (MH-1 TO MH-19)
RISER (R-1 TO R-22)
POWER POLE
TREE
BOUNDARY OF FILL AREA
LEACHATE COLLECTION SYSTEM
PROPERTY LINE
FENCE
STREAM EDGE
TREELINE
SCALE IN FEET
0
300
600
900
NOTES:
1. BOUNDARIES OF FILL AREAS DELINEATED BY GROUND CONDUCTIVITY SURVEY PERFORMED IN AUGUST 1991, TEST PITS EXCAVATED IN SEPTEMBER 1993, AND TOPOGRAPHY.
2. LEACHATE (L-x) AND AIR (A-x) SAMPLES COLLECTED FROM MANHOLES AND RISERS AS SHOWN.
ecology and environment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N 8,000
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NORTHEAST
FILL AREA
NORTHWEST FILL AREA
SOUTH-CENTRAL
FILL AREA
SOUTH
FILL AREA
DRAINAGE
COLLECTION
POND
CONC.
PAD
LEACHATE
LAGOON
CONCRETE
PAD
TANK 1
TANK 2
PUMP
HOUSE
PUMP
STATION
NO. 1
PUMP
STATION
NO. 2
CW-3A
CW-3B
CW-4A
SNYDER
TOWN
LINE
R-1
R-2
R-4
R-5
R-6
R-7
R-8
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R-12
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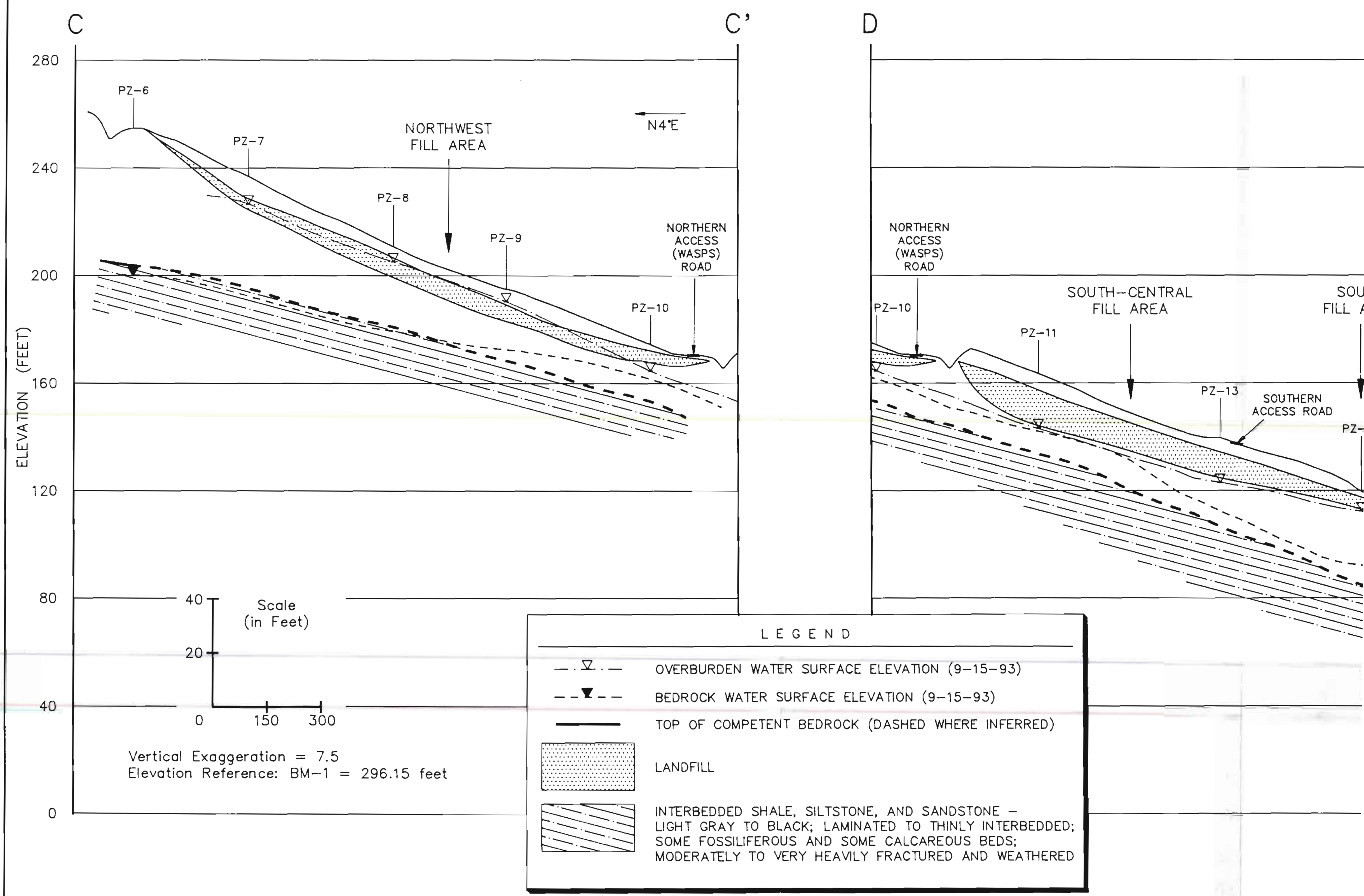
MH-19



C
C'
D
ELEVATION (FEET)
280
240
200
160
120
80
40
0
PZ-6
PZ-7
PZ-8
PZ-9
PZ-10
PZ-11
PZ-13
PZ-
NORTHWEST FILL AREA
N4°E
NORTHERN ACCESS (WASPS) ROAD
SOUTH-CENTRAL FILL AREA
SOUTHERN ACCESS ROAD
Scale (in Feet)
40
20
0
150
300
Vertical Exaggeration = 7.5
Elevation Reference: BM-1 = 296.15 feet
LEGEND
OVERBURDEN WATER SURFACE ELEVATION (9-15-93)
BEDROCK WATER SURFACE ELEVATION (9-15-93)
TOP OF COMPETENT BEDROCK (DASHED WHERE INFERRED)
LANDFILL
INTERBEDDED SHALE, SILTSTONE, AND SANDSTONE - LIGHT GRAY TO BLACK; LAMINATED TO THINLY INTERBEDDED; SOME FOSSILIFEROUS AND SOME CALCAREOUS BEDS; MODERATELY TO VERY HEAVILY FRACTURED AND WEATHERED

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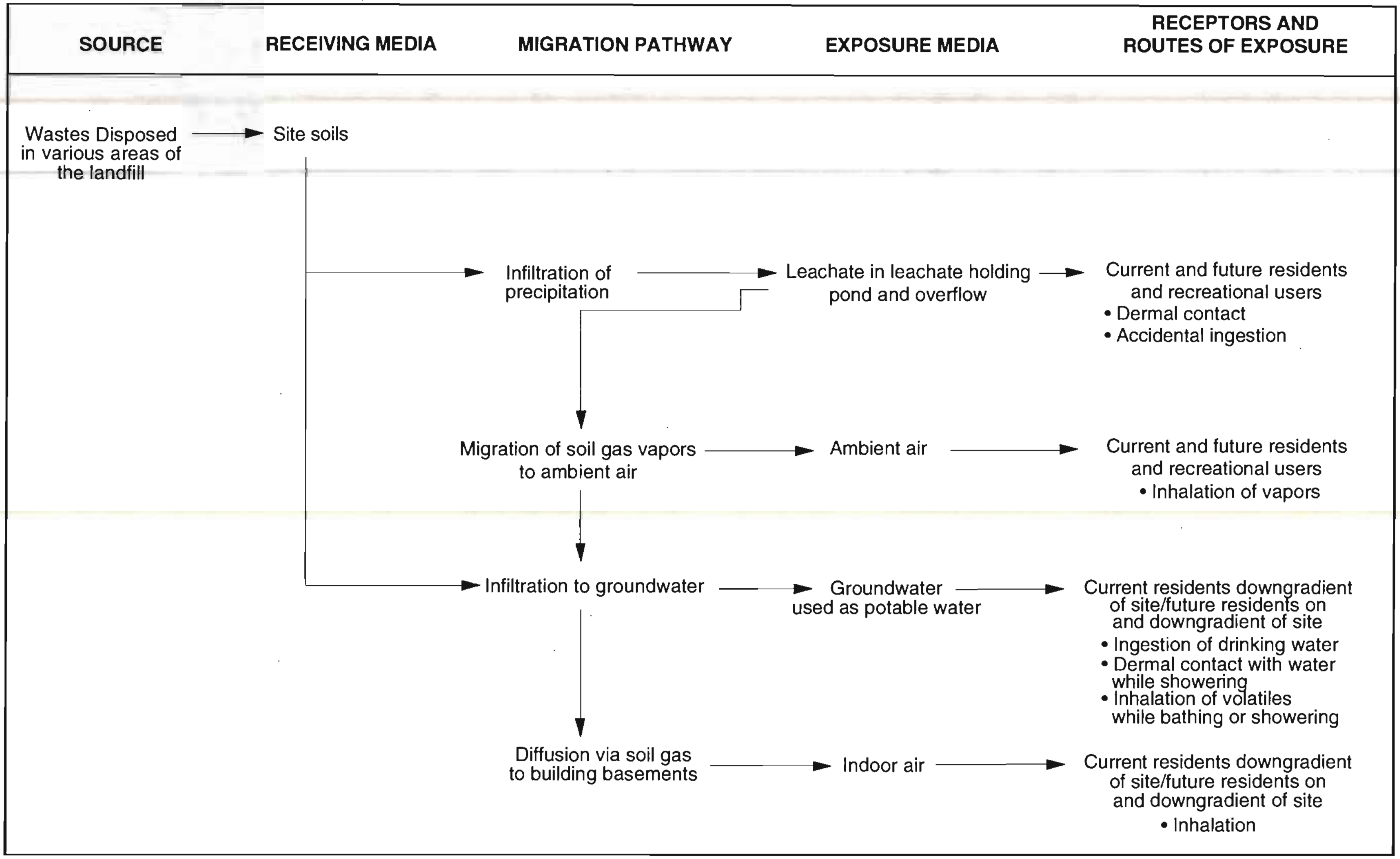

Figure 1-10 CONCEPTUAL SITE MODEL FOR WELLSVILLE-ANDOVER LANDFILL

2. IDENTIFICATION AND SCREENING OF TECHNOLOGIES

2.1 INTRODUCTION

This section presents the first phase of the FS for the Wellsville-Andover Landfill site. The first step in developing remedial alternatives is to develop RAOs. Thus, for each medium of interest at the site, RAOs that will protect both human health and the environment are established. These objectives are typically based on COPCs and CPECs, applicable or relevant and appropriate requirements (ARARs), and the findings of the human health risk evaluation and the habitat-based assessment. General response actions describing measures that will satisfy the remedial action objectives are then developed. This includes estimating the areas or volumes to which the response actions may be applied. Finally, remedial technologies applicable to each action are identified and discussed with respect to their effectiveness and implementability. The applicable technologies are then assembled into medium-specific remedial alternatives in Section 3.

2.2 REMEDIAL ACTION OBJECTIVES

2.2.1 Contaminants of Potential Concern and Exposure Pathways

The human health risk evaluation conducted as part of the RI identified six COPCs at the Wellsville-Andover Landfill site. Chemicals were selected as COPCs if they were detected at concentrations exceeding NYSDEC and NYSDOH criteria, and if their presence at those concentrations in more than one medium suggested they were site-related chemicals. COPCs selected as a result of this evaluation were 1,1-DCA, 1,1-DCE, 1,2-DCE, toluene, TCE, and VC.

Waste materials placed in the landfill were covered with clean fill. Therefore, direct contact with waste materials is not considered a potential exposure pathway. The sampling results did not reveal the presence of COPCs in surface soils, surface water, or stream sediments. Therefore, direct contact with these media on the site and adjacent areas also does not appear to be a complete exposure pathway.

One Phase I RI leachate sample contained TCE at a level above its NYSDEC Class C surface water standard. Samples taken from manholes near the leachate holding pond did not reveal significant levels above criteria values. Toluene and 1,1-DCA were detected in Phase II leachate samples collected near the northeast fill area. 1,1-DCA was detected in this sample at a concentration exceeding the NYSDEC Class C surface water standard. Because leachate has overflowed the collection system into the unnamed tributary of Duffy Creek, the potential for surface water contamination exists. In addition, dermal contact with and ingestion of contaminated landfill leachate are potential pathways of concern for site visitors and nearby residents.

TCE and VC were detected in LFG samples from the leachate collection system at levels above benchmark concentrations. These volatile organic chemicals could and probably do migrate to the landfill surface and into the ambient air, where site visitors and nearby residents might inhale them. This is a potentially complete exposure pathway.

COPCs were found in site groundwater and also in one off-site residential spring. Some of the same contaminants also have been found historically in other domestic wells downgradient of the site. Water from these wells is used for general domestic supply purposes. Thus, residents could potentially be exposed to contaminants in the water by drinking the water or by showering or bathing in it. Because the COPCs in the groundwater are VOCs, they might also migrate from the groundwater through soil gas into ambient air or even indoor air in areas downgradient from the landfill. If this were to occur, nearby residents might also be exposed to site contaminants through inhalation of the air.

The habitat-based assessment (HBA) conducted as part of the RI identified several inorganic CPECs in the leachate, including aluminum, cobalt, copper, iron, lead, and zinc. Although potential risks to wildlife from manganese in the sediment and calcium, cobalt, lead, nickel, and zinc in the surface soil cannot be ruled out, currently available data do not clearly indicate the risk posed by these contaminants. Only one sediment sample was found to be of concern in the HBA due to manganese. This sample (SED2-2) is considered to be upgradient of the site and unaffected by site contamination. The location of CPECs in the surface soils were at cover seeps and the area of Pump Station 2. The surface soils at the cover seeps will be part of any selected remedial action for the fill at the site. The soils around Pump Station 2 will be addressed as part of any leachate remedial action. Therefore, only the CPECs in the leachate will be directly addressed at this time.

2.2.2 ARARs and Other Policy and Guidance "To Be Considered"

The ARARs that apply to the site can be classified as chemical-specific, location-specific, or action-specific ARARs. Chemical-specific ARARs set health or risk-based concentration limits or ranges in various environmental media for specific hazardous substances. These requirements will be used to establish site cleanup levels or provide a basis for calculating cleanup levels for the media of interest. Chemical-specific ARARs are also used to indicate an acceptable level of discharge to determine treatment and disposal requirements that may occur in a remedial activity, and to assess the effectiveness of the remedial alternatives.

Location-specific requirements set restrictions on the types of remedial activities that can be performed based on site-specific characteristics or location. Alternative remedial actions may be restricted or precluded based on Federal and State siting laws for hazardous waste facilities, proximity to wetlands or floodplains, or proximity to manmade features such as existing landfills, disposal areas, and local historic buildings.

Action-specific requirements are triggered by the particular remedial activities that are selected to accomplish the cleanup. After remedial alternatives are developed, action-specific ARARs that specify performance levels, actions, or technologies, as well as specific levels for discharge of residual chemicals provide a basis for assessing the feasibility and effectiveness of the remedies.

Appendix A includes Tables 5-2 and 5-3 from *Conducting RI/FS for CERCLA Municipal Landfill Sites* (EPA 1991), which list location-specific and action-specific federal ARARs. Since the New York State Hazardous Waste Regulations closely parallel the federal (RCRA) regulations for hazardous solid wastes, these tables will be used as a guideline. In the development of alternatives, the more restrictive (state or federal) will be used, such as New York State landfill closure requirements.

Chemical-, location- and action-specific ARARs pertinent to the development of site-specific RAOs or identification of applicable remedial technologies are described below. Tables 2-1, 2-2, and 2-3 summarize the chemical-, location-, and action-specific ARARs and

TBCs for this site. Other action-specific ARARs may be identified as necessary in Section 3 during development of remedial alternatives.

2.2.2.1 Chemical- and Action-Specific ARARs

Soil and Waste

Based on historical evidence regarding the types of waste disposed of in the different fill areas, the northeast fill area may be considered a municipal solid waste unit, while the rest of the fill areas are considered hazardous waste disposal areas. Therefore, different landfill closure criteria will apply, depending on the area. The time of disposal (1978-1983 for the northeast, 1964-1978 for the remainder) also affects the ARARs pertinent to the Wellsville-Andover Landfill site.

With the above factors in mind, it was determined that 6 NYCRR Part 360-2 (October 1988) applies to the northeast fill area. This state regulation specifies requirements for municipal solid waste landfill closure, including placement of a final cover. Federal closure criteria are not applicable to this area, as they do not apply to municipal solid waste landfill units that ceased to receive waste before October 9, 1991.

For the northwest, south-central, and south fill areas, RCRA Subtitle C closure requirements will apply if the fill contains waste which is a listed or characteristic waste under RCRA, and (1) the waste was disposed of after November 19, 1980 (effective date of RCRA), or (2) the response action constitutes current treatment, storage, or disposal as specified by RCRA. Since methylene chloride and TCE are RCRA-listed wastes (these chemicals are assumed to have been used as degreasing agents prior to disposal) that were disposed of at the site prior to November 19, 1980, RCRA requirements will be potential ARARs only if disposal occurs during remedial activities.

If RCRA closure requirements are ARARs, only two types of closure are allowed: (1) clean closure and (2) landfill closure. For clean closure, all waste residues and contaminated containment system components (e.g., liners), contaminated subsoils, and structures and equipment contaminated with waste and leachate must be removed and managed as hazardous waste or decontaminated before site management is completed. Clean closure standards assume there will be unrestricted use of the site and no maintenance will be required after closure has been completed; they are often referred to as the "eatable solid, drinkable leachate" standards (40 CFR 264).

Landfill closure involves capping the unit with a final cover designed and constructed to have a permeability less than or equal to the permeability of any bottom liner system or natural subsoils present (40 CFR 264.310). In addition, post-closure care and maintenance of the unit is required for at least 30 years after closure. Thus, both RCRA Subtitle C closure requirements and New York State 6 NYCRR Part 360-2 regulations are ARARs for this site. EPA guidance documents regarding closure and final covers will then be TBCs for the site.

State requirements for hazardous waste landfill closure require placement of a final cover designed and constructed to have a permeability less than or equal to the permeability of any bottom liner system or natural subsoils present (6 NYCRR Part 373-3). This regulation is considered at least relevant and appropriate.

NYSDEC also has developed a Technical and Administrative Guidance Memorandum (TAGM) entitled "Determination of Soil Cleanup Objectives and Cleanup Levels." This TAGM is intended to provide guidance in determining soil cleanup levels at state superfund sites when the Director of NYSDEC's Division of Hazardous Waste Remediation (DHWR) determines that remediation of the site to predisposal conditions is not possible or feasible.

This TAGM suggests the use of soil background data near the site, if available, as cleanup objectives for heavy metals (which includes lead). Eastern United States or New York State soil background values may also be used; however, the site-specific background data are preferable. This TAGM also presents recommended soil cleanup objectives, and EPA Health Effects Assessment Summary Table (HEAST) values. This TAGM is not a promulgated rule and therefore cannot be considered an ARAR; however, it will be a TBC for soils at this site.

Groundwater

The groundwater beneath and in the vicinity of the site (both the groundwater within the overburden and within the fractured bedrock) is classified as Class GA groundwater, indicating the best possible usage is as a potable water supply. As such, maximum contaminant levels (MCLs) set under the Safe Drinking Water Act and NYSDEC Class GA groundwater standards are applicable regulations and therefore chemical-specific ARARs for this site.

Leachate

Leachate has been observed flowing off site into the unnamed tributary (a Class C stream) to Duffy Creek. Because the leachate is directly impacting surface waters, NYSDEC surface water standards are applicable regulations and therefore an action-specific ARAR for this site.

Surface water standards will also apply indirectly to the discharge of treated leachate. These action-specific ARARs will be identified in Section 3 during the development of the remedial alternatives for leachate.

Landfill Gas

The ARARs for air emissions from municipal solid waste landfills include the Clean Air Act (40 CFR 270) and all applicable amendments, and 6 NYCRR Part 212. The Annual Guideline Concentrations (AGCs) and Short-term Guideline Concentrations (SGCs) provided by NYSDEC's Air Guide-1 are state guideline values for ambient air and are considered TBCs for this site.

2.2.2.2 Location-Specific ARARs

Table 5-2, Potential Federal Location-Specific ARARs at Municipal Sites, from *Conducting RI/FS for CERCLA Municipal Landfill Sites* (EPA 1991), was used as a guideline for determining applicable federal location-specific ARARs. The site is not located within a seismically active county or floodplain, nor does it contain salt dome formations, underground mines, or caves. The habitat-based assessment conducted as part of the RI identified no critical habitat or endangered or threatened species within a 0.5-mile-radius detailed study area. However, several federal wetlands (but no state wetlands) were identified within a 2-mile radius of the site. Therefore, Executive Order 11990 (40 CFR 6, Appendix A - Protection of Wetlands), which requires action to minimize the destruction, loss, or degradation of wetlands, is applicable to the site. This order is not a promulgated regulation and is therefore not an ARAR, but will be considered a location-specific TBC.

Because discharge of treated water (leachate and/or groundwater) into the unnamed tributary to Duffy Creek is a possible remedial alternative, the Fish and Wildlife Coordination Act (40 CFR 6.302) may be applicable. The Act requires that the U.S. Fish and Wildlife

Services be consulted before a body of water is modified. An applicable state regulation pertaining to streams and navigable water bodies is 6 NYCRR Part 608.

The site is not included in the National Register of Historic Places; therefore, the National Historic Preservation Act is not applicable. A review of the New York State Museum and the New York State Historical Preservation Office archaeological site files did not reveal any state locations of historical artifacts or historic properties within an approximately 2-mile radius from the site. Therefore, the New York State Historic Preservation Act (9 NYCRR Parts 426-428) is not an ARAR.

2.2.3 Development of Remedial Action Objectives

Based on the site Human Health Risk Evaluation, HBA, and potentially complete exposure pathways, the following list of remedial action objectives was developed for protection of human health and the environment:

- Prevent ingestion of or direct contact with landfill wastes;
- Minimize or eliminate contaminant leaching to groundwater aquifers;
- Prevent inhalation of COPCs present in the LFG in excess of benchmark concentration;
- Prevent ingestion of or direct contact with water containing 1,1-DCA, 1,1-DCE, 1,2-DCE, toluene, TCE, and VC in excess of benchmark concentrations; and
- Eliminate leachate overflows and cover seeps.

2.2.4 Cleanup Goals

The final step required for the development of RAOs is to establish cleanup goals based on chemical-specific ARARs, TBCs, and COPC and CPEC. The aim of remedial action objectives is to meet ARARs and eliminate exposure to contaminants of concern such that human health and the environment are adequately protected. This can be achieved by eliminating exposure pathways (which is discussed in Section 2.3, Identification of General Response Actions) or reducing contaminant concentrations to levels that are accepted to be adequately protective of human health and the environment.

The process followed to develop chemical-specific cleanup goals for soils and groundwater is discussed below. Because no chemical-specific ARARs or TBCs were identified for leachate or LFG, no chemical-specific cleanup goals will be established in this FS.

The methodology used to establish these concentrations was to first review state and federal laws, regulations, and guidance documents, and identify any chemical-specific ARARs or TBCs. No chemical-specific ARARs for the soils medium were identified for any contaminant found in site soils; however, chemical-specific TBCs were identified.

Concentration-based RAOs were established by using the benchmark health risk value derived from NYSDEC (1991) Guidance for Human Direct Ingestion Pathway. If a value for a specific contaminant did not exist, the NYSDEC-recommended soil cleanup goal (NYSDEC TAGM HWR-92-4046) was used. These values were compared with background concentrations (the 90th percentile of the common range of soil concentration in eastern United States derived from the data of Shacklette and Boerngen [1984] for inorganics and background values found in rural soils from ATSDR [1989] for PAHs). If the background was the highest value, it was used as the concentration-based RAO. The concentration-based RAO was then compared with the highest concentration of the particular contaminant found in soils during the RI (surface soils and soils from borings). If the contaminant was not found above the concentration-based RAO, no cleanup goal was established. Otherwise, the concentration-based RAO became the site cleanup goal. The site cleanup goals derived for soils are presented in Table 2-4.

The concentration-based RAOs for groundwater contaminants were taken to be the lowest value of NYSDOH MCLs and NYSDEC Class GA groundwater standards for a particular contaminant. If the highest value of a contaminant observed in a groundwater monitoring well was lower than the concentration-based RAO, no cleanup goal was established. Otherwise, the concentration-based RAO became the site cleanup goal. The site cleanup goals for groundwater are presented in Table 2-5. Cleanup goals for other contaminants will be identified as necessary during the remedial design phase.

2.3 IDENTIFICATION OF GENERAL RESPONSE ACTIONS

Based on the information derived from the RI, general response actions—or classes of response—are identified for each medium of interest. General response actions can be considered conceptual alternatives for each medium of interest that will satisfy the remedial action objectives. The "no-action" alternative is included as a general response action for each medium of interest to serve as a basis for comparison with other potential response actions.

2.3.1 Soil and Waste

The general response actions for soil identified in this section address the pathways of direct contact (e.g., inhalation, dermal adsorption, and ingestion) and leaching. Containment (capping) would prevent direct contact with potential receptors and reduce leachate production resulting from surface water infiltration. Excavation, treatment, and disposal would remove, immobilize, or destroy waste material and soil contaminants as well as remove the source of contamination, thereby eliminating the potential for direct contact with the wastes as well as contaminant leaching into groundwater. The no-action alternative would leave the soils and wastes in their present condition, but may include institutional controls (e.g., fencing or deed restrictions), which would limit site access, thereby reducing the potential for exposure to contaminants.

2.3.2 Groundwater

General response actions appropriate for groundwater contamination are containment, extraction, treatment, disposal, institutional actions, and no action (monitoring). These remedial actions (excluding no action) could prevent contaminant-plume migration, remove the contaminants from the groundwater, and/or minimize potential exposure to contaminated groundwater, thus reducing the threat to human health and the environment. The no-action alternative would provide data on groundwater quality but allow possible further degradation of groundwater and contaminant-plume migration.

2.3.3 Leachate

General response actions appropriate for contaminated leachate are improved capture/collection, treatment, disposal, institutional actions, and continued action (instead of no action, because leachate is already being collected and treated and disposed of off site). All of these remedial actions would reduce contaminant leaching to groundwater and stop occurrences of seeps and leachate overflows from the holding pond, resulting in a decrease in the potential for exposure to contaminated leachate. The continued action alternative would allow for continued collection and treatment of leachate at the current rate. However, the present leachate collection system does not capture all of the leachate produced and is insufficient to handle volumes that are captured, leading to leachate overflows and subsequent contamination of the site and surrounding areas.

2.3.4 Landfill Gas

General response actions for LFG include gas collection and/or treatment, institutional actions, and no action. Except for the no-action response, these response actions would reduce exposure of the public to emissions exceeding benchmark concentrations for the COPCs. The no-action alternative would allow continued dissipation of LFG.

2.3.5 Surface Area and Volume Estimation of Contaminated Media

Landfill Surface Areas and Volumes

The surface area of each landfill area was obtained using the boundaries established in the Phase I RI and verified in the Phase II RI and computer-aided design (CAD) integration. Individual fill volumes were calculated by multiplying the respective surface area by an average fill thickness estimated from available depth data (see Table 2-6). For the northeast area, only one depth (from PZ-2) was obtained, and this was taken as the average. The average fill thickness of the northwest area is the average of the thicknesses obtained from PZ-7, PZ-8, PZ-9, and PZ-10. Data from PZ-11, PZ-12, and PZ-13 were needed to calculate the average fill thickness of the south-central area. The average fill thickness of the south area was obtained from PZ-13 and PZ-14. Table 2-7 shows the estimated surface area and fill volume of each landfill area.

Groundwater Volume

The groundwater contaminant plume could not be fully delineated because of insufficient groundwater data; therefore, the volume of contaminated groundwater was not estimated. However, portions of the plume boundary in the overburden groundwater and in the bedrock groundwater can be estimated with the available data and are shown in Figures 2-1 and 2-2, respectively.

Leachate Production Rates

Leachate is produced from infiltration of surface or rainwater and from groundwater contact with fill. Leachate production caused by infiltration has been estimated in two previous reports. The Phased/Interim Remedial Alternatives Report (E & E 1992b) used a simple water-balance model to estimate an annual flow of 20.2 million gallons per year for the entire landfill. This model was based on an estimated total fill area, which is greater than the actual total fill area. In the Leachate Investigation Report (E & E 1992c), the total leachate production was estimated to be 19 million gallons per year based on flows measured in the leachate collection system. This estimate is considered overly conservative because it was based on the assumption that the flows measured during a three-month period in the spring were representative of leachate flows throughout the year.

Leachate production caused by infiltration was estimated for each fill area by using the "Hydrologic Evaluation of Landfill Performance" (HELP) model developed by the United States Department of the Army. The HELP model uses meteorological data, including temperature and precipitation, soil characteristics such as porosity and hydraulic conductivity, and landfill cover design data such as thicknesses of cover materials to estimate leachate production. These inputs can either be user-specified data or default values already contained in the HELP model. To tailor the model to local conditions, monthly mean temperature and precipitation data from the Alfred, New York, weather station (located approximately 15 miles from the Wellsville-Andover Landfill site) were used. The latitude of the site was used for solar radiation parameters. Default values were used for cover soil permeability and porosity. Cover soils were assumed to be uncompacted and rainwater runoff was assumed to be zero. These data and assumptions were used for all of the fill areas. However, the respective surface areas and soil cover thicknesses were used during estimation of individual leachate production. Table 2-7 shows the estimated leachate production due to infiltration in each fill area.

Using the HELP model, total leachate production from infiltration of surface or rainwater was estimated to be approximately 14 million gallons per year, which is 5 to 6 million gallons lower than previous estimates. Because the HELP model is widely accepted and used, estimates from this model are more likely to be representative of actual leachate production at the Wellsville-Andover Landfill.

Leachate production caused by groundwater contact with fill has been estimated only for the northwest fill area because groundwater is currently flowing through only this area. The volumetric rate of leachate production caused by this flow was assumed to be the cross sectional area of fill contacted multiplied by the maximum estimated groundwater flow rate through the overburden. The cross-sectional area was estimated based on the maximum measured depth of fill multiplied by the width of the fill corresponding to this depth. This estimate is meant to be conservative and therefore does not take into account the porosity of the surrounding soils or landfill wastes. Estimated leachate production due to groundwater in each of the areas is shown in Table 2-7.

Landfill Gas Production Rates

LFG generation is due to anaerobic decomposition of organic materials in the landfill and depends on the moisture content of the waste. (The highest generation rates occur between 60 and 80 percent saturation.) LFG production rates were estimated using the "Landfill Air Emissions Estimation Model" computer program developed under the guidance of the EPA Office of Solid Waste. The model uses the dates of landfill use and yearly mass loadings to estimate current LFG emissions. Because yearly mass loadings data are not available, this information was estimated. Total volumes deposited were estimated from current landfill volume estimations and an assumed landfill settlement of 40% (Tchobanoglous *et al.* 1977). Original total mass was then calculated from an estimated fill density of 750 pounds per cubic yard (lb/yd^3) (Tchobanoglous *et al.* 1977). Equal yearly mass loadings were then assumed. The model assumes that the composition of the LFG is 50% methane and 50% carbon dioxide and contains other components at only trace levels. Table 2-7 shows the estimated total LFG produced for each landfill area.

2.4 IDENTIFICATION OF APPLICABLE REMEDIAL TECHNOLOGIES

Applicable remedial technologies are identified below for each general response action. Because municipal landfills often share similar characteristics (e.g., large volume and heterogeneity of wastes, groundwater contaminated by leachate), it is possible to streamline the identification of applicable remedial technologies. The technologies described in *Conducting Remedial Investigation/Feasibility Studies for CERCLA Municipal Landfill Sites* (EPA 1991) were used as a starting point for the development of this section. This section was refined by retaining only those remedial technologies appropriate for the Wellsville-Andover Landfill site, taking into account the following:

- Site conditions and characteristics that may affect implementability of the technology;
- Physical and chemical characteristics of contaminants that determine the effectiveness of various technologies; and
- Performance and operating reliability of the technology.

2.4.1 Soil and Waste

Remedial technologies for the contaminated soil and waste are used to contain or remove the soil at the Wellsville-Andover Landfill site. Such technologies are discussed below.

Containment

Capping. Capping, or surface sealing, is applicable to all land disposal sites. In general, capping isolates wastes from contact with surface water runoff and infiltration, controls off-site transport of contaminated sediments, and minimizes the potential for surface leaks of leachate. Capping techniques use materials such as synthetic membranes, slags, soils, asphalt, concrete, and chemical sealants.

Capping is generally performed when subsurface contamination at a site precludes excavation and removal of wastes because of potential hazards and/or prohibitive costs. Capping also may be performed as an interim remedial measure to reduce infiltration of precipitation and control air releases. The main disadvantages of capping are uncertain design life and the need for long-term maintenance. However, long-term maintenance requirements can be considerably more economical than excavation and removal of the waste.

Multilayered caps are most common and are the minimum required for municipal landfill closure according to 6 NYCRR Part 360. These caps can be composed of natural soils, mixed soils, a synthetic liner, or any combination of these materials. Standard design practices specify permeabilities of less than or equal to 10^{-7} cm/s for the low-permeability layer.

Environmental, public health, and institutional impacts of the various capping technologies are similar. During construction, short-term impacts include noise, dust, and increased truck traffic through that area. Long-term groundwater pollution decreases because of reduced infiltration and leaching. However, waste material and soil contaminants would remain on site and be a potential source of future groundwater contamination and public exposure; thus, future development of the site would have to be strictly controlled. Despite the potential drawbacks, capping is an applicable technology because a final cover is the minimum required for landfill closure. In addition, capping may be more economical than excavating and removing the waste for treatment and disposal at a fully permitted facility.

Multilayered Caps. The following are examples of multilayered caps applicable to the site.

- **Loam Over Sand Over Clay Over Sand.** This technology involves clearing and grubbing, grading, and covering site soils with a 12-inch sand layer (the gas venting layer) overlain by 18 inches of compacted clay to minimize infiltration and eliminate particulate emissions from the soil surface. The clay is covered with a 24-inch sand layer to control moisture and protect the integrity of the clay layer, and 6 inches of loam (topsoil) to allow revegetation. This final cover system meets the requirements of 6 NYCRR Part 360. This technology is effective and has longevity and durability, assuming proper design, installation, and maintenance. Although it is susceptible to cracking from settlement and frost heave, it tends to be self-repairing. Long-term maintenance is required to prevent growth of deep-rooting trees and shrubs that could penetrate the clay seal.

- **Loam Over Sand Over Synthetic Membrane Over Sand.** 6 NYCRR Part 360 allows substitution of a synthetic membrane for the clay layer. Thus, this technology involves clearing and grubbing, surface grading, and covering site soils with a 12-inch-thick blanket of sand (the gas venting layer) overlain by an impermeable synthetic membrane that is covered by a 24-inch sand drainage layer. This sequence of materials is covered by 6 inches of loam (topsoil) to allow revegetation. The seams in the membrane require careful installation and sealing. Flexibility of the membrane makes this technology relatively less susceptible to cracking from influences such as settlement and frost heave; however, the self-repairing capability of clay is lost. There is limited long-term experience with synthetic membranes.

- **Loam Over Sand Over Synthetic Membrane Over Clay (RCRA Cap).** This technology involves clearing and grubbing, grading, and covering site soils with a 12-inch sand layer (the gas venting layer) overlain by 24 inches of compacted clay and an impermeable synthetic membrane that is covered by 12 inches of compacted sand. The compacted clay and synthetic membrane act as barriers to the infiltration of water, while the top sand layer provides a drainageway for percolating water. Overlying this sequence of materials is 24 inches of loam (topsoil) to allow revegetation. This sequence of materials meets RCRA requirements for final covers and exceeds 6 NYCRR Part 360 requirements for a composite final cover. This technology takes advantage of the self-repairing properties of clay, along with the impermeable nature of a synthetic membrane. The seams in the membrane require careful installation and sealing.

Consolidation

Consolidation entails combining materials from one location with those of another and is accomplished through the use of excavators and/or loaders, dump trucks, and compaction equipment. For the site, consolidation will involve moving fill materials from areas of the landfill and placing them on top of existing fill in order to decrease the final area or "foot-print" of the fill, thereby decreasing the area and cost of the landfill cap. Wastes should be consolidated within the same area of contamination (AOC); otherwise, land disposal restrictions will apply.

At the Wellsville-Andover Landfill, consolidation activities will potentially need to be performed using Level B protection because of the presence of VC, which is very hazardous to human health and difficult to detect with "real-time" instruments. This will slow worker production and increase the time needed to complete consolidation activities. Some fill areas are below the groundwater table, which will make consolidation more difficult. Engineering controls may be needed to lower the groundwater table in the area of remedial work. Despite the difficulties, removal of fill beneath the groundwater table may be desirable as this will eliminate the production of leachate caused by the movement of groundwater through the contaminated fill. The soils remaining in the areas from which the fill was removed must then be tested to determine if they are contaminated. After the bottom soils have been determined to be clean or have been remediated, the area should be filled to grade with clean on-site soils.

This technology will be retained for further consideration for fills containing hazardous wastes because of its potential to reduce the costs of capping. Consolidation will not be considered for the northeast fill area because this area does not contain hazardous wastes and is relatively thick; therefore, little will be gained by reducing its already relatively compact size.

Excavation

Excavation, removal, and hauling of contaminated soils is generally accomplished with conventional heavy construction equipment (e.g., backhoes, bulldozers, and dump trucks). Excavation of contaminated waste materials is typically followed by land disposal or treatment. Given the large volume of waste at the Wellsville-Andover Landfill, excavation would be more useful for consolidation of wastes and removal of hot spots.

Excavation is a proven and reliable technology for removal of contaminated soils and is also relatively simple to implement. Excavation will therefore be retained for further evaluation.

On-Site Disposal

On-site disposal of soil generated by excavation of contaminated material or by an on-site treatment or pretreatment process includes the placement of such wastes in or on existing fill areas. This would be most appropriate for investigation wastes and contaminated material from the installation of final treatment systems. This action may also be used in combination with others in order to consolidate wastes, if necessary.

Off-Site Disposal

Off-site disposal of contaminated waste material and soil involves hauling excavated material to a commercial disposal facility. The type of facility chosen would depend on whether the material is classified as hazardous under RCRA and New York's Hazardous Waste Regulations. Nonhazardous wastes can be disposed of in a nonhazardous/solid waste facility. Hazardous wastes may only be disposed of at a RCRA-permitted facility. Prior to land disposal, most hazardous wastes must meet specific treatment standards codified in 40 CFR Part 268.

2.4.2 Groundwater Remedial Technologies

Groundwater remedial technologies can be applied to contain, collect, divert, or remove the groundwater in the area of the Wellsville-Andover Landfill in an effort to prevent further migration of contaminants from the site and to manage the migration that has already occurred.

Collection

Groundwater collection systems are used to control, contain, or remove groundwater contaminant plumes. Groundwater collection can be achieved by using pumping wells or subsurface drains.

- **Groundwater Pumping** methods involve the active manipulation and management of groundwater through the use of well systems. The selection of an appropriate well system depends on a number of factors, including the depth and area of contamination and the hydrologic and geologic characteristics of the aquifer.

- **Subsurface Drains** include any type of buried conduit used to convey and collect contaminated groundwater by gravity flow. Subsurface drains function essentially like a line of extraction wells and therefore can perform many of the same functions as wells. Use of subsurface drains is generally limited to shallow depths.

Active groundwater extraction at this site is not believed to be practical. Assuming an average hydraulic conductivity (k) of approximately 1 gallon per day per square foot (gal/day/ft^2) based on the RI slug tests and a reasonable aquifer thickness (or extraction well screen length) of 50 feet, the resulting transmissivity (T) would be 50 gal/day/ft^2. As determined from the relationship between transmissivity, the coefficient of storage, and specific capacity (Brown *et al.* 1963), the specific capacity of an extraction well would be less than 0.1 gallon per minute (gpm) per foot of drawdown for any storage coefficient, even for a 24-inch-diameter well. For a maintained drawdown of 10 feet, the resulting extraction rate would be 1 gpm.

Assuming 75 acres would remain uncapped at this 120-acre site and a conservative infiltration estimate of 12 inches per year, the resulting groundwater discharge would be 3,267,000 ft^3/year or about 47 gpm. Therefore, based on the above information, at least 50 wells of large diameter would be required to effectively capture the groundwater. The relatively large expense involved in constructing and maintaining this network of wells makes groundwater extraction through wells impractical. These conditions also make *in situ* treatment impractical. A system of passive subsurface drains would capture the near-surface groundwater contamination and would not address the deeper contaminated groundwater. Therefore, this collection system is not considered to be fully effective. However, a system of passive subsurface drains located within the contaminant plume may be part of an overall action that would serve to protect residential drinking water sources from possible contamination. Considering the heterogenous nature of the geology/hydrogeology, effective placement of such drains to protect near-surface residential water sources would be difficult. However, this technology may be considered as part of potential future phased action at this site due to its potential effectiveness for shallow contaminated groundwater.

Because the typical groundwater collection technologies available are not fully effective for this site, point-of-use treatment systems may be necessary to protect individual water systems.

Physical/Chemical Treatment

Physical and chemical treatment processes potentially applicable for remediation of contaminated groundwater by residential treatment systems include the following:

- **Carbon Adsorption** is used to remove dissolved organic compounds from groundwater. The process has been demonstrated as an effective and reliable means of removing low-solubility organic substances over a broad concentration range. Carbon adsorption can be designed for either column or batch applications, but groundwater treatment is typically performed using columns. In column applications, adsorption involves the passage of contaminated water through a bed of activated carbon that adsorbs the contaminants onto the carbon. When the activated carbon has been used to its maximum adsorptive capacity (i.e., spent), it is then removed for disposal, destruction, or regeneration.

- **Air Stripping** is a mass-transfer process in which volatile organic contaminants are transferred to the air stream by pumping the contaminated groundwater through a packed air-stripping tower. The organic-laden air stream from the tower is then typically treated using carbon adsorption. Air stripping, using packed towers, is a well-established, effective remedial technology for the removal of VOCs from groundwater.

- **Ultraviolet (UV)/Ozonation** uses a combination of UV and ozone to chemically oxidize organic compounds present in water. Complex organic molecules are broken down into a series of less-complex molecules. The end products are water, carbon dioxide, and hydrogen chloride. As part of the EPA's Superfund Innovative Technology Evaluation (SITE) program, UV/ozonation was demonstrated as an effective method for treatment of groundwater containing chlorinated organic compounds.

2.4.3 Leachate

Remedial technologies for leachate are used to collect, remove, or treat leachate generated from landfills.

Collection

The function of a leachate collection system is to minimize or eliminate the migration of leachate away from the solid waste unit. This system is typically used to control seepage along the sideslopes of a landfill and to prevent discharges to surface and groundwater systems. Leachate collection systems commonly used are subsurface drains and vertical extraction wells.

- **Subsurface drains** consist of underground, gravel-filled trenches generally equipped with tile or perforated pipe for greater hydraulic efficiency. They are used to intercept and channel leachate to a sump, wet well, or appropriate surface discharge before it can infiltrate to the main aquifer system. Typically, subsurface drains are installed at the perimeter of the landfill, although it may be appropriate to consider installation within the landfill if the thickness of fill is less than approximately 15 feet. Depth of waste as well as hazards associated with excavating landfill material usually prevent installation of drains within the landfill.

- **Vertical extraction wells** are wells drilled in the waste and screened in a highly permeable water bearing zone. The wells, which typically run to the base of the landfill, are fitted with a pump to extract leachate and create a negative hydraulic gradient zone to promote leachate flow toward the wells. Note that without the proper precautions, placing wells into the landfill contents may create health and safety risks. Perimeter wells may also be installed at the landfill boundary as a source control measure to control off-site migration of leachate and contaminated groundwater. Maintenance of the wells is essential because the permeable layer is prone to fouling caused by biological growth or precipitation of metal hydroxides.

Treatment

The most common technologies used at municipal landfill sites to treat leachate include biological treatment for removal of biodegradable organics, physical treatment such as air stripping and carbon adsorption for VOC removal, and chemical treatment, such as metals precipitation for removal of inorganics. The degree of treatment depends to a great extent on the strength of the leachate and whether the effluent is to be discharged directly to surface water, groundwater, or to a POTW.

Biological Treatment. Biological treatment systems are designed to expose wastewater containing biologically degradable organic compounds to a suitable mixture of microorganisms in a controlled environment that contains sufficient essential nutrients for the biological reaction to proceed. Biological treatment is based on the ability of microorganisms to utilize organic carbon as a food source or to otherwise break down or transform the contaminants through the catalyzing action of its enzymes. The treatment is classified as either aerobic, anaerobic, or facultative. Aerobic treatment requires the availability of free dissolved oxygen for the biooxidation of the waste. Anaerobic treatment is intolerant of free dissolved oxygen and utilizes "chemically bound" oxygen (such as sulfates), and energy inherently present in the organic substances, in breaking down the organic material. Facultative organisms can function under aerobic or anaerobic conditions as the oxygen availability dictates.

Biological treatment processes are widely used and, if properly designed and operated, capable of achieving high efficiency at removing organic substances. Such systems are given sufficient reaction time so that they can reduce the concentration of any degradable organic material to a very low concentration. Typically, biological treatment systems employ activated sludge, sequencing batch reactors, aerobic or anaerobic fluidized bed systems, rotating biological contactor (RBC) systems, fixed-film bioreactors, or aerated lagoons.

Physical Treatment. The descriptions of the physical treatment technologies applicable to leachate (air stripping and carbon adsorption) are the same as those given in the preceding section regarding groundwater treatment.

Chemical Treatment. Precipitation is a chemical (or electrochemical) process that converts soluble metallic ions and certain anions to an insoluble form for subsequent removal from the wastewater stream. Various coagulants and coagulant aids such as alum, ferric chloride, sodium sulfide, organic polymers, and sodium hydroxide are selected, depending on the specific waste material to be removed, and rapidly mixed with the wastewater to cause the colloidal particles to agglomerate into a floc large enough to be removed by a subsequent clarification process. The performance of the process is affected by chemical interactions, temperature, pH, solubility variances, and mixing effects.

Disposal

Disposal of treated leachate can be accomplished either on site or off site.

On-Site Disposal. Treated leachate could be discharged on site depending on the extent of treatment. On-site discharge can be performed by reinjection into the groundwater aquifer or by discharge to surface water. Treated leachate discharged by groundwater aquifer reinjection must meet NYSDEC Class GA groundwater standards. Discharge to surface water must comply with substantive SPDES permit requirements.

Off-Site Disposal. Direct discharge to a POTW may be appropriate for leachate streams containing concentrations of contaminants that are amenable to treatment provided by the POTW. Pretreatment may be required before discharge to the POTW. Previous E & E reports indicate that pretreating the leachate for iron would reduce the amount of sludge produced, thereby decreasing the stress on the sludge storage capacity of the POTW currently accepting and treating the leachate.

2.4.4 Landfill Gas

Remedial technologies for LFG are used to collect, remove, or treat gases generated by landfills. Disposal of LFG is accomplished by venting the treated or untreated LFG to the atmosphere. Applicable technologies are discussed below.

Landfill Gas Collection

A proper landfill cover reduces odors and vertical migration of LFG; however, it may also increase lateral migration of LFG and the potential of entrapping explosive gases in nearby structures. Lateral migration may be controlled by the addition of a gas venting layer to the landfill cap or by altering pressure gradients within the fill. LFG collection systems, which alleviate lateral migration, can be divided into two types: passive and active.

Passive Systems. Passive LFG systems alter the subsurface gas flow pathways without using mechanical means. Generally, a series of permeable interception systems divert gas flow to points of controlled release. Undesirable flow to outside areas is prevented by impermeable barriers. Passive systems are not designed to recover LFG; their purpose is to control the release of LFG to the atmosphere. Typical passive systems consist of pipe and/or trench vents. Pipe vents are used to vent LFG at a point where it is collecting and building pressure. They are often used in conjunction with flares that burn the gas at the point of release. Trench vents consist of trenches backfilled with a permeable material (gravel) constructed around the perimeter of the waste site. This forms a path of least resistance for the gas to flow upward to the atmosphere. A barrier system, such as a geosynthetic liner, can be added to the outside wall to increase the effectiveness of the trench.

Active Systems. Active systems control the migration of LFG through mechanical means that alter pressure gradients to redirect subsurface gas flows. Major system components typically include extraction wells, collection headers, vacuum blowers or compressors, and treatment or use systems. Active systems are typically used to prevent migration, control odor problems, or comply with land use requirements.

The most common type of active system is the on-site extraction well system. It consists of a series of wells in the landfill, typically 100 to 300 feet apart. The wells are then connected by a header pipe that is placed under negative pressure by using vacuum blowers. The pressure differential draws the LFG upward through the extraction wells and through a free vent, activated carbon system, or flare.

Landfill Gas Treatment

Treatment of LFG is necessary if air emission standards are violated, an odor problem exists, or future use includes allowing public access. The most common technology used for treatment of LFG at CERCLA sites is thermal destruction using enclosed ground flares.

Thermal Treatment. Enclosed ground flare systems consist of two major components: a refractory-lined flame enclosure (stack) and a burner assembly at the base. The LFG is fed through an open-ended pipe where it is ignited by pilot burners. A supplemental fuel is combined with the LFG, if needed, to support combustion.

Physical Treatment. Carbon adsorption may also be used to treat collected LFG. As described under physical/chemical treatment of groundwater, the carbon would remove organic contaminants from the LFG prior to discharge into the atmosphere.

Table 2-1 WELLSVILLE-ANDOVER LANDFILL SITE CHEMICAL-SPECIFIC ARARs AND TBCs		
Medium	**ARAR**	**TBC**
Groundwater	NYSDEC Groundwater Standards; Safe Drinking Water Act MCLs for groundwater	—
Surface water	NYSDEC Class C Surface Water Standards	—
Soils	—	NYSDEC TAGM Soil Cleanup Levels
Air	—	—

Key:

— = None identified.

Source: Ecology and Environment Engineering, P.C. 1994.

Table 2-2

WELLSVILLE-ANDOVER LANDFILL SITE LOCATION-SPECIFIC ARARs AND TBCs

Location	ARAR	TBC
Wetland	NA	Executive Order 11990
Stream or river	Fish and Wildlife Coordination Act; 6 NYCRR Part 608	NA
Floodplain	NA	NA
Salt dome	NA	NA
Underground mines	NA	NA
Caves	NA	NA
Threatened or endangered species	NA	NA
Historic artifacts or site	NA	NA

Key:

NA = Not applicable.

Source: Ecology and Environment Engineering, P.C. 1994.

Table 2-3

WELLSVILLE-ANDOVER LANDFILL SITE ACTION-SPECIFIC ARARs AND TBCs

Action	ARAR	TBC
Capping	RCRA capping 6 NYCRR Part 360 capping	—
Discharge of leachate	Substantive SPDES permitting requirements	—
Landfill gas discharge	Substantive air permitting requirements; Clean Air Act	Air Guide-1 AGCs and SGCs

Key:

— = None identified.

Source: Ecology and Environment Engineering, P.C. 1994.

Table 2-4

WELLSVILLE-ANDOVER LANDFILL SITE
REMEDIAL ACTION OBJECTIVES AND CLEANUP GOALS FOR SOILS
(mg/kg)

Chemical	Benchmark Background Concentrations[a]	Benchmark Health Risk Value[b]	NYSDEC Recommended Soil Cleanup goal[c]	Maximum Detected Concentrations	Remedial Action Objective	Site Cleanup Goal
INORGANIC SUBSTANCES						
Aluminum	128,000	NA	30 or SB	18,100	128,000	None
Arsenic	16	80	7.5 or SB	17.9	80	None
Barium	867	4,000	300 or SB	741	4,000	None
Cadmium	NA	NA	1 or SB	1.8	1	1
Calcium	14,400	NA	SB	173,000	14,400	14,400
Chromium	112	80,000	10 or SB	40.4	80,000	None
Cobalt	19.8	NA	30 or SB	87.3	19.8	19.8
Copper	48.7	3,000[e]	25 or SB	37	3,000	None
Iron	54,100	NA	2,000 or SB	283,000	54,100	54,100
Lead	33	250	30 or SB	56.1	250	None
Magnesium	10,700	NA	SB	17,100	10,700	10,700
Manganese	1,450	20,000	SB	4,540	20,000	None
Mercury	0.265	20	0.1	0.12	20	None
Nickel	38.2	2,000	13 or SB	88	2,000	None
Potassium	23,500	NA[d]	4,000 or SB	2,250	23,500	None
Vanadium	140	600	150 or SB	25.6	600	None

Key at end of table.

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Table 2-4

**WELLSVILLE-ANDOVER LANDFILL SITE
REMEDIAL ACTION OBJECTIVES AND CLEANUP GOALS FOR SOILS
(mg/kg)**

Chemical	Benchmark Background Concentrations[a]	Benchmark Health Risk Value[b]	NYSDEC Recommended Soil Cleanup goal[c]	Maximum Detected Concentrations	Remedial Action Objective	Site Cleanup Goal
Zinc	104	20,000	20 or SB	356	20,000	None
Cyanide	NA	2,000	NA	3.5	2,000	None
ORGANIC SUBSTANCES						
Volatiles			Total Volatiles <10			
Acetone	NA	6,000	0.2	0.240	6,000	None
Chloromethane	NA	NA	—	0.040	None	None
Ethylbenzene	NA	8,000	5.5	0.018	8,000	None
total 1,2-Dichloroethene	NA	800[f]	0.3	0.087	800	None
Trichloroethene	NA	64	1.4	0.022	64	None
Vinyl chloride	NA	0.36	0.2	0.021	0.36	None
Semi-Volatiles			Total Semivolatiles <500			
Anthracene	NA	20,000	50	0.014	20,000	None
Benzo(b)fluoranthene	0.020 - 0.030	0.22	1.1	0.140	0.22	None
Benzo(k)fluoranthene	0.010 - 0.110	0.22	1.1	0.022	0.22	None
Benzo(g,h,i)perylene	0.010 - 0.070	NA	50	0.047	50	None
Benzo(a)pyrene	0.002 - 1.3	0.061	0.061 or MDL	0.088	0.061 or MDL	0.061 or MDL
Bis(2-ethylhexyl)phthalate	NA	50	50	2.1	50	None

Key at end of table.

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Table 2-4

WELLSVILLE-ANDOVER LANDFILL SITE
REMEDIAL ACTION OBJECTIVES AND CLEANUP GOALS FOR SOILS
(mg/kg)

Chemical	Benchmark Background Concentrations[a]	Benchmark Health Risk Value[b]	NYSDEC Recommended Soil Cleanup goal[c]	Maximum Detected Concentrations	Remedial Action Objective	Site Cleanup Goal
Butylbenzylphthalate	NA	20,000	50	0.260	20,000	None
Chrysene	0.038	NA	0.4	0.050	0.4	None
Dibenz(a,h)anthracene	NA	0.014	0.014 or MDL	0.044	0.014 or MDL	0.014 or MDL
Fluoranthene	0.003 - 0.040	3,000	50	0.185	3,000	None
Indeno(1,2,3-cd)pyrene	0.010 - 0.015	NA	3.2	0.045	3.2	None
Phenanthrene	0.030	NA	50	0.047	50	None
Pyrene	0.001 - 0.197	2,000	50	0.140	2,000	None

a For inorganics, benchmark value is the upper 90th percentile of concentrations in eastern U.S. soils (Shacklette and Boerngen 1984); for PAHs, benchmark value is the background value found in rural soils (ATSDR 1989).
b Guidance derived from human direct ingestion pathway (NYSDEC 1991c).
c NYSDEC TAGM HWR-92-4046.
d NYSDEC value was derived from potassium cyanide and is inappropriate for this use.
e RCRA CMS action level for copper in soil (USEPA 1990).
f Derived from cis-1,2-dichloroethene.

Key:

MDL = Method detection limit.
NA = Not available.
SB = Site background.
— = None provided.

Source: Compiled by Ecology and Environment Engineering, P.C. 1994.

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Table 2-5

WELLSVILLE-ANDOVER LANDFILL SITE
REMEDIAL ACTION OBJECTIVES AND CLEANUP GOALS FOR GROUNDWATER
(μg/L)

Chemical	NYSDOH MCL[a]	NYSDEC Class GA Groundwater Standard[b]	Maximum Detected Concentrations[c]	Remedial Action Objective	Site Cleanup Goal
INORGANIC SUBSTANCES					
Aluminum	NA	NA	51,300	NA	None
Arsenic	50 P	25	45.5	25	25
Barium	1,000 P	1,000	1,470	1,000	1,000
Beryllium	NA	NA	3.2	NA	None
Cadmium	50	10	10.8	10	10
Calcium	NA	NA	173,000	NA	None
Chromium	50 P	50	291	50	50
Cobalt	NA	NA	109	NA	None
Copper	1,000 S	200	208	200	200
Cyanide	NA	100	160	100	100
Iron	300 S[e]	300[e]	131,000	300	300
Lead	50 P	25	484	25	25
Magnesium	NA	35,000 G	71,500	35,000	35,000
Manganese	300 S[e]	300[e]	8,530	300	300
Nickel	NA	NA	366	NA	None
Potassium	NA	NA	42,100	NA	None
Selenium	10	10	1.7	10	None

Key at end of table.

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Table 2-5

WELLSVILLE-ANDOVER LANDFILL SITE
REMEDIAL ACTION OBJECTIVES AND CLEANUP GOALS FOR GROUNDWATER
(μg/L)

Chemical	NYSDOH MCL[a]	NYSDEC Class GA Groundwater Standard[b]	Maximum Detected Concentrations[c]	Remedial Action Objective	Site Cleanup Goal
Sodium	NA	NA	51,600	20,000	20,000
Vanadium	NA	NA	67.1	NA	None
Zinc	5,000 S	5,000 S	549	300	300
ORGANIC SUBSTANCES					
Volatiles					
Acetone	50 G	5	33	5	5
Benzene	5	5	14	0.7	0.7
Chloroethane	5	5	13	5	5
Chloroform	7	7	2	7	None
1,1-Dichloroethane	5	5	11	5	5
1,1-Dichloroethene	5	5	12	5	5
total 1,2-Dichloroethene	5	5	5,600	5	5
Ethylbenzene	5	5	11	5	5
Methylene chloride	5	5	4	5	None
Toluene	5	5	10[d]	5	5
1,1,1-Trichloroethane	5	5	6	5	5
1,1,2-Trichloroethane	5	5	1.5[d]	5	None

Key at end of table.

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Table 2-5

WELLSVILLE-ANDOVER LANDFILL SITE
REMEDIAL ACTION OBJECTIVES AND CLEANUP GOALS FOR GROUNDWATER
(μg/L)

Chemical	NYSDOH MCL[a]	NYSDEC Class GA Groundwater Standard[b]	Maximum Detected Concentrations[c]	Remedial Action Objective	Site Cleanup Goal
Trichloroethene	5	5	1,800[d]	5	5
Vinyl chloride	5	2	2,100	2	2

a Maximum Contaminant Level (10 NYCRR 5-1.52).
b NYSDEC 1991a.
c Maximum detected concentrations in monitoring wells.
d Average of duplicate samples.
e Total concentration of iron and manganese is not to exceed 500 μg/L.

Key:

G = Guidance value (NYSDEC 1991).
NA = Not available.
P = NYSDOH primary contaminant.
S = NYSDOH secondary contaminant.

Source: Compiled by Ecology and Environment Engineering, P.C. 1994.

Table 2-6

WELLSVILLE-ANDOVER LANDFILL SITE
LANDFILL COVER THICKNESS AND DEPTH OF DEBRIS

Piezometer	Depth to Bedrock	Total Depth of Piezometer	Landfill Cover Depth	Debris Depth
PZ-2	23	23	0 - 2.5	2.5 - 15.5
PZ-3	13	23	—	None encountered
PZ-7	—	20	0 - 7	7 - 12
PZ-8	—	20	0 - 4	4 - 11
PZ-9	—	21	0 - 6	6 - 12
PZ-10	—	18.3	0 - 3	3 - 8
PZ-11	—	28	0 - 4	4 - 20
PZ-12	—	18	0 - 4	4 - 9
PZ-13	—	21	0 - 3	3 - 13
PZ-14	—	17.5	0 - 3	3 - 9

a All depths are in feet below ground surface (BGS).

Source: Lu 1993.

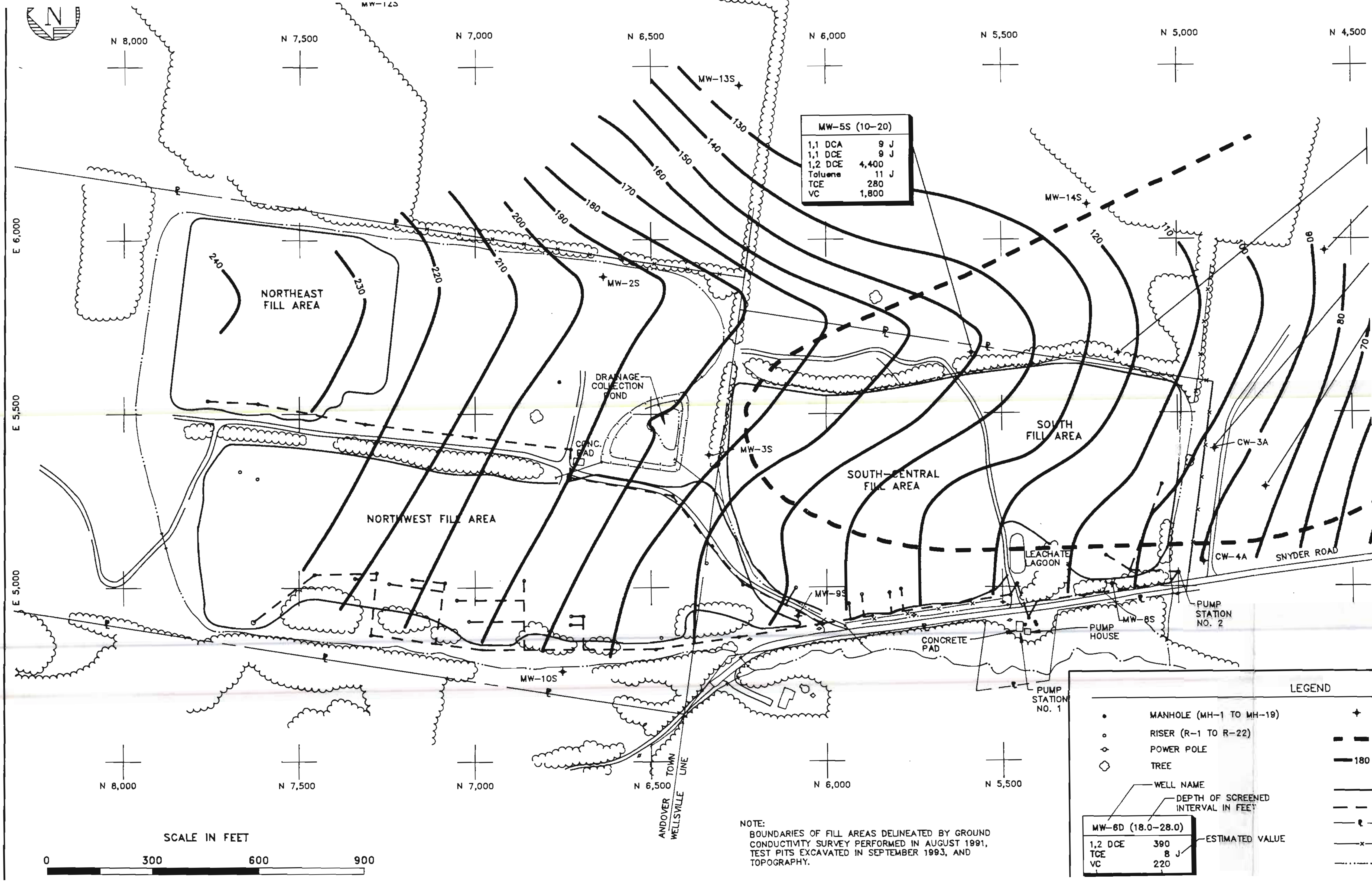
Table 2-7

WELLSVILLE-ANDOVER LANDFILL SITE CONTAMINATED MEDIA ESTIMATES

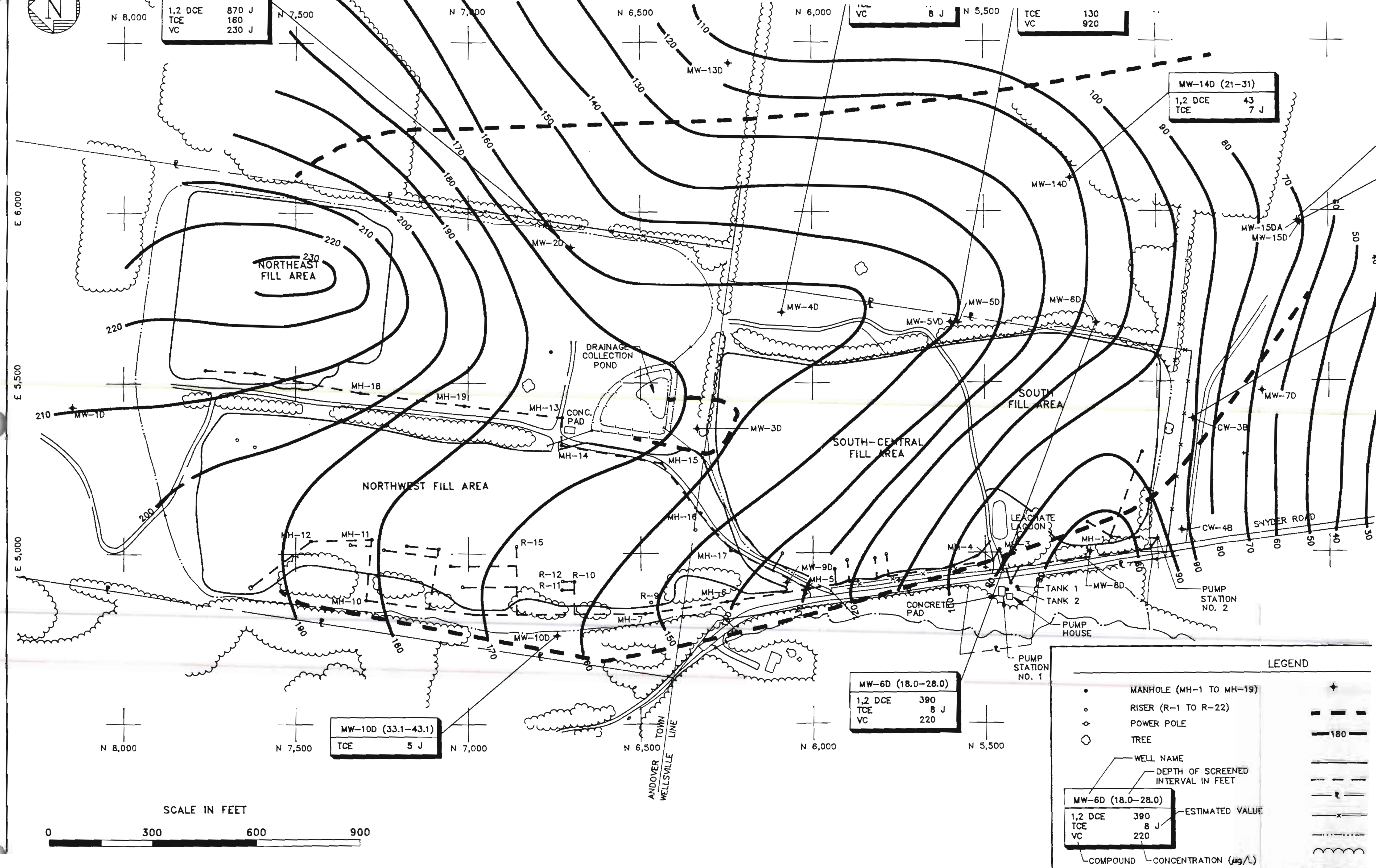
Fill Parameters	
Northeast	
Average fill thickness	13 ft
Area	310,440 ft^2 (7.1 acres)
Volume	149,470 yd^3
Northwest	
Average fill thickness	5.8 ft
Area	796,340 ft^2 (18.3 acres)
Volume	148,270 yd^3
South-Central	
Average fill thickness	10.3 ft
Area	453,790 ft^2 (10.4 acres)
Volume	173,110 yd^3
South	
Average fill thickness	8 ft
Area	289,460 ft^2 (6.6 acres)
Volume	85,760 yd^3
Landfill Gas Production[a]	
Northeast Fill	27 million ft^3/yr
Northwest Fill	25 million ft^3/yr
South-Central Fill	22 million ft^3/yr
South Fill	13 million ft^3/yr
Leachate Production Due to Groundwater	
Northeast Fill	0
Northwest Fill	443,000 gal/yr
South-Central Fill	0
South Fill	0
Leachate Production Due to Infiltration[b]	
Northeast Fill	2,524,000 gal/yr
Northwest Fill	5,355,000 gal/yr
South-Central Fill	3,490,000 gal/yr
South Fill	2,226,000 gal/yr

[a] Gas production estimated from "Landfill Air Emissions Estimation Model" Version 1.1a (EPA 1991).
[b] Leachate production estimated from "Hydrologic Evaluation of Landfill Performance Model," Version 2.05 (Department of the Army 1989).

Source: Ecology and Environment Engineering, P.C. 1993.



NOTE:
BOUNDARIES OF FILL AREAS DELINEATED BY GROUND CONDUCTIVITY SURVEY PERFORMED IN AUGUST 1991, TEST PITS EXCAVATED IN SEPTEMBER 1993, AND TOPOGRAPHY.



E 5,000
E 5,500
E 6,000
N 8,000
N 7,500
N 7,000
N 6,500
N 6,000
N 5,500
NORTHEAST FILL AREA
NORTHWEST FILL AREA
SOUTH-CENTRAL FILL AREA
SOUTH FILL AREA
DRAINAGE COLLECTION POND
CONC. PAD
CONCRETE PAD
LEACHATE LAGOON
TANK 1
TANK 2
PUMP HOUSE
PUMP STATION NO. 1
PUMP STATION NO. 2
SNYDER ROAD
ANDOVER TOWN LINE
WELLSVILLE
MW-1D
MW-2D
MW-3D
MW-4D
MW-5D
MW-5VD
MW-6D
MW-7D
MW-8D
MW-9D
MW-10D
MW-13D
MW-14D
MW-15DA
MW-15D
CW-3B
CW-4B
MH-1
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-9
R-10
R-11
R-12
R-15
230
220
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
1,2 DCE 870 J
TCE 160
VC 230 J
VC 8 J
TCE 130
VC 920
MW-14D (21-31)
1,2 DCE 43
TCE 7 J
MW-10D (33.1-43.1)
TCE 5 J
MW-6D (18.0-28.0)
1,2 DCE 390
TCE 8 J
VC 220
SCALE IN FEET
0
300
600
900
LEGEND
MANHOLE (MH-1 TO MH-19)
RISER (R-1 TO R-22)
POWER POLE
TREE
WELL NAME
DEPTH OF SCREENED INTERVAL IN FEET
MW-6D (18.0-28.0)
1,2 DCE 390
TCE 8 J
VC 220
ESTIMATED VALUE
COMPOUND
CONCENTRATION (µg/L)
180

3. DEVELOPMENT AND SCREENING OF REMEDIAL ALTERNATIVES

3.1 DEVELOPMENT AND SCREENING OF REMEDIAL ALTERNATIVES

In this section, remedial technologies identified and retained in Section 2 are assembled into alternatives. These alternatives are then screened based on their short-term and long-term effectiveness and their implementability.

Effectiveness pertains to the alternative's ability to eliminate significant threats to human health and the environment through reductions in toxicity, mobility, and volume of hazardous wastes at the site. Short term refers to the construction and implementation period; long term refers to the period after the remedial action is in place and effective.

Implementability measures both the technical and administrative feasibility of constructing, operating, and maintaining a remedial action alternative. Technical feasibility refers to the ability to construct, reliably operate, and meet technical specifications or criteria, and the availability of specific equipment and technical specialists to operate necessary process units. It also includes operation, maintenance, replacement, and monitoring of technical components of an alternative, if required, after the remedial action is complete. Administrative feasibility refers to compliance with applicable rules, regulations, and statutes, the ability to obtain approvals from other offices and agencies, and the availability of treatment, storage, and disposal services and capacities.

The alternatives have been developed for specific media in order to facilitate their evaluation. Descriptions of the alternatives, as well as their effectiveness and implementability evaluations, are provided below. Section 3.2 summarizes the evaluations and indicates whether an alternative was retained or rejected. Retained alternatives are then combined into site-wide alternatives, which will undergo detailed analyses in Section 4.

3.1.1 Soil and Waste Alternatives

The landfill currently has a soil cover with depths ranging from 2.5 to 7 feet. The RI found fill thickness to range from greater than 3 feet to 16 feet. Although no significant contamination was detected in surface soils, several seeps found in the landfill cover and overflows from the leachate holding pond and Pump Station 2 provide pathways through which humans and animals may come into contact with COPCs and CPECs. In addition, waste material in the northwest fill area is currently below the groundwater table. Contaminants from the fill leach directly into the groundwater.

Several alternatives were developed to mitigate potential threats to human health and the environment. These alternatives were also developed based on federal and New York State guidance documents and are described below.

3.1.1.1 Alternative 1: No Action

A no-action alternative is evaluated to provide a baseline with which other alternatives may be compared.

For this FS, the no-action alternative will include deed restrictions and a formal groundwater monitoring program. Deed restrictions would be placed on the use of land within the site boundaries. A clause prohibiting future development or excavation of the contaminated areas would be added to the property deed or deeds that include the site. While implementation of this action will not increase the minimal protection already provided by the existing soil cover, it will assist in maintaining the cover's integrity.

Groundwater would be monitored upgradient and downgradient of the site until it is determined that groundwater meets cleanup goals. Monitoring would also detect changes in groundwater quality caused by leaching of landfill contaminants. Results would be recorded on a permanent record. This information would be used to assess contaminant migration and determine if additional remedial actions are necessary to adequately protect human health and the environment.

This alternative does not improve on the minimal protection already provided by the existing landfill cover, nor is it considered a permanent remedy because it does not reduce the toxicity, volume, or mobility of the hazardous waste on site. The resultant risks associated with the no-action alternative would be the same as those identified in the human health risk evaluation conducted as part of the RI.

3.1.1.2 Alternative 2: Capping

The intent of Alternative 2 is to provide additional protection of human health and the environment by reducing the mobility of the contaminants and significantly reducing the hazards of direct contact with and incidental ingestion of COPCs and CPECs.

To identify appropriate capping requirements, the four existing fill areas are classified according to the type of waste (municipal or hazardous) historically disposed of in each particular fill area. As described in previous NYSDEC reports, the northeast fill area accepted municipal and industrial solid waste from 1978 to 1983; the northwest, south-central, and south fill areas accepted municipal, industrial, and waste currently considered hazardous. Hence, the northeast fill area will be capped in accordance with state guidelines for municipal solid waste (6 NYCRR Part 360-2), while the northwest, south-central, and south fill areas will have final covers that comply, at a minimum, with state hazardous waste regulations.

Municipal Cap

The Wellsville-Andover Landfill does not have an approved closure plan and ceased to accept waste before October 9, 1993 (the effective date of the most recent version of 6 NYCRR Part 360-2). Therefore, 6 NYCRR 360-2, effective October 31, 1988, is applicable for this portion of the alternative; the October 9, 1993, version is relevant and appropriate, and is included in this discussion. Three types of caps are described below. Figure 3-1 shows cross sections of the three caps described.

Municipal Cap A. Based on 6 NYCRR Part 360-2.15(b) (October 31, 1988), this cover would consist of a topsoil layer, a barrier protection layer, a low-permeability soil cover with a maximum coefficient of permeability of 1 x 10^{-7} cm/s, and a gas venting layer.

Municipal Cap B. 6 NYCRR Part 360-2.15(b) allows the use of a geomembrane in place of the low-permeability soil cover. Therefore, this cover would be similar to Municipal Cap A, except that a 40-mil (minimum) geomembrane would replace the low-permeability soil cover.

Municipal Cap C. Under the October 9, 1993, version of 6 NYCRR Part 360-2, an appropriate final cover for the Wellsville-Andover Landfill would be a composite cap using both a 40-mil (minimum) geomembrane and a low-permeability soil cover with a maximum coefficient of permeability of 1×10^{-6} cm/s. This cap would provide better protection than the two caps previously described because it takes advantage of the self-repairing properties of clay and the impermeable nature of a synthetic membrane.

Hazardous Waste Cap

As discussed in Section 2, RCRA requirements, particularly land disposal restrictions (LDRs) and closure standards, will be applicable to the Wellsville-Andover Landfill site only if "placement" of waste occurs as part of the remedial action. State regulations require final covers of hazardous waste facilities regardless of the chosen remedial action (6 NYCRR Part 373). Because these state requirements parallel RCRA requirements for final covers, EPA guidance on the recommended design for RCRA Subtitle C covers (Design and Construction of RCRA/CERCLA Final Covers, [EPA 1991]) will be used for the cap design, which is illustrated in Figure 3-2.

Consolidation of hazardous material may be performed prior to capping of the hazardous fill areas. Therefore, Alternative 2 is divided into two subalternatives: capping without consolidation and capping with consolidation.

Alternative 2A: Capping Without Consolidation

Under this option, the northeast fill area would be covered with a municipal cap and the northwest, south-central, and south fill areas would be covered with a multilayer cap in compliance with RCRA guidelines.

Construction of a cap over the municipal portion (cap area would be approximately 8 acres) would require approximately one year to complete. Cap materials can be supplied by local vendors within a five-mile radius. Because post-closure operation and maintenance is required for a minimum period of 30 years after landfill closure, the expected lifetime of the cap is assumed to be 30 years. In addition to maintenance of soil cover integrity and cover vegetation, annual baseline and quarterly routine monitoring must be performed on groundwater, surface water, and leachate samples for a minimum of five years. Requirements for subsequent analysis will be determined by NYSDEC at the end of each year.

Capping of the hazardous fill areas (an approximate total of 35 acres) could be completed in about 12 to 16 months. The expected lifetime of the hazardous waste cap is also 30 years. As with the municipal cap, periodic maintenance such as seasonal care of cap vegetation and quarterly inspections would be required.

Capping the landfill would significantly reduce infiltration into the landfill, thereby minimizing the volume of leachate generated and reducing the migration of contaminants from fill material to groundwater. However, this alternative will not reduce the volume or the toxicity of the solid hazardous wastes, and therefore is not considered a permanent remedy.

Alternative 2B: Capping With Consolidation

In addition to a municipal cap for the northeast fill area as previously presented, this option includes consolidation of the hazardous material prior to cap construction in order to minimize the area of the hazardous waste cap. At the Wellsville-Andover Landfill, excavating the waste from the northwest fill area (approximately 150,000 cubic yards) and consolidating it with that of the south-central and south fill areas has the added benefit of eliminating the hazardous material known to be in contact with groundwater.

Given the similar nature of materials found in the northwest, south-central, and south fill areas, their relative proximity to each other, and the fact that Phase II RI trenching in this area did not identify any boundaries between these fill areas, E & E has concluded that these areas constitute one Area of Contamination (AOC). Because AOC determinations are required to be made by the Lead Regulatory Agency, this AOC designation must be made by NYSDEC. This designation is significant because hazardous wastes may be moved within an AOC without triggering LDR treatment requirements, while the movement of hazardous wastes from one AOC to another may trigger LDR treatment requirements.

At the federal level, EPA has addressed the LDR issues associated with the excavation of hazardous wastes from one AOC at a RCRA facility and placing them in another AOC in a recent rulemaking (58 FR 8658, February 16, 1993). That rule, which is considered an ARAR for federal Superfund remedial programs, allows movement and consolidation of remediation wastes within a Corrective Action Management Unit (CAMU) without subjection to LDR treatment requirements. CAMUs are defined as areas at a facility designated by the state or EPA for managing remediation wastes. Because New York State has not yet adopted this rule and the existing comparable state requirement is considered to be more stringent than this federal regulation, a variance from state regulations would have to be obtained to take advantage of this mechanism.

In order to implement this alternative without triggering LDR treatment requirements, which would significantly increase the cost of this alternative as well as prolong the time needed to implement it, either all of the fill areas must be designated as one AOC or a portion of the site must be designated as a CAMU.

Other factors pertinent to the capping with consolidation alternative are described below:

- Consolidation activities would most likely have to be conducted in Level B protection because of the presence of VC.
- Engineering controls to lower the groundwater table may be necessary to facilitate remedial work.
- Engineering controls may also be required to prevent off-site migration of contaminants and odors that could be released during consolidation.
- Soils beneath fill areas from which waste will be removed would have to be tested to determine if they require remediation. After an area is designated as clean, it would be backfilled with clean soil.

Construction of the cap, including consolidation of the waste, is expected to take less than two years. The expected lifetime of the cap is 30 years as discussed above. Post-closure care is required for 30 years after completion of closure activities. This includes maintaining the integrity and effectiveness of the final cover, and monitoring groundwater and leachate.

3.1.1.3 Alternative 3: On-Site Hazardous Waste Landfill Plus Municipal Cap

Under Alternative 3, the northeast fill area would be covered with a municipal cap while wastes from the northwest, south-central, and south fill areas would be consolidated and placed into a single hazardous waste landfill constructed on site.

Municipal Cap. The options for the municipal cap are similar to those described in Alternative 2.

On-Site Hazardous Waste Landfill. The landfill would have a minimum capacity of approximately 400,000 cubic yards and would consist of a double-liner system (which includes a leachate collection system) and a hazardous waste cap designed in accordance with 6 NYCRR Part 373. The cross section of the cap will be the same as that shown for the hazardous waste cap of Alternative 2. Figure 3-3 shows a cross section of a typical double liner and leachate collection system.

As with the capping with consolidation alternative (Alternative 2B), it would be necessary to seek AOC/CAMU designation in order to facilitate implementation of this alternative. A RCRA permit would not be necessary. Concerns related to consolidation activities, as described previously, would be pertinent.

The construction process would be extremely complex compared to the previous alternatives because it would be performed in multiple phases with simultaneous excavation, backfilling, and landfill construction. It may be necessary to stage existing waste material in order to construct a landfill of sufficient size to accommodate the waste because of site boundary constraints. The time required for completion of the landfill, including excavation, bottom liner construction, excavation, staging, and disposal of material, capping, and regrading/backfilling of the site would be approximately two to three years. The expected lifetime of the landfill is 30 years. Periodic maintenance and monitoring would be required, as previously discussed for the capping alternative.

Compared with the previous alternatives, Alternative 3 would provide greater protection of human health and the environment by isolating the hazardous materials in an on-site hazardous waste landfill. Infiltration into the municipal waste would be significantly reduced. However, this remedy is not considered permanent because the toxicity and/or volume of hazardous wastes would not be reduced.

3.1.2 Groundwater Alternatives

At the Wellsville-Andover Landfill site, COPCs were found at significant concentrations in the groundwater. Samples from the monitoring wells on the eastern boundary of the south and south-central fill areas contained the highest concentrations of these COPCs. A sample from a residential well south of the site also contained TCE at a concentration slightly exceeding groundwater standards.

The overburden groundwater (monitoring wells screened at 0 to 26 feet BGS) plume of COPCs above groundwater standards was shown in Figure 2-1. The bedrock groundwater (monitoring wells screened at 21 to 59 feet BGS) plume of COPCs above groundwater standards was shown in Figure 2-2. The groundwater contamination is assumed to be present not in distinct layers but in a continuous volume that is intercepted at distinct depths by the existing wells. The direction of groundwater contamination flow appears to follow area topography with a tendency to the southeast.

Ingestion of and dermal contact with contaminated groundwater as well as inhalation of VOCs that volatilize from the groundwater are potential exposure pathways by which nearby residents and site visitors could be exposed to site contaminants. Several alternatives have been developed to mitigate these threats to human health and the environment and are described below.

3.1.2.1 Alternative 1: No Action

A No-Action alternative is included to provide a baseline with which other groundwater alternatives may be compared. Although no groundwater remediation will be conducted, deed restrictions and groundwater monitoring are proposed for inclusion in this alternative. The No-Action alternative is evaluated under two scenarios: without a landfill cap, and with a landfill cap.

Alternative 1A: No Action Without a Landfill Cap

This alternative would leave the contaminated groundwater (as well as the fill material) in its present condition. Deed restrictions would be placed on the site to limit intrusive work and use of groundwater. The groundwater and drinking water sources in the area would be monitored on a regular basis to assess the groundwater condition.

Because no groundwater remedial actions would be implemented, there would be no change in the current level of protection of human health and the environment. The resultant risks associated with this alternative would be the same as those identified in the human health risk evaluation included in the RI. This alternative would be relatively simple to implement and is not considered permanent.

Alternative 1B: No Action with a Landfill Cap

Under this scenario, deed restrictions and groundwater monitoring would be included as described above. Although the contaminated groundwater would not be treated, the cap over the landfill would significantly reduce infiltration of precipitation into the landfill, thereby minimizing leachate generation and contaminant migration into the groundwater. Groundwater monitoring would provide a measure of the effectiveness of the cap system in reducing contaminant migration into the groundwater. Present contaminant concentrations would eventually be reduced through natural attenuation. Thus, this alternative provides some long-term protection of human health and the environment.

Although contaminant concentrations would be reduced eventually, this alternative does not significantly minimize the toxicity, mobility, and volume of the currently contaminated groundwater. Therefore, this alternative cannot be considered permanent.

3.1.2.2 Alternative 2: Collection and Off-Site Treatment and Disposal

This alternative assumes that the landfill will be capped with a final cover. In order to improve on Alternative 1B, the presently contaminated groundwater would be extracted and then hauled to an off-site treatment and disposal facility. The groundwater would be extracted from the most contaminated area, stored in a holding tank or lagoon, and then transported by truck to a POTW for treatment and disposal.

It was found during the RI that the existing overburden and bedrock wells have very low yields. As a result, the radius of influence achieved by pumping any well installed at the site is expected to be small. This precludes the use of wells for groundwater extraction for both the shallow and deep portions of the aquifer because the wells would have to be spaced extremely close to each other in order to effectively contain the contaminant plume. Additionally, the heterogeneity of the bedrock and resulting anisotropic hydraulic characteristics of the bedrock aquifer would make design of an effective contaminant migration control system exceedingly difficult, even if sufficient yields could be achieved. Therefore, extraction of contaminated groundwater from the bedrock is considered unfeasible.

Collection of overburden groundwater is feasible. Installing an interceptor trench along all downgradient sides of the site would be more practical than installing numerous wells. This trench would descend into the bedrock and along the border of the site in order to most effectively reduce off-site contaminant migration. Contaminant migration in the shallow groundwater must be controlled at the site because excavation may be performed in the future at any of the properties adjacent to the site, thereby exposing the public to COPCs.

Assuming that surface infiltration into the fill areas is effectively eliminated by capping and an effective leachate collection system is installed, a perimeter groundwater interceptor trench would only serve to collect existing contaminated groundwater. Following collection of this existing slug of contaminated groundwater, the trench would then only collect clean groundwater derived from infiltration into the noncapped areas of the site. Therefore, a groundwater interceptor trench is deemed unnecessary if effective contaminant source control is implemented.

Although this alternative would have significantly reduced the toxicity, mobility, and volume of contaminated groundwater, extraction and therefore *ex situ* treatment of the bedrock groundwater is unfeasible; contaminated overburden groundwater would most likely be collected by the improved leachate collection system and thus be treated together with the leachate. *In situ* treatment would be impractical for the same reasons that make extraction difficult. Therefore, collection and treatment remedial alternatives for the groundwater will be eliminated from further consideration.

Alternative 3: Point-of-Use Treatment

Because the collection of contaminated groundwater is impractical, source control and natural attenuation would be relied on to remediate the groundwater. However, the water used by residents with drinking water wells/springs in the contaminated groundwater plume should meet drinking water standards that are considered protective of human health. This alternative uses a phased approach that involves a regular (quarterly or as deemed necessary as data is compiled) monitoring of the residences most likely to be affected by the site contaminants (approximately 10). Results of this monitoring (and the RI data) would be used to determine when a drinking water source should receive a point-of-use (residential) treatment system or other system to protect the drinking water source. These residential treatment systems would be vendor-designed based on particular contaminants present, concentrations, and desired treatment level.

This alternative would reduce the toxicity of the contaminated groundwater at residences to acceptable levels through treatment. The remaining contamination would eventually be reduced in both volume and toxicity by natural attenuation and source control. The mobility of groundwater, however, is not expected to be significantly impacted. This alternative could be initiated immediately, but would require O&M until the groundwater meets cleanup goals (assumed to be 30 years for evaluation purposes). The technologies required are well-proven, commercially available, and reliable.

3.1.3 Leachate Alternatives

The fill areas at the site currently have a limited leachate collection system (LCS). This system collects leachate from the edges of all four fill areas (see Figure 1-2). Collected leachate is stored in two 10,000-gallon underground storage tanks (USTs) and a lagoon that overflows periodically during wet periods. The current leachate production at the landfill has been estimated by the HELP model to be approximately 14 million gallons per year. The Village of Wellsville currently transports up to approximately 30,000 gpd of leachate from the landfill to the Village's POTW for disposal. The Village of Wellsville typically disposes of 6 to 9 million gallons of leachate at their POTW each year. The remaining leachate (5 to 8 million gallons per year) either overflows the current system at the lagoon and PS-2 or is uncollected and leaches into the groundwater. Leachate samples have indicated the presence of some VOCs, high iron, and five-day biochemical oxygen demand (BOD_5) content.

Because the leachate from a hazardous waste landfill is a listed waste (F039), it must be managed as such. The village currently transports leachate from the site to their POTW with village-owned trucks. They do not manifest their loads and do not use a permitted hazardous waste hauler. The receiving POTW does not have to be a RCRA-permitted facility as long as it meets the RCRA permit-by-rule requirements (40 CFR 270.60(c)). These requirements include the following:

- POTW must have a current discharge permit (NPDES or SPDES);
- POTW must be in compliance with the permit;
- POTW must comply with RCRA regulations regarding an identification number, use of a manifest system, and reporting requirements;
- The waste received must meet all applicable federal, state, or local pretreatment requirements; and
- If the permit was issued after November 8, 1984, the POTW must comply with corrective action requirements under 40 CFR Part 264.101.

The Village of Wellsville POTW must meet these requirements if it is to continue accepting leachate from the Wellsville-Andover Landfill site.

Various alternatives for leachate handling were evaluated in the Draft Leachate Investigation Report prepared for the site (E & E 1992). These alternatives were reviewed and have been incorporated into this FS with modifications, as necessary, to account for current conditions and RAOs.

3.1.3.1 Alternative 1: Continued Action

This alternative will be used as the baseline with which to compare the other leachate alternatives. Under this alternative, the Village of Wellsville would continue to dispose of leachate at their POTW at the rate of approximately 30,000 gpd. However, they would either have to become a licensed hazardous waste hauler and comply with the requirements of 40 CFR 263 or they would have to contract a licensed hauler to transport the leachate to the POTW. This alternative will be evaluated under two scenarios: without a landfill cap, and with a landfill cap.

Alternative 1A: Continued Action Without a Landfill Cap

Of the alternatives to be considered for leachate, this alternative provides the least amount of protection of human health and the environment. The collected leachate would continue to overflow the system during wet weather. The portion of the leachate not collected would continue to contaminate the groundwater. This alternative would not result in any additional short-term or long-term risks or impacts, would require minimal time to implement and, with proper maintenance, is expected to remain effective for 25 to 30 years. This alternative involves well-proven, easily constructed, commercially available, and reliable technologies. The risks to human health and the environment would be as discussed in the human health risk evaluation and habitat-based assessment included in the RI. This alternative is considered partially permanent because contaminants that are collected are destroyed by treatment. Those not collected (approximately half) are not affected by treatment.

Alternative 1B: Continued Action with a Landfill Cap

This alternative would provide an increased level of protection of human health and the environment over the previous alternative. This increase would be due mainly to the expected reduction in leachate production once the landfill areas have been capped. The HELP model showed that leachate production due to infiltration would be reduced by more than 99% if a RCRA cap (i.e., a multilayered cap with both a clay layer and flexible membrane) were used. The collected leachate is expected to be reduced to 25% of current levels (or approximately 10,000 to 15,000 gpd on average, which is below the current hauling rate of 30,000 gpd) within two to three years after completion of the cap. This rate is expected to continue to decline after this initial period to a much lower rate (the HELP model predicts negligible leachate generation after capping). Uncollected leachate would continue to contaminate the groundwater, but the amount of leachate entering groundwater and the frequency of leachate hauling to the POTW is expected to decrease.

This alternative would not result in any additional short-term risks or impacts. The long-term risks would be reduced because leachate production due to infiltration would drop significantly. This would be due entirely to the capping of the landfill. This alternative would require minimal time to implement and, with maintenance, is expected to remain effective for 25 to 30 years. This alternative involves well-proven, easily constructed, commercially available, and reliable technologies. This alternative would be considered to be more permanent than the previous alternative because it is expected that nearly all of the leachate will be collected and the contaminants destroyed.

3.1.3.2 Alternative 2: Improvement of the Leachate Collection System and Off-Site Disposal at a POTW

This alternative assumes that the chosen alternative for the solid waste is not the No Action alternative (i.e., a landfill cap has been installed). Under this alternative, the existing leachate collection system would be improved through expansion along with the implementation of the solid waste alternative, and would be expected to collect a majority, if not all, of the leachate generated. This leachate would then be hauled by a permitted transporter to a POTW for treatment and disposal. The collected leachate is expected to be reduced to 25% of current levels (or approximately 10,000 to 15,000 gpd on average, which is below the current hauling rate of 30,000 gpd) within two to three years after completion of the cap and improvement of the leachate collection system. This rate is expected to continue to decline after this initial period to a much lower rate. There would be little or no uncollected leachate that could continue to contaminate the groundwater. Given these assumptions, the current leachate disposal method, and the uncertainty of future leachate production rates, an on-site treatment system is not considered practical at this time.

If required by the receiving POTW, pretreatment would be performed before hauling the leachate to the POTW to reduce the sludge generated as a result of the leachate. Pretreatment would be accomplished by aeration, which would encourage the formation of ferric hydroxide. This would then be settled out of the leachate and disposed of either at a licensed landfill or processed at a POTW. The remaining liquids would produce significantly less sludge than is currently resulting from the leachate. The Phased/Interim Remedial Alternative Report prepared for the site (E & E 1992) evaluated pretreatment method steps and recommended a pretreatment method that would require construction of a lagoon system and pump station similar to that discussed in the Draft Leachate Investigation Report. However, the size of this system would be reduced to account for the reduction in leachate generation expected from the implementation of a solid waste alternative.

This alternative may result in some additional short-term risks and impacts posed by the release of hazardous gases during expansion of the LCS. The long-term risks would be reduced because leachate production would be reduced and the effectiveness of the LCS would be increased. This alternative would require minimal time to implement and, with maintenance, is expected to remain effective for 25 to 30 years. This alternative involves well-proven, easily constructed, commercially available, and reliable technologies. This alternative would provide more protection of human health and the environment than the previous alternatives and is classified as permanent because contaminants are destroyed. O&M requirements will be significantly greater than those of the previous alternatives.

3.1.4 Landfill Gas Alternatives

With exception of Alternative 1, the following alternatives are assumed to be in conjunction with solid waste capping. The no-action alternative will only be considered if capping is not selected as a remedial action because it is not prudent to install a cap that does not allow for sufficient escape of the continuously generated LFG. LFG control is an important aspect for any capping alternative because insufficient control may result in lateral migration of toxic compounds and methane, and/or rupture of the cap. The remedial action alternatives and options developed to address LFG production at the Wellsville-Andover Landfill are presented below.

By volume, LFG generally consists of approximately 50% carbon dioxide, 50% methane, and trace amounts of non-methane organic compounds (NMOCs). Methane is explosive when present in concentrations of 5% or greater. The most frequently detected NMOCs in LFG are TCE, benzene, and VC (EPA 1991). Both TCE and VC were found in the Wellsville-Andover LFG and were identified as COPCs in the RI.

As described in Section 2.4.4, these gases may be passively or actively collected. Active collection, which is more complex and requires more maintenance than passive collection, is used only when control of lateral LFG migration is necessary. Results from the perimeter soil gas sampling conducted during the Phase II RI suggest that lateral migration of LFG is not significant at the Wellsville-Andover Landfill site. (The few elevated VOC and combustible gas concentrations observed around the perimeter of the fill areas may have occurred because the fill boundaries were not field located for this sampling effort; thus, some samples may have been collected within fill areas.) The presence of a landfill cap should not prevent escape of the gases because the cap will include a gas venting layer. Therefore, active collection will not be considered in the development of LFG remedial alternatives. Passive collection has been proposed for the following alternatives except for the no-action alternative.

3.1.4.1 Alternative 1: No Action

The no-action alternative is included to establish a baseline against which the other alternatives can be compared. Under this alternative, no additional efforts would be made to collect or treat LFG. Currently, LFG disperses naturally through the cover soils and the existing risers that are part of the LCS. This alternative would provide no additional protection of human health or the environment and is not classified as permanent because contaminants are neither destroyed nor their volumes reduced.

3.1.4.2 Alternative 2: Passive LFG Collection

Alternative 2A: Vent to Atmosphere

Passive collection systems use naturally occurring pressure differentials and natural or engineered pathways to collect LFG. Passive collection systems require minimal maintenance because no mechanical or electrical systems are required. This type of collection system may be used for both municipal and hazardous waste landfills.

This alternative entails collecting LFG passively and then venting it directly to the atmosphere without treatment. SCREEN2, a model developed by the EPA, was used to evaluate the air quality impact from venting to the atmosphere. Results of the model showed that the AGC for VC may be exceeded even with stacks as tall as 50 feet. However, this modeling effort is considered to be extremely conservative because it was based on the highest concentration between the only two samples collected from gas risers. Additional LFG samples should be taken throughout the landfill to obtain a better representation of the average contaminant concentrations being emitted by the landfill. In addition, actual landfill gas production may differ considerably from that estimated in Section 2.3.5 using the Landfill Gas Estimation model. Therefore, the predicted exceedance of the AGC for VC is not sufficient to warrant dismissal of the vent to atmosphere alternative. If this alternative is selected, additional sampling and/or modeling of LFG shall be performed after completion of capping activities to ensure compliance with AGCs and SGCs.

This alternative would not result in any additional long-term risks or impacts because LFG is currently venting naturally through the cover soils and LCS. The short-term risks to workers (but not the community) would increase because this system would be installed into the existing landfill and direct release and potential exposure to COPCs would occur. This alternative would require minimal time to implement and, with maintenance, is expected to remain effective for 25 to 30 years and involves well-proven, easily constructed, commercially available, and reliable technologies. This alternative would provide protection of human health and the environment similar to that of Alternative 1 and is also not classified as permanent for the same reasons.

Alternative 2B: Carbon Adsorption of LFG

This alternative would collect LFG passively and then treat the LFG through an on-site carbon adsorption system. The carbon would adsorb the TCE and VC, but methane would be relatively unaffected and vented to the atmosphere. The spent carbon would have to be replaced periodically as removal of TCE and VC decline. The amount of carbon needed would be determined from VC isotherms because VC is the lighter of the two hydrocarbons and is the limiting COPC. The contaminated carbon would then need to be regenerated or disposed of off site at a permitted facility.

This alternative would not result in any additional short-term risks or impacts. Long-term risks and impacts of COPCs in LFG would be minimized because they would be reduced in the LFG prior to discharge to the atmosphere. This alternative would require minimal time to implement and, with maintenance, is expected to remain effective for 25 to 30 years. This alternative involves well-proven, easily constructed, commercially available, and reliable technologies. Depending on AGC and SGC requirements, total emissions of TCE and VC may be reduced by at least 90%. This alternative would provide more protection of human health and the environment than the previous alternatives and is classified as permanent because it removes COPCs from the LFG stream.

Alternative 2C: LFG Flaring

Flaring is an on-site, open combustion process in which the oxygen required for combustion of LFG is provided by either ambient or forced air. Flaring involves a collection system that brings LFG to the flaring point; the LFG is then exposed to a flame or sparking source and is combusted.

For this alternative, LFG would be passively collected and then flared, thereby significantly reducing the amount of TCE, VC, and methane that would otherwise be released to the environment. Modeling of emissions was conducted using SCREEN2. The primary concern with flaring is the conversion of chlorinated compounds into acid gases such as hydrochloric acid (HCl). The model was run under the assumption that the chlorinated organics in the site's LFG are at the maximum concentrations found in the LFG samples. It was then assumed that the chlorinated organics were totally converted by flaring into HCl gas. Using these conservative assumptions, the model showed that HCl AGCs and SGCs will not be exceeded if flaring is used to treat the LFG.

This alternative would not result in any additional short-term or long-term risks or impacts. Long-term risks and impacts of COPCs in LFG would be minimized because they would be significantly reduced by this alternative. Flaring would require minimal time to implement and, with maintenance, is expected to remain effective for 25 to 30 years. This alternative involves well-proven, easily constructed, commercially available, and reliable technologies. It is anticipated that total potential TCE, VC, and methane emissions would be reduced by at least 75%. This alternative would provide more protection of human health and the environment than any of the previous alternatives and is classified as permanent because TCE, VC, and methane are destroyed.

3.2 SUMMARY OF EFFECTIVENESS AND IMPLEMENTABILITY EVALUATIONS

Table 3-1 shows whether an alternative was retained or rejected. Best professional judgment, in addition to the effectiveness and implementability evaluations, provided the basis for the decision made regarding each alternative. The rationale for retaining or rejecting an alternative is briefly described below.

3.2.1 Soil and Waste

Alternative 1 (No Action) was rejected because it violates an applicable action-specific regulation for closure of municipal landfills, 6 NYCRR Part 360-2, which requires placement of a final cover.

Alternative 2A (Capping without Consolidation) and Alternative 2B (Capping with Consolidation) were retained because capping will significantly reduce the infiltration of precipitation into the landfill, thereby reducing the volume of contaminants leached into the groundwater. In addition, leachate seeps will be eliminated. Consolidation is being considered because it would result in a smaller cap area; in addition, excavating waste from the northwest fill area and consolidating it with that of the south-central and south fill areas will reduce the amount of hazardous material contacted by groundwater.

Alternative 3 (On-Site Hazardous Waste Landfill and Municipal Cap) was rejected because construction of a hazardous waste landfill would be more complex and more costly than installation of a landfill cap.

3.2.2 Groundwater

Alternative 1A (No Action Without a Landfill Cap) was rejected because capping is required at this site. Therefore, any alternative that does not include capping cannot be considered as feasible.

Alternative 1B (No Action with a Landfill Cap) was rejected because it will not eliminate a major exposure pathway. Even though a smaller volume of COPCs will be leached into the groundwater as a result of capping, the threat posed by the currently contaminated groundwater will remain.

Alternative 2 (Collection and Off-Site Treatment and Disposal) was rejected because extraction and therefore *ex situ* treatment are not feasible for the site.

Alternative 3 (Point-of-Use Treatment) was retained. Even though this alternative does not provide immediate protection of human health and the environment because of its reliance on natural attenuation to reduce the toxicity and volume of the contaminated groundwater, the provision of point-of-use treatment systems to affected households is considered effective in protection of human health by eliminating the exposure pathways.

3.2.3 Leachate

Alternative 1A (Continued Action Without a Landfill Cap) was rejected because capping is required at this site. Therefore, any alternative that does not include capping cannot be considered as feasible.

Alternative 1B (Continued Action with a Landfill Cap) was rejected because uncollected leachate would continue to contaminate groundwater.

Alternative 2 (Improvement of Leachate Collection System and Off-Site Disposal at a POTW) was retained because implementation of this alternative will reduce the volume of leachate that contaminates the groundwater and soil.

3.2.4 Landfill Gas

Alternative 1 (No Action) was rejected because placement of a cap will automatically entail installation of a system that would allow for sufficient escape of the continuously generated LFG.

Alternative 2A (Passive Collection, Vent to Atmosphere) was retained for possible integration into a site-wide alternative. Implementation of this alternative without treatment will be contingent on results of the proposed air monitoring discussed in Section 3.1.4.2. If monitoring results indicate that treatment is necessary, flaring (Alternative 2C below) will be added to this alternative.

Alternative 2B (Passive Collection, Carbon Treatment) was rejected because it would be more costly to implement compared to flaring. Currently available data suggest that a tremendous amount of carbon would be needed in order to treat the landfill gas to the point at which it meets emission standards.

Alternative 2C (Passive Collection, Flaring) was retained as the representative treatment technology because it is an effective method for destroying the site COPCs. This alternative would be used only if the results of the proposed air monitoring program show that treatment (i.e., flaring) is necessary to meet air standards.

3.3 DEVELOPMENT OF SITE-WIDE REMEDIAL ALTERNATIVES

Examining the results of the evaluation of medium-specific alternatives, two site-wide remedial alternatives are readily apparent. One alternative involves capping the landfill as it exists and treating contaminated leachate off site. The second alternative is similar, except that consolidation of the northwest fill area with the south-central and south fill areas would be performed prior to capping.

Alternative A will therefore consist of the following components:

- Capping without consolidation (Soil and Waste Alternative 2A);
- Point-of-use treatment of groundwater (Groundwater Alternative 3);
- Improvement of the leachate collection system and off-site disposal of the leachate at a POTW (Leachate Alternative 2);
- Passive collection of LFG and vent to atmosphere (Landfill Gas Alternative 2A) with flaring (Landfill Gas Alternative 2C), if necessary.

Alternative B will be similar, except that consolidation will be included:

- Capping with consolidation (Soil and Waste Alternative 2B);
- Point-of-use treatment of groundwater (Groundwater Alternative 3);
- Improvement of the leachate collection system and off-site disposal of the leachate at a POTW (Leachate Alternative 2);
- Passive collection of landfill gas and vent to atmosphere (Landfill Gas Alternative 2A) with flaring (Landfill Gas Alternative 2C), if necessary.

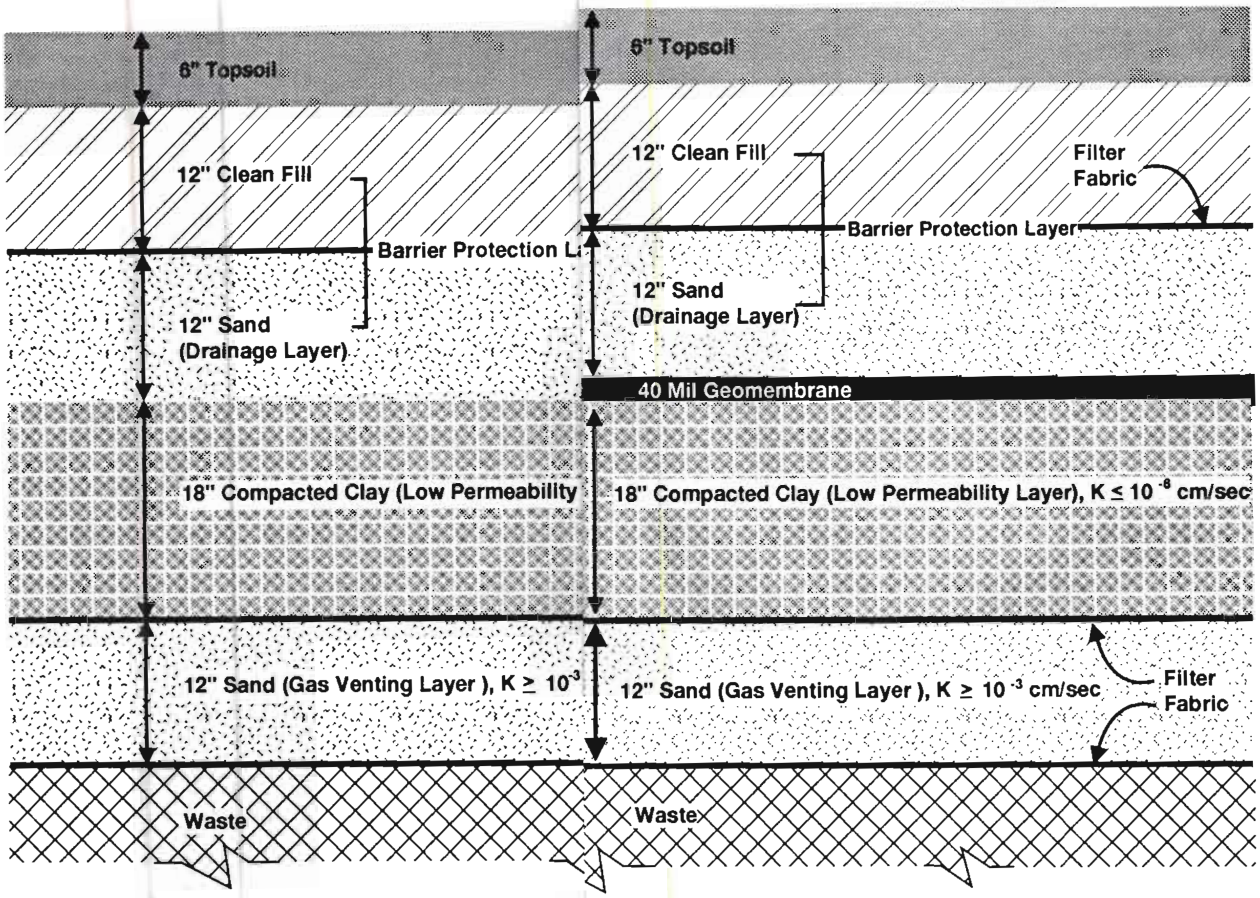
These two site-wide alternatives will be further defined and analyzed in detail in Section 4.

Table 3-1

MEDIUM-SPECIFIC REMEDIAL ALTERNATIVES SCREENING

Remedial Alternative	Comments
Soil and Waste	
Alternative 1: No Action	Reject - violates 6 NYCRR Part 360-2 requirements
Alternative 2A: Capping without consolidation	Retain
Alternative 2B: Capping with consolidation	Retain
Alternative 3: On-site Hazardous Waste Landfill and Municipal Cap	Reject - Will be more costly than Alternatives 2A and 2B
Groundwater	
Alternative 1A: No Action without a Landfill Cap	Reject - Capping will be implemented
Alternative 1B: No Action with a Landfill Cap	Reject - Does not eliminate exposure pathway
Alternative 2: Collection and Off-site Treatment and Disposal	Reject - Not feasible for site
Alternative 3: Point-of-Use Treatment	Retain
Leachate	
Alternative 1A: Continued Action without a Landfill Cap	Reject - Capping will be implemented
Alternative 1B: Continued Action with a Landfill Cap	Reject - Uncollected leachate would still contaminate groundwater
Alternative 2: Improvement of the Leachate Collection System and Off-site Disposal at a POTW	Retain
Landfill Gas	
Alternative 1: No Action	Reject - Capping will be implemented
Alternative 2A: Passive Collection, Vent to Atmosphere	Retain
Alternative 2B: Passive Collection, Carbon Treatment	Reject - Will be more costly than Alternative 2C, which is equally effective
Alternative 2C: Passive Collection, Flaring	Retain

02: OB3_4432.CDR



MUNICIPAL CAP A

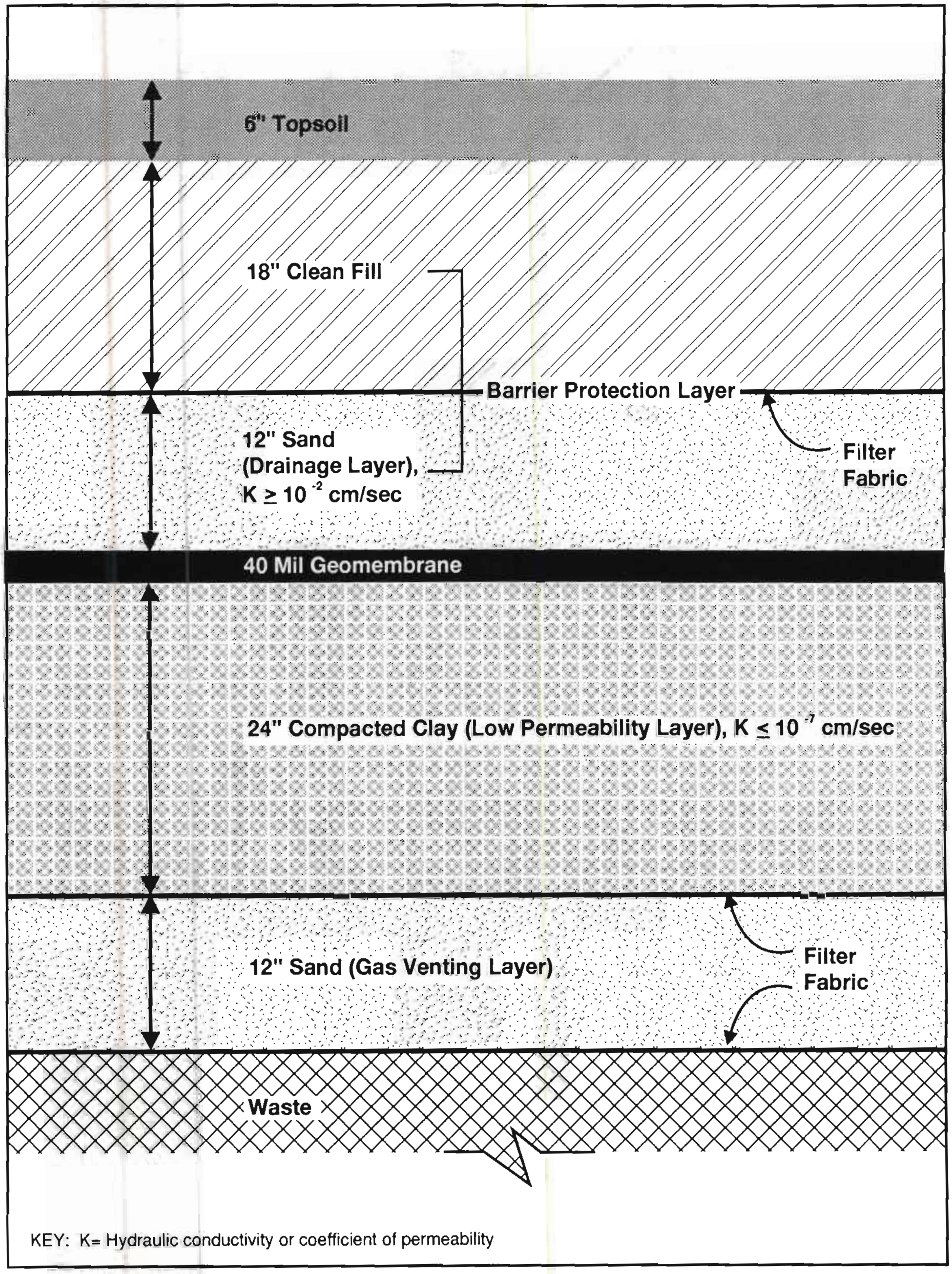
MUNICIPAL CAP C

KEY: K= Hydraulic conductivity or coefficient of permeability

SOURCE: Ecology and Environment, Engineering P.C. 1994

Figure 3-1 MUNICIPAL CAP CROSS SECTIONS WELLSVILLE - ANDOVER LANDFILL FS

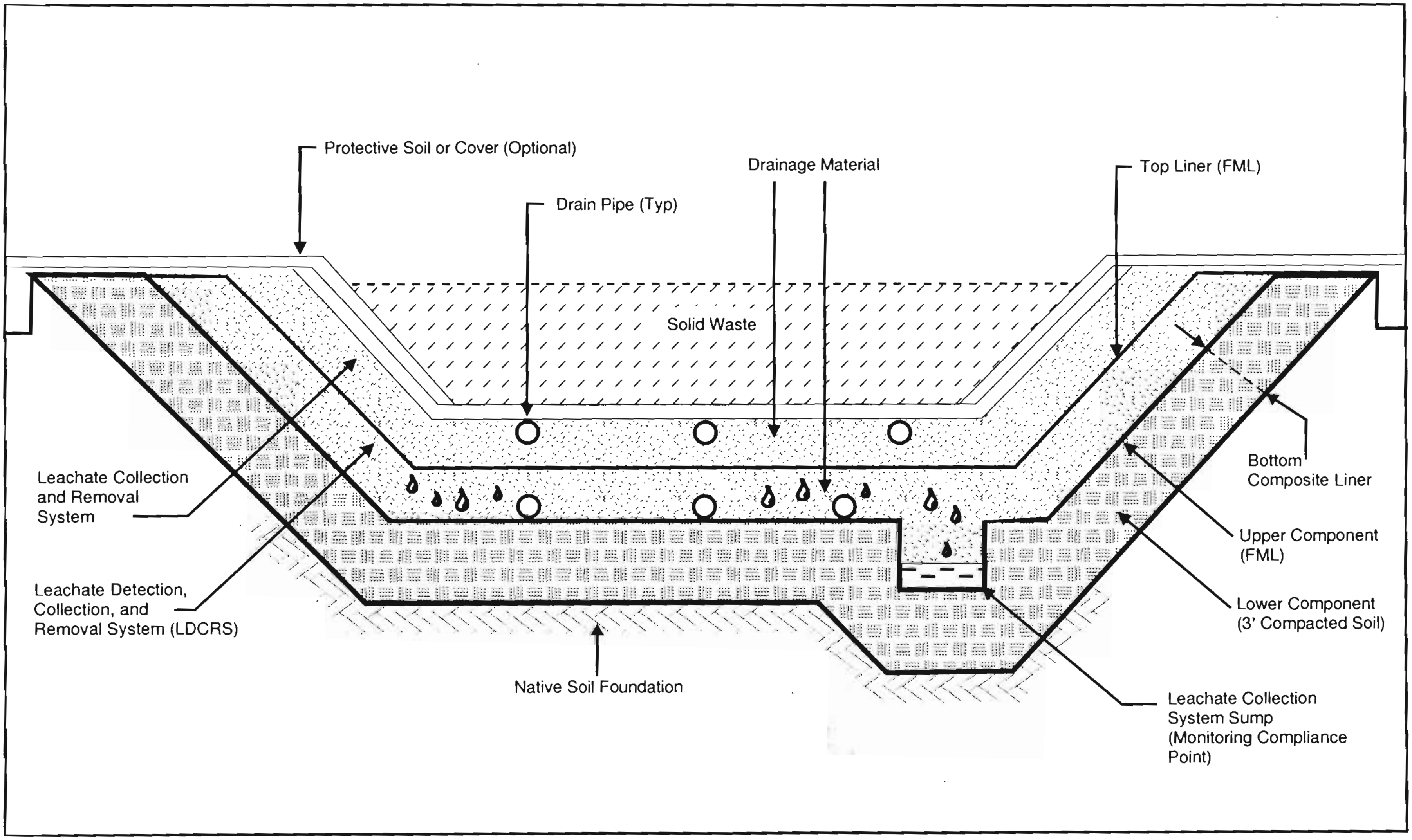
02: OB344324.CDR



SOURCE: Ecology and Environment, Engineering P.C. 1994

Figure 3-2 HAZARDOUS WASTE (RCRA) CAP CROSS SECTION WELLSVILLE-ANDOVER LANDFILL FS

02: OB344325.CDR



SOURCE: Requirements for Hazardous Waste Landfill Design, Construction and Closure (EPA 1989)

NOT TO SCALE

Figure 3-3 SCHEMATIC OF A DOUBLE LINEAR AND LEACHATE COLLECTION SYSTEM FOR A LANDFILL WELLSVILLE - ANDOVER LANDFILL FS

4. DETAILED ANALYSIS OF ALTERNATIVES

Introduction

The detailed analysis of the site-wide alternatives developed as a result of the preliminary screening of media-specific alternatives is intended to provide the relevant information needed to select a site remedy. The alternatives will be assessed using the seven evaluation criteria listed below:

- Compliance with SCGs (ARARs);
- Overall protection of human health and the environment;
- Short-term impacts and effectiveness;
- Long-term effectiveness and permanence;
- Reduction of toxicity, mobility, or volume;
- Implementability; and
- Cost.

These criteria will be used as the basis for conducting the detailed analyses and recommendation of a site remedy. Descriptions and analyses of the site-wide alternatives follow.

Compliance with SCGs

This evaluation criterion will be used to determine whether each alternative will meet all of its identified SCGs.

The detailed analysis will summarize which requirements are applicable, relevant, and appropriate to an alternative and describe how the alternative meets these requirements.

Overall Protection of Human Health and the Environment

This criterion will provide a final check to assess whether each alternative provides adequate protection of human health and the environment. The overall assessment of protection draws on the assessments conducted under other evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with SCGs.

Evaluation of the overall protectiveness of an alternative will focus on whether a specific alternative achieves adequate protection and will describe how site risks posed through each pathway being addressed by the FS are eliminated, reduced, or controlled through treatment, engineering, or institutional controls. This evaluation will allow for consideration of whether an alternative poses any unacceptable short-term or cross-media impacts.

Short-Term Impacts and Effectiveness

This evaluation criterion will address the effects of the alternative during the construction and implementation phase until remedial response objectives are met. Under this criterion, alternatives will be evaluated with respect to their effects on human health and the environment during implementation of the remedial action.

Long-Term Effectiveness and Permanence

The evaluation of alternatives under this criterion will address the results of the remedial action in terms of the risk remaining at the site after response objectives have been met. The primary focus of this evaluation will be the extent and effectiveness of the controls that may be required to manage the risk posed by treatment residuals and/or untreated wastes remaining at the site.

Reduction of Toxicity, Mobility, or Volume

This evaluation criterion will address the regulatory preference for selecting remedial actions that employ treatment technologies permanently and significantly reducing the toxicity, mobility, or volume of the contaminants. This preference is satisfied when treatment is used to reduce the principal risks at a site through destruction of contaminants, for a reduction of total mass of contaminants, to attain irreversible reduction in mobility, or to achieve reduction of the total volume of contaminated media.

Implementability

The implementability criterion will address the technical and administrative feasibility of implementing an alternative and the availability of various services and materials required during its implementation.

Cost

Detailed cost analysis of the selected remedial alternatives will include the following steps:

- Estimation of capital and O&M costs; and
- Present worth analysis.

Costs developed during the FS are expected to provide an accuracy of +50% to -30%.

4.1 ALTERNATIVE A - CAPPING WITHOUT CONSOLIDATION

4.1.1 Description

This alternative includes capping of the wastes in place without major consolidation, improvement of the leachate collection system, and installation of a passive landfill gas collection system (see Figure 4-1 in back pocket). The landfill gas would be vented directly to the atmosphere. Flaring may be added, if necessary. The collected leachate would be trucked off site for treatment and disposal at a POTW. Pretreatment of the leachate would be performed if required by the POTW. However, it is assumed that this will not be necessary based on the current method of leachate disposal used. The source of contamination for the groundwater (i.e., leachate) would be significantly reduced through the installation of caps and improved leachate collection systems. Because it is believed that these contaminant source control actions will be effective, and given that groundwater extraction is infeasible for this site, the contaminated groundwater would be allowed to naturally attenuate. Residential wells/springs within the groundwater contaminant plume and existing groundwater monitoring wells would be analyzed for contaminants on a regular basis (quarterly or as deemed necessary as data are compiled) until it has been determined that the groundwater has reached remediation goals. If a residential well/spring is expected to become, or found to be, contaminated above NYSDOH drinking water standards, an individual point-of-use treatment system for domestic water use may be installed at the affected residence.

Institutional controls such as regulatory restrictions on the construction and use of private water wells would also be implemented. Recommendations regarding the type or extent of such restrictions would be made to appropriate agencies or boards (i.e., NYSDOH, local planning or zoning boards) as the final project plans develop.

Capping under this alternative would include three separate caps. The northeast cell (municipal cell) would be capped in accordance with 6 NYCRR Part 360 regulations. This cap would cover approximately 8.2 acres.

Three municipal cap designs (A, B, and C) were presented in Section 3. Two of the three were determined to be applicable under 6 NYCRR Part 360-2, effective October 31, 1988 (Designs A and B). The third design was determined to be relevant and appropriate under the October 9, 1993, version of the same regulation. Design A (as discussed previously) consists primarily of multilayers of natural materials. Design B is similar to that of Design A with one exception: the low-permeability soil cover is replaced with a 40-mil (minimum) geomembrane liner (FML). Both of these designs provide essentially the same level of effectiveness, require the same installation time, and would fulfill the minimum requirements for cap durability (30 years). Design C is a composite cap that uses both the low-permeability soil cover and the 40-mil very low-density polyethylene (VLDPE) liner (or 60-mil high-density polyethylene [HDPE] liner). Design C would provide a higher level of effectiveness than the other two designs, and is expected to have a longer lifetime. This design would require slightly more time to install than Designs A and B.

All three municipal cap designs would satisfy the requirements for capping of the northeast fill area. Therefore, a cost analysis was conducted on each of the cap alternatives to identify the lowest-cost alternative. The cost evaluations were based on vendor quotes and appropriate reference materials. For the purposes of this analysis, the costs included only those associated with the purchase, transportation, and installation of materials. Quotes for natural materials were obtained from vendors within a 5- to 10-mile radius of the

Wellsville-Andover Landfill; these materials are readily available and meet the specifications identified in 6 NYCRR Part 360-2. Costs for the seeding/mulching of topsoil were not included because they are common to all three designs. A cost comparison of each of the three municipal cap designs is presented in Table 4-1.

Design B (geomembrane) will be selected for the northeast fill area cap based on cost-effectiveness. The cost is estimated to be approximately $26 per square yard (sq. yd.), and is significantly less than the costs associated with Designs A and B ($42 and $45/sq. yd., respectively). A cross section of this cap design is illustrated in Figure 3-1. The cap will have an approximate total thickness of 42 inches. This type of cap will consist of, from bottom to top:

- Foundation/gas venting layer consisting of 12 inches of coarse-grained material with a hydraulic conductivity of 1 x 10^{-2} cm/s and structurally capable of supporting the cap, or a layer of geosynthetic material having the same characteristics, with perforated venting pipes extending through the cover;
- Low hydraulic conductivity layer consisting of a 40-mil (minimum) VLDPE liner with a maximum hydraulic conductivity of 1 x 10^{-12} cm/s;
- Drainage layer consisting of 12 inches of soil with a minimum hydraulic conductivity of 1×10^{-2} cm/s, or a layer of geosynthetic material having the same characteristics, with a granular or geo-synthetic filter layer on top to prevent clogging; and
- Soil layer consisting of 18 inches of soil to support vegetation and protect the liner.

The flexible membrane liner (geomembrane) should be constructed of 40-mil (minimum) VLDPE; selection of a higher-rated FML (i.e. 60-mil HDPE or VLDPE) would improve impermeability characteristics with a minor increase in cost ($0.77/sq. yd., or a 3% increase). Therefore, this FS will assume that a 60-mil FML would be used for this alternative.

The northwest, south-central, and south cells of the Wellsville-Andover Landfill have been historically used for municipal and industrial solid waste disposal. These cells are considered to contain hazardous waste; therefore, each of these cells will be covered with a hazardous waste cap.

The hazardous waste cap design cross section is illustrated in Figure 3-2. The cap depth is approximately 72 inches and is comprised of the same layers as the Municipal Cap C design.

This cap would meet the performance standards for a RCRA Subtitle C final cover. This type of cap would consist of, from bottom to top:

- Foundation/gas venting layer as described for the municipal cap;
- Low hydraulic conductivity layer consisting of 24 inches of compacted soil with a hydraulic conductivity of 1×10^{-7} cm/s in direct contact with a 20-mil (minimum) geomembrane liner;
- Drainage layer as described for the municipal cap; and
- Soil layer consisting of 24 inches of soil to support vegetation and protect the low hydraulic conductivity layer.

The northwest fill area cap (and the other proposed caps) would extend 10 feet beyond the edge of the fill area. This will help ensure that all fill areas will be covered and that surface water will not infiltrate the soils immediately surrounding the fill areas. Thus, the northwest fill area cap would cover an area of approximately 17.6 acres. The south and south-central fill areas would also be capped with a hazardous waste cap as described above. Because these two cells do not show any geophysical indications of being separate and distinct from each other, they will be capped with one continuous cap covering an area of approximately 19.1 acres (hereinafter referred to as the south/south-central fill area).

Capping Methodology

The methodology presented below is based on the hazardous waste cap. The methodology for the municipal cap construction is very similar to that of the hazardous waste cap.

The cells and surrounding areas would first be cleared and grubbed to remove trees and brush. Haul roads would be constructed to allow access to the fill areas for construction of the cap and related systems. Roads would also be constructed to facilitate vehicular travel around each of the finished cap areas and other important system components such as leachate collection pipe clean-outs and surface water detention ponds. The edges of the cells would then be reshaped to allow for uncomplicated capping of geometric shapes. This would include minor consolidation activities within the cells.

An improved leachate collection system would then be installed in and around the cells. The improved system would be designed to incorporate as many portions of the existing system that are deemed to be advantageous. Leachate collection pipes would be installed at the bottom of the fill in trenches and surrounded with granular material. Leachate collection pipes would also be installed around the downgradient sides of each fill area and would have adequate clean-outs and inspection ports. All leachate collected would be directed to an improved holding tank/pond system by gravity flow, where possible, and by a centralized pump station for leachate collected from the southern portion of the site. The soils around the leachate collection pump and Pump Station 2 that have been contaminated by leachate overflows would be excavated and placed on the fill prior to capping.

The foundation/gas venting layer would then be placed over the fill areas. Because seeps have been found in the existing soil cover and have therefore contaminated the surface soils, the existing cover would be left in place as part of the foundation layer. The foundation/gas venting layer would be placed and compacted in 6-inch lifts. The final shape of this layer would be the same as the final design shape. A geosynthetic filter layer would be placed on top of the gas venting layer to prevent clogging from the layer above. The LFG would be vented passively through a system of vents placed over the waste areas at a distribution of one vent per acre as required for sanitary landfills (the fill is largely municipal in nature). Perimeter LFG venting systems would also be installed. These would consist of gravel-filled trenches (covered by the cap to prevent infiltration) venting to the atmosphere. The depth of the trenches would be to the approximate bottom of the fill and would have drains into the LCS. The sides of the trenches furthest from the fill would be lined with an impervious membrane to minimize lateral migration of LFG beyond the cap and prevent infiltration of water from adjacent areas into the fill.

COPC concentrations in the LFG would be measured at the perimeter of the site property after completion of the cover to determine if treatment is necessary to meet air standards. During the RI field activities, breathing zone air monitoring results did not indicate significant concentrations of contaminants that would have caused an upgrade in the level of protection. Therefore, it is assumed that once the cap and venting system is complete, breathing zone readings outside of the immediate area of a vent would meet air standards. If treatment is required, flaring systems would be added to some or all of the vents, as necessary, to meet the standards.

The low hydraulic conductivity layer (24 inches of compacted soil with a hydraulic conductivity of 1 x 10^{-7} cm/s in direct contact with a 20-mil geomembrane liner or 60-mil liner for the municipal cap) would then be placed over the gas venting layer. The soil would be placed and compacted in six-inch lifts. Compaction should be accomplished by a bulldozer or a sheepsfoot roller. Permeability and density testing would be conducted on each layer to assure proper construction. Natural material for this layer is readily available from at least three separate locations within 5 to 10 miles of the site. The 20-mil geomembrane would then be installed on top of the soil layer. The top of the soil layer would have to be smoothed (final surface compacted with a steel-wheeled roller) to allow for more complete direct contact between the soil and the liner than could be achieved from a surface compacted with a sheepsfoot roller.

The 12-inch soil drainage layer would be placed on top of the liner in two 6-inch lifts. This layer must be free of sharp objects that could damage the liner below. It must also be placed in such a manner that the liner is not damaged by the equipment used. A geosynthetic filter layer would be placed on top of the drainage layer to prevent clogging of the layer that may result from migration of soil particles from the layer above. A geosynthetic drainage layer could also be used as is discussed further below.

The drainage layer would be covered by a 24-inch-thick soil layer (18 inches thick for the municipal cap) that would support vegetation and protect the layers below. This layer would be placed in lifts 8 to 12 inches thick. Uncontaminated soils from the site property could be used for the lower portion of this layer. The upper portion would consist of topsoil from an off-site source. The surface of the cap would be shaped to manage surface water infiltration and runoff while controlling erosion. This layer would be planted with a low-maintenance grassy vegetation native to the area. Mulching and fertilization would also be conducted to promote growth. This work would be conducted as soon as possible after completion of topsoil placement to minimize drying and erosion of soils.

The thickness of this layer and the 12-inch drainage layer will provide 36 inches of protection for the low hydraulic conductivity soil layer from the effects of freeze/thaw action. The liner materials proposed for both the municipal and hazardous waste caps are not expected to be adversely impacted by freeze/thaw action. The Village of Wellsville building department reported that the typical maximum frost depth for Wellsville was 30 inches. The 12-inch soil drainage layer and soil layer above it, as proposed for the hazardous waste cap, would provide adequate freeze/thaw protection. Therefore, a geosynthetic drainage layer will not be used for this cap. However, because no low hydraulic conductivity soil layer is proposed for the municipal cap, a geosynthetic drainage layer could be used.

Surface water controls (e.g., ditches, dikes, and detention ponds) would be included in this alternative to minimize erosion and infiltration of the cap and to reduce the downstream impact of the increased runoff caused by the installation of the cap.

Placement of the cap and surface water controls will reduce infiltration; therefore, groundwater elevations are expected to decrease. This decrease in groundwater elevation will reduce the amount of fill in the northwest area that is in direct contact with groundwater, thereby reducing the amount of leachate produced. Whether groundwater elevations will fall completely below the northwestern fill cannot be determined at this time.

Annual inspections of the cap would be required; however, it is recommended that more frequent inspections be conducted during the first six months after completion of the cap because problems such as erosion, settlement, and/or subsidence are more likely to appear during this time frame. Proper and timely repair of any defects such as settling or erosion would be required to preserve the integrity of the cap. Maintenance of the cap would be limited to periodic mowing of the vegetation to prevent naturally occurring invasion by deep-rooted plants and/or burrowing animals.

Periodic air monitoring/sampling of the venting system and the air at the perimeter of the site may need to be conducted to assure that air standards are met. Periodic inspection of the leachate collection system would also be conducted to check for proper O & M.

4.1.2 Evaluation

4.1.2.1 Compliance with Applicable New York State Standards, Criteria, and Guidelines

The applicable chemical-specific SCGs for this alternative include the following:

- NYSDEC Class GA groundwater standards;
- NYSDEC Class C surface water standards for the leachate; and
- Air Guide-1 AGCs and SGCs for the LFG.

Compliance with the NYSDEC Class GA groundwater standards would be achieved through natural attenuation processes. Although NYSDEC Class C standards have been applied to the leachate, the receiving POTW is expected to treat the leachate in compliance with the POTW's SPDES permit effluent standards. LFG emissions are not expected to exceed applicable AGCs and SGCs; however, if air monitoring results indicate that treatment is required, flaring systems would be added, as necessary, to meet the standards.

This alternative complies with action-specific SCGs applicable to this site. It incorporates a cap design consistent with 6 NYCRR Part 360 for the municipal cell (northeast cell) and a multilayer cap design consistent with 6 NYCRR Part 373 for the hazardous waste cells (northwest and south/south-central cells). The leachate would be pretreated on site if required by the receiving POTW.

Because several federal wetlands were identified within a 2-mile radius of the site, Executive Order 11990, which requires action to minimize the destruction, loss, or degradation of wetlands, is applicable to the site. It is expected that actions would be taken during implementation of this alternative to ensure compliance with this SGC.

4.1.2.2 Overall Protection of Human Health and the Environment

This alternative would prevent exposure to the fill materials and significantly reduce release of contaminants to the groundwater by limiting infiltration of water through the fill. The potential for further groundwater flow through the northwest fill area would still exist for some time. However, the groundwater table in this area is expected to be lowered as a result of the placement of a cap over the fill. This alternative is expected to significantly reduce further contamination of the groundwater. Because infiltration would be minimized, the production of leachate would also be significantly reduced, thereby reducing the potential for uncontrolled releases from the leachate collection system to the surrounding areas and surface waters. Based on RI data, COPC concentrations at the perimeter of the site property are expected to meet air standards once the cap is in place. However, if it is determined that treatment is required, flaring systems would have to be added to some or all of the vents, as necessary, to meet the standards.

4.1.2.3 Short-Term Impacts and Effectiveness

During the construction of the cap and related facilities, dust production, noise, significantly increased truck traffic, and potential increases in VOC emissions are the expected short-term impacts to the surrounding community and environment. Dust production and VOC emissions would be controlled effectively through the use of common dust-control techniques such as water spray or foam. Work hours, equipment exhaust mufflers, and truck routes could be controlled to minimize the impacts caused by the noise of the equipment and the increased truck traffic necessary to complete this work.

4.1.2.4 Long-Term Effectiveness and Permanence

This proposed alternative would remain effective over the long term, provided that proper inspections, monitoring, and repair actions are conducted. The caps would have to be inspected annually to check for signs of erosion, settlement, or other obvious signs of damage. The LFG system would also require inspection and monitoring to ensure that air standards are met. The LCS would also be inspected/monitored on a more frequent basis, at least initially, to determine the impact of the caps and LCSs on the rate of leachate collection and to note any variations. The rate of trucking required to adequately handle the leachate collected would also be determined from these records. The effectiveness of the LCS is highly dependent on the disposal of adequate amounts of leachate such that the leachate holding pond/tanks are not breached by excess leachate.

Each of these systems would require periodic maintenance. The caps would have to be mowed and the LCS flushed/cleaned to ensure proper operation. The maintenance of the passive LFG system would be minimal.

4.1.2.5 Reduction of Toxicity, Mobility, and Volume

The toxicity and volume of the fill contaminants would not be reduced under this alternative. The mobility of the fill contaminants may be slightly reduced from current levels because of the proposed increase in cover depth over the fill. The mobility of the LFG would be increased and controlled through the venting systems. The toxicity of the LFG is not expected to be reduced. However, the volume of the LFG is expected to decline over time because the moisture content of the fill material will eventually be significantly reduced by elimination of infiltration. The toxicity of the leachate may increase under this alternative because dilution by infiltration and groundwater would be minimized. However, this would also significantly reduce the volume of leachate generated and the mobility of the leachate would be more effectively controlled by the proposed LCS. The toxicity and volume of groundwater contamination is expected to lessen over time because of source control (i.e., capping and effective leachate collection) and natural attenuation. The mobility of the contaminated groundwater is not expected to be impacted by this alternative. Residential users of the groundwater in the area would be protected from contamination by regular sampling of warning wells (i.e., existing monitoring wells and residential wells/springs) and installation of residential water treatment systems, if necessary.

4.1.2.6 Implementability

The technical components of this alternative are well demonstrated. Some work within the fill material is expected to require level B personal protection for workers. However, the techniques, materials, and labor necessary for the implementation of this alternative are readily available and have been widely used at similar sites.

The possibility of having to undertake future remedial actions is minimal, except in the case of groundwater use. It is possible, under this alternative, that existing drinking water wells/springs in the area and path of the contaminated groundwater originating from the site may become contaminated above drinking water standards. Regular sampling and analysis of the residential wells/springs and monitoring wells would be used to provide an indication of whether residential water treatment systems are warranted for individual residences. The approach presented is cost-effective because groundwater monitoring would be required as part of the long-term monitoring of the caps, regardless of the potential for residences being impacted by the contaminated groundwater.

4.1.2.7 Cost

The cost estimates for this FS were developed from published estimating sources (Means 1993), vendor quotes, past project bid results, and engineering judgment. Total estimated capital costs for this alternative are approximately $16.7 million and are detailed in Table 4-2. This includes $4.5 million (approximately 27% of the total cost) for the low hydraulic conductivity soil (clay) layer and $1.9 million (15%) for contingencies.

Annual costs for O&M of this alternative are estimated to be approximately $155,000 per year for 30 years. This includes approximately $72,000 for groundwater monitoring, $30,000 for leachate hauling and disposal, and 10% for contingencies (see Table 4-3). The present worth of these annual costs is approximately $2.1 million. This was calculated using a discount rate of 6%, which is approximately the current 30-year treasury bond rate.

The total estimated cost for this alternative is approximately $18.9 million.

4.2 ALTERNATIVE B - CAPPING WITH CONSOLIDATION

4.2.1 Description

This alternative is the same as the previous alternative, except for the consolidation of the northwest fill area with the south/south-central fill area prior to capping (see Figure 4-2 in back pocket). All other aspects of this alternative are similar. Therefore, only the differences from the previous alternative will be described here.

The consolidation proposed as part of this alternative would entail moving the northwest fill and placing it on the south/south-central fill area. The northwest fill area is believed to be partially submerged in the current groundwater table. Therefore, removing this fill and consolidating it with other fill areas is desirable because this would reduce direct contact between the fill and the groundwater. Consolidation of these areas would also reduce the area requiring a hazardous waste cap by approximately half.

Because of agitation during moving of the fill, the current northwest fill volume of 150,000 cubic yards is expected to increase an estimated 10% after moving and compaction activities.

6 NYCRR Part 360 regulations limit landfill side slopes to a maximum slope of 33% so that slope failure is less likely to occur. Therefore, this FS assumes conservatively that the cap side slopes will not exceed 25% grade. Calculations of the height of the fill were performed assuming a base equal to the area of the south/south-central fill area, top slope grades of 5%, and side slope grades of 25%. Placement of the northwest fill on the south/south-central fill would result in a height increase of approximately 12 feet. Placing the RCRA cap on top of this would result in a net height increase of 18 feet over existing elevations. Heavy equipment needed to move fill would include excavators, bull dozers, and dump trucks.

Consolidation Methodology

The areas that would receive the excavated fill would be cleared and grubbed prior to transferring the fill. The slopes and footprint of the current areas would be reshaped to allow for an uncomplicated geometric shape to cap. This would include minor consolidation activities within the south/south-central fill area.

Because the northwest fill is saturated with water, ditches and/or lined staging areas may need to be constructed around the perimeters of the fill areas to ensure that contaminated water does not run off the site as surface water. Liquids collected in these ditches and/or staging areas would be disposed of in the leachate collection system.

The leachate collection system of the south/south-central fill area would be improved prior to consolidation. Leachate collection pipes would be installed at the bottom of the fill in trenches and surrounded with granular material as previously described.

To facilitate easy access and egress of the dump trucks carrying fill, haul roads would be constructed on site. After the haul roads are completed, equipment mobilized, and the improved leachate collection system installed, consolidation activities would begin. The fill would be moved in sections. First, the existing soil cover on the northwest fill area would be removed from a section and staged to be used as daily cover over the consolidated fill. An excavator would then transfer fill to a dump truck or lined staging area for dewatering. Excavation would proceed in a north-to-south direction and would extend down to at least one foot of soil below the bottom of the fill. Full trucks would be driven via the haul road to the consolidation area where the fill would be dumped; the truck would then be returned to the fill area for refilling. After removal of the fill and bottom soil, the newly exposed bottom soil would be tested to ensure compliance with cleanup requirements. If cleanup goals have not been met, additional soil would be excavated and consolidated with the fill on the south/south-central fill area. This procedure would continue, as necessary, until testing shows that soil cleanup goals have been met. At the end of a work day, the stored daily cover and/or foam would be used to cover the exposed fill of both the removal and consolidation areas to minimize release of LFG.

Spray foam may be needed to suppress the volatilization of contaminants from the exposed fill during excavation activities. Volatilization in sufficient concentration and volume would pose a threat to human health and the environment in the immediate area of excavation. It is estimated that at a minimum, the excavator and bull dozer operators would need to wear level B protection given their constant proximity to exposed fill. These conditions are estimated to decrease normal production rates of excavation by approximately 20%. In addition, a continuous monitoring program would be necessary to ensure the safety of the dump truck operators, other support personnel, and the general public.

After completion of consolidation activities, the former northwest fill area would be partially or completely backfilled (depending on soils available on the property) and graded to ensure storm water control and prevent ponding of water near the landfill.

Construction of the landfill cap over the consolidated fill could begin as soon as significant portions of the fill are placed at their final grades. The cap would be constructed as described for the previous alternative.

Once the cap and venting system is complete, it is assumed that breathing zone readings outside of the immediate area of a vent would meet air standards. If treatment is determined to be required, flaring systems would be added to some or all of the vents, as necessary, to meet the standards.

4.2.2 Evaluation

4.2.2.1 Compliance with Applicable New York State Standards, Criteria, and Guidelines

The applicable chemical-specific SGCs for this alternative include the following:

- NYSDEC recommended soil cleanup objectives for soil remaining in the northwest fill area;
- NYSDEC Class GA groundwater standards;
- NYSDEC Class C surface water standards for the leachate; and
- Air Guide-1 AGCs and SGCs for the LFG.

Compliance with NYSDEC-recommended soil cleanup objectives would be ensured by excavating all underlying soils from the northwest fill area that have COPC concentrations exceeding the cleanup objectives. Compliance with the NYSDEC Class GA groundwater standards would be achieved through natural attenuation processes. Although NYSDEC Class C standards have been applied to the leachate, the receiving POTW is expected to treat the leachate in compliance with the POTW's SPDES permit effluent standards. LFG emissions are not expected to exceed applicable AGCs and SGCs; however, if air monitoring results indicate that treatment is required, flaring systems would be added, as necessary, to meet the standards.

This alternative complies with action-specific SGCs applicable to this site. It incorporates a cap design consistent with 6 NYCRR Part 360 for the municipal cell (northeast cell) and a multilayer cap design consistent with 6 NYCRR Part 373 for the hazardous waste cells (northwest and south/south-central cells). The leachate would be pretreated on site if required by the receiving POTW. Engineering controls would be employed to suppress volatilization of contaminants during excavation and consolidation activities so that AGCs and SGCs would not be exceeded.

Because several federal wetlands were identified within a 2-mile radius of the site, Executive Order 11990, which requires action to minimize the destruction, loss, or degradation of wetlands, is applicable to the site. It is expected that actions would be taken during implementation of this alternative to ensure compliance with this SGC.

4.2.2.2 Overall Protection of Human Health and the Environment

This alternative would prevent exposure to the fill materials and significantly reduce release of contaminants to the groundwater by limiting infiltration of water through the fill. The potential for further groundwater flow through the northwest fill area would be eliminated through consolidation. This alternative is expected to significantly reduce further contamination of the groundwater. Because infiltration would be minimized, the production of leachate would also be significantly reduced, thereby reducing the potential for uncontrolled releases from the leachate collection system to the surrounding areas and surface waters. Based on RI data, COPC concentrations at the perimeter of the site are expected to meet air standards once the cap is in place. However, if treatment is determined to be required, flaring systems would have to be added to some or all of the vents, as necessary, to meet the standards.

4.2.2.3 Short-Term Impacts and Effectiveness

During the construction of the cap and related facilities, dust production, noise, significantly increased truck traffic, and increases in VOC emissions, especially during consolidation activities, are the expected short-term impacts to the surrounding community and environment. Dust production and VOC emissions would be controlled through the use of common dust-control techniques such as water spray and foam. The control of VOC emissions would require significant effort during consolidation. This would be done through the use of foam suppressants and by limiting the area of fill exposed at all times. Consolidation activities will pose prolonged health risks to workers because of the hazardous environment created (i.e., release of hazardous vapors) and the physical restraints of working in level B protection. Work hours, equipment exhaust mufflers, and truck routes could be controlled to minimize the impacts caused by the noise of the equipment and the increased truck traffic necessary to complete this work.

4.2.2.4 Long-Term Effectiveness and Permanence

This proposed alternative would remain effective over the long term, provided that proper inspections, monitoring, and repair actions are conducted as discussed for the previous alternative.

4.2.2.5 Reduction of Toxicity, Mobility, and Volume

The toxicity and volume of the fill contaminants would not be reduced under this alternative. The mobility of the fill contaminants may be slightly reduced from current levels because of the proposed increase in cover depth over the fill. The mobility of the LFG would be increased and controlled through the venting systems, but the toxicity of the LFG is not expected to be reduced. The volume of the LFG is expected to decline over time because the moisture content of the fill material will eventually be significantly reduced by elimination of infiltration. The toxicity of the leachate may increase under this alternative because dilution by infiltration and groundwater would be virtually eliminated. However, this would also significantly reduce the volume of leachate generated, and the mobility of the leachate would be more effectively controlled by the proposed LCS. The toxicity and volume of groundwater contamination is expected to lessen over time because of source control (i.e., capping, effective leachate collection, and removal of fill from below the water table) and natural attenuation. The mobility of the contaminated groundwater is not expected to be impacted by this alternative. Residential users of the groundwater in the area would be protected from contamination by regular sampling of wells and installation of residential water treatment systems, if necessary.

4.2.2.6 Implementability

The technical components of this alternative are well demonstrated. Consolidation work is expected to require level B personal protection for workers and careful monitoring to ensure protection of the community. However, the techniques, materials, and labor necessary for the implementation of this alternative are readily available and have been widely used at similar sites.

The possibility of having to undertake future remedial actions is the same as discussed for the previous alternative.

4.2.2.7 Cost

Total estimated capital costs for this alternative are approximately $14.5 million and are detailed in Table 4-4. This includes $2.3 million (approximately 16% of the total cost) for the low hydraulic conductivity soil (clay) layer, $1.7 million for consolidation (approximately 12% of the total cost), and $2.1 million (20%) for contingencies.

Annual costs for O&M of this alternative are estimated to be approximately $144,000 per year for 30 years. This includes the same costs for groundwater monitoring and leachate hauling and disposal as the previous alternative. However, the cap maintenance costs are expected to be less (see Table 4-5). The present worth of these annual costs is approximately $2 million. This was calculated using a discount rate of 6%, which is approximately the current 30-year treasury bond rate.

The total estimated cost for this alternative is approximately $16.4 million.

4.3 COMPARATIVE ANALYSIS OF ALTERNATIVES

A comparative analysis of the two alternatives is provided in this section. This analysis centers on the differences between the alternatives as they relate to the criteria used above to evaluate them.

4.3.1 Compliance with Applicable New York State Standards, Criteria, and Guidelines

Both alternatives analyzed above are expected to meet SCGs.

4.3.2 Overall Protection of Human Health and the Environment

Both Alternative A and Alternative B would prevent exposure to the fill materials and significantly reduce release of contaminants to the groundwater by limiting infiltration of water through the fill. Groundwater contamination due to direct contact of groundwater with the northwestern fill would be eliminated by Alternative B. Whether this contamination pathway would be completely eliminated by Alternative A is unknown; however, it is likely that it would be significantly reduced. Although Alternative B is more likely to result in greater mitigation of long-term impacts to human health and the environment, short-term risks resulting from consolidation activities are considered to be greater than the short-term risks posed by Alternative A.

4.3.3 Short-Term Impacts and Effectiveness

Alternative B is expected to have greater short-term impacts because of consolidation activities. However, the expected truck traffic through the local area would be less than that of Alternative A because the area to be capped would be smaller, therefore requiring fewer off-site materials.

4.3.4 Long-Term Effectiveness and Permanence

Both alternatives are expected to remain effective over the long term, provided that proper inspections, monitoring, and repair actions are conducted.

4.3.5 Reduction of Toxicity, Mobility, and Volume

Both alternatives provide for a similar reduction in the volume of LFG and leachate generated and reduction (or control) of the mobility of the leachate. The mobility of the contaminated groundwater is not expected to be impacted by either alternative. The volume of groundwater contaminated is expected to be less under Alternative B because of consolidation of the northwest fill area.

4.3.6 Implementability

The implementation of Alternative B is expected to be more difficult than that of Alternative A because Alternative B consolidation work is expected to require level B personal protection for workers and careful monitoring to ensure protection of the community.

4.3.7 Cost

The estimated total capital costs for Alternatives A and B are $16.7 million and $14.5 million, respectively. The difference in these costs is primarily due to the reduction in area being capped under Alternative B.

Estimated annual costs for O&M for Alternatives A and B are $155,000 and $144,000, respectively, for 30 years. The difference in these costs is due to the reduced maintenance associated with the reduced cap area under Alternative B. The present worth of these annual costs is approximately the same for the two alternatives ($2.1 million versus $2.0 million).

The estimated total cost for Alternatives A and B are approximately $18.9 million and $16.4 million, respectively. The difference in these costs is due almost entirely to the difference in capital costs for Alternatives A and B, which is $2.5 million.

The estimated capital costs for Alternative B are less certain than for Alternative A because of the additional complexity associated with the full-scale consolidation of the northwest fill area. A contingency amount of 20% for Alternative B and 15% for Alternative A was used to account for this.

Table 4-1

COST COMPARISON OF MUNICIPAL LANDFILL CAP DESIGNS
WELLSVILLE-ANDOVER LANDFILL
(in dollars)

Cap Component	Municipal Cap A (soil barrier)	Municipal Cap B (geomembrane)	Municipal Cap C (composite)
Gas Vent Layer	7.00/SY	7.00/SY	7.00/SY
Filter Fabric	1.67/SY	1.67/SY	1.67/SY
Low-Permeability Soil Barrier and/or Geomembrane	18.82/SY	3.15/SY	21.97/SY
Drainage Layer	7.00/SY	7.00/SY	7.00/SY
Filter Fabric	1.67/SY	1.67/SY	1.67/SY
Cover Soil Layer	5.45/SY	5.45/SY	5.45/SY
Component Total	41.61/SY	25.94/SY	44.76/SY

Key:

SY = Square yard.

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Table 4-2

Alternative A: Cap Without Consolidation
Summary of Capital Costs

Description	Quantity	Unit	Unit Cost	Cost
mobe/demobe (~4% of the capital subtotal)	1	ls	$494,270.00	$494,270
site services	12	month	$35,000.00	$420,000
health and safety	275	day	$700.00	$192,500
health and safety (Level B)	90	day	$1,800.00	$162,000
access roads	9,200	sy	$3.60	$33,120
clearing/grubbing	8	acre	$1,200.00	$9,600
Northeast area:				
cut and fill	8,000	cy	$5.00	$40,000
improve leachate collection system	2,100	lf	$26.50	$55,650
filter fabric	39,600	sy	$2.20	$87,120
12" sand-gas venting layer	39,600	sy	$7.00	$277,200
60-mil F.M.L.	39,600	sy	$4.10	$162,360
geotextile filter fabric w/netting	39,600	sy	$4.30	$170,280
18" cover soil layer	39,600	sy	$5.45	$215,820
seeding, mulch	43,500	sy	$0.80	$34,800
Northwest area:				
cut and fill	38,000	cy	$5.00	$190,000
improve leachate collection system	6,900	lf	$19.60	$135,240
filter fabric	85,400	sy	$2.20	$187,880
12" sand-gas venting layer	85,400	sy	$7.00	$597,800
filter fabric	85,400	sy	$2.20	$187,880
24" clay layer	85,400	sy	$25.20	$2,152,080
20-mil F.M.L.	85,400	sy	$2.40	$204,960
12" sand-drainage layer	85,400	sy	$7.00	$597,800
filter fabric	85,400	sy	$2.20	$187,880
24" cover soil layer	85,400	sy	$6.20	$529,480
seeding, mulch	94,000	sy	$0.80	$75,200
construct detention pond	1	ea	$5,000.00	$5,000
South-Central/South area:				
cut and fill	19,000	cy	$5.00	$95,000
improve leachate collection system	7,200	lf	$26.00	$187,200
filter fabric	92,500	sy	$2.20	$203,500
12" sand-gas venting layer	92,500	sy	$7.00	$647,500
filter fabric	92,500	sy	$2.20	$203,500
24" clay layer	92,500	sy	$25.20	$2,331,000
20-mil F.M.L.	92,500	sy	$2.40	$222,000
12" sand-drainage layer	92,500	sy	$7.00	$647,500
filter fabric	92,500	sy	$2.20	$203,500
24" cover soil layer	92,500	sy	$6.20	$573,500
seeding, mulch	100,000	sy	$0.80	$80,000
construct detention ponds	2	ea	$3,000.00	$6,000
construct new leachate pond	1	ls	$35,000.00	$35,000
install new pump station	1	ls	$10,000.00	$10,000
Air monitoring/sampling program	1	ls	$10,000.00	$10,000
SUBTOTAL CAPITAL				$12,861,120
15% Legal, Administrative, & Engineering Fees-				$1,929,168
15% Contingencies-				$1,929,168
TOTAL CAPITAL COSTS				$16,719,456
O&M NET PRESENT WORTH (see Table 4-3)				$2,131,828
GRAND TOTAL COST - ALTERNATIVE A				$18,851,284

Table 4-3

Alternative A: Cap Without Consolidation
Operation and Maintenance Costs

interest rate (%) 6
operation and maintenance (years) 30

Description	Quantity/Yr.	Units	Unit Cost	Annual Cost
Leachate hauling & disposal-POTW (R.T. 15 miles)	100	truck	$300.00	$30,000
Groundwater monitoring:				
monitoring well sample collection	50	ea	$125.00	$6,250
monitoring well sample analysis	50	ea	$750.00	$37,500
residential sample collection	20	ea	$125.00	$2,500
residential sample analysis	20	ea	$750.00	$15,000
data validation/report	140	ea	$75.00	$10,500
Maintenance				
Cap	1	ls	$8,000.00	$8,000
Venting System	1	ls	$2,500.00	$2,500
Leachate Collection System	1	ls	$15,000.00	$15,000
Miscellaneous	1	ls	$3,000.00	$3,000
Pump Station	1	ls	$1,000.00	$1,000
SUBTOTAL O&M				$131,250
8% Legal, Administrative, & Engineering Fees-				$10,500
10% Contingencies-				$13,125
TOTAL ANNUAL O&M COSTS				$154,875
TOTAL O&M PRESENT WORTH				$2,131,828

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Table 4-4

Alternative B: Cap With Consolidation
Summary of Capital Costs

Description	Quantity	Units	Unit Cost	Cost
mobe/demobe (~4% of the capital subtotal)	1	ls	$409,520.00	$409,520
site services	12	month	$35,000.00	$420,000
health and safety	275	day	$700.00	$192,500
health and safety (Level B)	90	day	$1,800.00	$162,000
access roads	9,200	sy	$3.60	$33,120
clearing/grubbing	8	acre	$1,200.00	$9,600
Consolidation:				
moving fill/soil cover	470,000	cy	$3.70	$1,739,000
sampling of bottom soils	320	sample	$750.00	$240,000
common earth backfill/grading	77,400	cy	$7.90	$611,460
topsoil/grading	12,900	cy	$24.10	$310,890
seeding, mulching	100,000	sy	$0.80	$80,000
Northeast area:				
cut and fill	8,000	cy	$5.00	$40,000
improve leachate collection system	2,100	lf	$26.50	$55,650
filter fabric	39,600	sy	$2.20	$87,120
12" sand-gas venting layer	39,600	sy	$7.00	$277,200
60-mil F.M.L.	39,600	sy	$4.10	$162,360
geotextile filter fabric w/netting	39,600	sy	$4.30	$170,280
18" cover soil layer	39,600	sy	$5.50	$217,800
seeding, mulch	43,500	sy	$0.80	$34,800
South-Central/South area:				
cut and fill	19,000	cy	$5.00	$95,000
improve leachate collection system	7,200	lf	$26.00	$187,200
filter fabric	92,500	sy	$2.20	$203,500
12" sand-gas venting layer	92,500	sy	$7.00	$647,500
filter fabric	92,500	sy	$2.20	$203,500
24" clay layer	92,500	sy	$25.20	$2,331,000
20-mil F.M.L.	92,500	sy	$2.40	$222,000
12" sand-drainage layer	92,500	sy	$7.00	$647,500
filter fabric	92,500	sy	$2.20	$203,500
24" cover soil layer	92,500	sy	$6.20	$573,500
seeding, mulch	100,000	sy	$0.80	$80,000
construct detention ponds	2	ea	$3,000.00	$6,000
construct new leachate pond	1	ls	$35,000.00	$35,000
install new pump station	1	ls	$10,000.00	$10,000
Air monitoring/sampling program	1	ls	$10,000.00	$10,000
SUBTOTAL CAPITAL				$10,708,500
15% Legal, Administrative, & Engineering Fees-				$1,606,275
20% Contingencies-				$2,141,700
TOTAL CAPITAL COSTS				$14,456,475
O&M NET PRESENT WORTH (see Table 4-5)				$1,985,646
GRAND TOTAL COST - ALTERNATIVE B				$16,442,121

Table 4-5

Alternative B: Cap With Consolidation
Operation and Maintenance Costs

interest rate (%) 6
operation and maintenance (years) 30

Description	Quantity/Yr	Units	Unit Cost	Annual Cost
Leachate hauling & disposal-POTW (R.T. 15 miles)	100	truck	$300.00	$30,000
Groundwater monitoring:				
monitoring well sample collection	50	ea	$125.00	$6,250
monitoring well sample analysis	50	ea	$750.00	$37,500
residential sample collection	20	ea	$125.00	$2,500
residential sample analysis	20	ea	$750.00	$15,000
data validation/report	140	ea	$75.00	$10,500
Cap maintenance				
Cap repair	1	ls	$6,000.00	$6,000
Venting System	1	ls	$1,500.00	$1,500
Leachate collection system	1	ls	$10,000.00	$10,000
Miscellaneous	1	ls	$2,000.00	$2,000
Pump Station	1	ls	$1,000.00	$1,000
SUBTOTAL O&M				$122,250
8% Legal, Administrative, & Engineering Fees-				$9,780
10% Contingencies-				$12,225
TOTAL O&M COSTS				$144,255
TOTAL O&M PRESENT WORTH				$1,985,646

5. RECOMMENDATIONS

Section 4 illustrates that both Alternatives A and B will provide adequate protection of human health and the environment and meet SGCs (ARARs). Each alternative has advantages and disadvantages. Alternative A will have fewer short-term risks but may not reduce the groundwater table low enough to eliminate contact with the fill. Alternative B will eliminate contact between the fill and the groundwater, but will pose more short-term risks than Alternative A. The difference in estimated total present worth cost for these alternatives is approximately $2.5 million (14%). Alternative B is less expensive than Alternative A. There is greater uncertainty associated with the estimated cost for Alternative B due to the complexity and uncertainty involved with consolidation. However, this uncertainty is accounted for by a higher allowance for contingencies in the cost estimate for Alternative B.

E & E believes that either alternative is equally appropriate for this site. Alternative A is estimated to cost more than Alternative B, but Alternative A poses fewer short-term risks than Alternative B. The installation of an impermeable cover over the fill areas will reduce the level of the groundwater table. Whether the level will drop far enough to prevent the fill from coming into contact with the groundwater is unknown. However, the proposed improvements to the leachate collection system should significantly reduce the amount of any contamination leaching into the groundwater. Therefore, the long-term risks associated with Alternative A are expected to only be slightly greater than those associated with Alternative B. NYSDEC must determine whether the estimated cost savings of $2.5 million for Alternative B is worth the increased short-term risks involved with major consolidation operations and the slightly fewer long-term risks associated with the certainty that groundwater will not come into contact with fill material. The appropriate alternative for this site will be selected based on this decision.

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APPENDIX A

POTENTIAL FEDERAL ARARs
LOCATION-SPECIFIC AND ACTION-SPECIFIC

(From: *Conducting Remedial Investigation/Feasibility Studies for CERCLA Municipal Landfill Sites*, EPA 1991)

Table 5-2
POTENTIAL FEDERAL LOCATION-SPECIFIC ARARs AT MUNICIPAL LANDFILL SITES

	Location	Requirement	Prerequisite(s)	Citation	Comments
1.	Within 61 meters (200 feet) of a fault displaced in Holocene time	New treatment, storage, or disposal of hazardous waste prohibited.	RCRA hazardous waste; PCB treatment, storage, or disposal.	40 CFR 264.18(a)	Counties considered seismically active listed in 40 CFR 264 Appendix VI.
2.	Within 100-year floodplain	Facility must be designed, constructed, operated, and maintained to avoid washout.	RCRA hazardous waste; PCB treatment, storage, or disposal.	40 CFR 264.18(b); 40 CFR 761.75	Applicable if part of the landfill is in the 100-year floodplain.
3.	Within floodplain	Action to avoid adverse effects, minimize potential harm, restore and preserve natural and beneficial values of the floodplain.	Action that will occur in a floodplain, i.e., lowlands, and relatively flat areas adjoining inland and coastal waters and other flood-prone areas.	Executive Order 11988, Protection of Floodplains, (40 CFR 6, Appendix A)	Applicable if part of the landfill is in the 100-year floodplain.
4.	Within salt dome formation, underground mine, or cave	Placement of noncontainerized or bulk liquid hazardous waste prohibited.	RCRA hazardous waste; placement.	40 CFR 264.18(c)	Need to verify that the site does not contain any salt dome formations, underground mines, or caves used for waste disposal.
5.	Critical habitat upon which endangered species or threatened species depends	Action to conserve endangered species or threatened species, including consultation with the Department of the Interior.	Determination of endangered species or threatened species.	Endangered Species Act of 1973 (16 USC 1531 et seq.); 50 CFR Part 200, 50 CFR Part 402	Need to identify whether any endangered species are known to exist on the site. May apply in rural areas.
6.	Wetland	Action to minimize the destruction, loss, or degradation of wetlands. Action to prohibit discharge of dredged or fill material into wetland without permit.	Wetland as defined by Executive Order 11990 Section 7.	Executive Order 11990, Protection of Wetlands, (40 CFR 6, Appendix A) Clean Water Act Section 404; 40 CFR Parts 230, 231	Applicable if wetlands are present next to or on the site.
7.	Wilderness area	Area must be administered in such a manner as will leave it unimpaired as wilderness and to preserve its wilderness character.	Federally owned area designated as wilderness area.	Wilderness Act (16 USC 1131 et seq.); 50 CFR 35.1 et seq.	Need to verify that the site is not within a Federal Wilderness Area.
8.	Wildlife refuge	Only actions allowed under the provisions of 16 USC Section 668 dd(c) may be undertaken in areas that are part of the National Wildlife Refuge System.	Area designated as part of National Wildlife Refuge System.	16 USC 668 dd et seq.; 50 CFR Part 27	Need to verify that the site is not within a National Wildlife Refuge.

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Table 5-2
POTENTIAL FEDERAL LOCATION-SPECIFIC ARARs AT MUNICIPAL LANDFILL SITES

	Location	Requirement	Prerequisite(s)	Citation	Comments
9.	Area affecting stream or river	Action to protect fish or wildlife.	Diversion, channeling, or other activity that modifies a stream or river and affects fish or wildlife.	Fish and Wildlife Coordination Act (16 USC 661 et seq.); 40 CFR 6.302	The Fish and Wildlife Coordination Act requires consultation with the Department of Fish and Wildlife prior to any action that would alter a body of water of the United States.
10.	Within area affecting national wild, scenic, or recreational river	Avoid taking or assisting in action that will have direct adverse effect on scenic river.	Activities that affect or may affect any of the rivers specified in Section 1276(a).	Scenic Rivers Act (16 USC 1271 et seq. Section 7(a); 40 CFR 6.302(e)	Need to verify that national wild or scenic rivers are not located on the site and will not be affected by site remediation.
11.	Within coastal zone	Conduct activities in manner consistent with approved state management programs.	Activities affecting the coastal zone including lands thereunder and adjacent shorelands.	Coastal Zone Management Act (16 USC Section 1451 et seq.)	Applicable if the site has direct access to coastal areas.
12.	Oceans or waters of the United States	Action to dispose of dredge and fill material into ocean waters is prohibited without a permit.	Oceans and waters of the United States.	Clean Water Act Section 404, 40 CFR 125 Subpart M; Marine Protection Resources and Sanctuary Act Section 103	Applicable if disposal of dredge and fill material in ocean waters is planned.
13.	Within area where action may cause irreparable harm, loss, or destruction of significant artifacts	Action to recover and preserve artifacts.	Alteratin of terrain that threatens significant scientific, prehistorical, historical, or archaeological data.	National Archaeological and Historical Preservation Act (16 USC Section 469); 36 CFR Part 65	Should scientific, prehistorical, or historical artifacts be found at the site, this will become applicable.
14.	Historic project owned or controlled by federal agency	Action to preserve historic properties; planning of action to minimize harm to National Historic Landmarks.	Property included in or eligible for the National Register of Historic Places.	National Historic Preservation Act Section 106 (16 USC 470 et seq.); 36 CFR Part 800	Need to identify whether the site is included in the National Register of Historic Places.

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Table 5-3
POTENTIAL FEDERAL ACTION-SPECIFIC ARARs FOR MUNICIPAL LANDFILL SITES

Actions	Requirement	Prerequisites	Citation	Comments
Air Stripping	Design system to provide odor-free operation.		CAA Section 101[a]	Odor regulations are intended to limit nuisance conditions from air pollution emissions.
	File an Air Pollution Emission Notice (APEN) with the State to include estimation of emission rates for each pollutant expected.		40 CFR 52[a]	State will have particular interest in emissions for compounds on their hazardous, toxic, or odorous list. Preliminary meeting with state prior to filing APEN is recommended in the regulation. Meeting would identify additional issues of concern to the State.
	Include with filed APEN the following: • Modeled impact analysis of source emissions. • Provide a Best Available Control Technology (BACT) review for the source operation.	This additional work and information is normally applicable to sources meeting the "major" criteria and/or to sources proposed for nonattainment areas.	40 CFR 52[a]	State may identify further requirements for permit issuance after first review. These provisions follow the federal Prevention of Significant Deterioration (PSD) framework with some modifications. Additional requirements could include ambient monitoring and emission control equipment design revisions to match Lowest Achievable Emission Requirements (LAER). While a permit is not required for an onsite CERCLA action, the substantive requirements identified during the permitting process are applicable.
	Predict total emissions of volatile organic compounds (VOCs) to demonstrate emissions do not exceed 450 lb/hr, 3,000 lb/day, 10 gal/day, or allowable emission levels from similar sources using Reasonably Available Control Technology (RACT).	Source operation must be in an ozone nonattainment area.	40 CFR 52[a]	The control technology review for this regulation (RACT) could coincide with the BACT review suggested under the PSD program.
	Verify through emission estimates and dispersion modeling that hydrogen sulfide emissions do not create an ambient concentration greater than or equal to 0.10 ppm.		40 CFR 61[b]	
	Verify that emissions of mercury, vinyl chloride, and benzene do not exceed levels expected from sources in compliance with hazardous air pollution regulations.		40 CFR 61[a]	Regulation 8 indicates any source emitting the regulated compounds is subject to this regulation. However, some of the specific regulations further restrict the scope of applicability.
Capping	Placement of a cap over hazardous waste (e.g., closing a landfill, or closing a surface impoundment or waste pile as a landfill, or similar action) requires a cover designed and constructed to: • Provide long-term minimization of infiltration of liquids through the capped area. • Function with minimum maintenance. • Promote drainage and minimize erosion or abrasion of the cover. • Accommodate settling and subsidence so that the cover's integrity is maintained. • Have a permeability less than or equal to the permeability of any bottom liner system or natural subsoils present.	RCRA waste in landfill. Significant management (treatment, storage, or disposal) of hazardous waste will make requirements applicable; capping without disturbance will not make requirements applicable, but technical requirements may be relevant and appropriate.	40 CFR 264.228(a) (Surface Impoundments) 40 CFR 264.258(b) (Waste Piles) 40 CFR 264.310(a) (Landfills)	RCRA capping requirements could be relevant and appropriate to capping hazardous wastes in place. RCRA is generally considered relevant if it can be verified, through review of records, interviews, or other means, that the landfill accepted RCRA wastes after November 19, 1980. The appropriateness of RCRA requirements is based also on each requirement's technical merit in a given situation. If a groundwater containment problem exists, a RCRA cap would serve to isolate and contain landfill solids and contaminated soils and limit infiltration of precipitation. EPA guidance on RCRA caps for new RCRA landfill cells includes multibarrier caps of clay and liners. Excavation and reconsolidation of the wastes onsite, in a location outside of the current area of contamination, would make these requirements, as well as the landfill construction and operation requirements applicable for wastes that can be designated as hazardous. If the wastes are excavated and reconsolidated in their current location, the capping requirements are applicable. The major determining factors are the location of the final disposal, and the classification of the waste materials.

Table 5-3
POTENTIAL FEDERAL ACTION-SPECIFIC ARARs FOR MUNICIPAL LANDFILL SITES

Actions	Requirement	Prerequisites	Citation	Comments
	Eliminate free liquids, stabilize wastes before capping (surface impoundments).		40 CFR 264.228(a)	
	Restrict post-closure use of property as necessary to prevent damage to the cover.		40 CFR 264.117(c)	
	Prevent run-on and run-off from damaging cover.		40 CFR 264.228(b) 40 CFR 264.310(b)	
	Protect and maintain surveyed benchmarks used to locate waste cells (landfills, waste piles).		40 CFR 264.310(b)	
	Disposal or decontamination of equipment, structures, and soils.		40 CFR 264.111	
Closure with Waste in Place (Capping)	Eliminate free liquids by removal or solidication.		40 CFR 264.228(a)(2)	See discussion under Capping.
	Stabilization of remaining waste and waste residues to support cover.		40 CFR 264.228(a)(2) and 40 CFR 264.258(b)	
	Installation of final cover to provide long-term minimization of infiltration.		40 CFR 264.310	
	Post-closure care and groundwater monitoring.		40 CFR 264.310	
Clean Closure (Removal)	General performance standard requires minimization of need for further maintenance and control; minimization or eliminatin of post-closure escape of hazardous waste, hazardous constituents, leachate, contaminated runoff, or hazardous waste decomposition products.	Disturbance of RCRA hazardous waste (listed or characteristic) and movement outside the unit or area of contamination. May apply to surface impoundment or to contaminated soil, including soil from dredging or soil disturbed in the course of drilling or excavation and returned to land.	40 CFR 264.111	Clean closure removal of contaminated materials does not appear to be feasible for most municipal landfill sites because of the large volume of wastes. However, clean closure removal may be considered for portions of the site, such as hot spot areas. The RCRA clean closure requirements would be considered relevant and appropriate to contaminated wastes which are not hazardous, but which are similar to hazardous wastes.
	Disposal or decontamination of equipment, structures, and soils.		40 CFR 264.111 and 268	The RCRA Land Disposal Restrictions require treatment of RCRA wastes to specified levels or by specified technologies. The RCRA requirements would be considered relevant and appropriate to wastes that are not RCRA hazardous wastes, but which are similar (same constituents) as RCRA wastes. RCRA Land Disposal Restrictions require treatment of RCRA wastes to specified levels or by specified technologies before land disposal. If treatment to the specified level or by the specified technology is not achievable or appropriate, a variance must be obtained from the EPA. If the wastes are determined to be RCRA wastes, these requirements would be applicable.

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Table 5-3
POTENTIAL FEDERAL ACTION-SPECIFIC ARARs FOR MUNICIPAL LANDFILL SITES

Actions	Requirement	Prerequisites	Citation	Comments
Clean Closure (Removal) (cont'd.)	Removal or decontamination of all waste residues, contaminated containment system components (e.g., liners, dikes), contaminated subsoils, and structures and equipment contaminated with waste and leachate, and management of them as hazardous waste. Meet health-based levels at unit.	Not applicable to undisturbed material. Disposal of RCRA hazardous waste (listed or characteristic) after disturbance and movement outside the unit or area of contamination.	40 CFR 264.228(a)1) and 40 CFR 264.258	In the event that the wastes being removed are determined to be hazardous wastes, the requirements of this section would be applicable.
Consolidation	Area from which materials are removed should be remediated.	Disposal by disturbance of hazardous waste (listed or characteristic) and moving it outside unit or boundary of contaminated area.	See Closure	If nonhazardous wastes are excavated and moved outside the current area of contamination, these requirements will become relevant and appropriate. These regulations are intended to insure that when wastes are consolidated at a central location, the satellite areas (former locations of the wastes) are remediated. If the wastes which are excavated for consolidation are determined to be hazardous wastes, this regulation will be applicable.
	Consolidation in storage piles/storage tanks will trigger storage requirements.		See Container Storage, Tank Storage, Waste Piles in this table.	RCRA requirements for storage in containers, tanks, or piles will be relevant and appropriate for nonhazardous wastes which are similar to RCRA hazardous wastes, or for hazardous wastes disposed prior to Novemer 1980, which are excavated from the site and stored prior to consolidation and/or disposal. If excavated materials can be classified as hazardous wastes, the requirement will be applicable.
	Placement on or in land outside unit boundary or area of contamination will trigger land disposal requirements and restrictions.	After November 8, 1988.	40 CFR 286 (Subpart D)	Certain listed hazardous wastes are not eligible for disposal in landfills or other land-based facilities unless treated to RCRA specified criteria. The requirement may be relevant and appropriate to some nonhazardous wastes at municipal landfill sites which are contaminated with hazardous constituents at levels similar to those in listed wastes, and are excavated for reconsolidation and disposal outside the current area of contamination. If any of the wastes are determined to meet the definitions of the restricted hazardous wastes, the requirements will be applicable.
	Develop fugitive and odor emission control plan for this action if existing site plan is inadequate.		CAA Section 101[a] and 40 CFR 52[a]	Odor regulations are intended to limit nuisance conditions from air pollution emissions. Fugitive emission controls are one feature of the state implementation plan used to achieve/maintain the ambient air quality standards for particulate matter.
	File an Air Pollution Emission Notice (APEN) with state to include estimation of emission rates for each pollutant expected.		40 CFR 52[a]	See discussion under Air Stripping.
	Include with the filed APEN the following: • Modeled impact analysis of source emissions • A Best Available Control Technology (BACT) review for the source operation	This additional work and information is normally applicable to sources meeting the "major" criteria and/or to sources proposed for nonattainment areas.	40 CFR 52[a]	See discussion under Air Stripping.

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Table 5-3
POTENTIAL FEDERAL ACTION-SPECIFIC ARARs FOR MUNICIPAL LANDFILL SITES

Actions	Requirement	Prerequisites	Citation	Comments
Consolidation (cont'd.)	Predict total emissions of volatile organic compounds (VOCs) to demonstrate emissions do not exceed 450 lb/hr, 3,000 lb/day, 10 gal/day, or allowable emission levels from similar sources using Reasonably Available Control Technology (RACT).	Source operation must be in an ozone nonattainment area.	40 CFR 52[a]	See discussion under Air Stripping.
	Verify through emission estimates and dispersion modeling that hydrogen sulfide emissions do not create an ambient concentration greater than or equal to 0.10 ppm.		40 CFR 61[a]	See discussion under Air Stripping.
	Verify that emissions of mercury, vinyl chloride, and benzene do not exceed levels expected from sources in compliance with hazardous air pollution regulations.		40 CFR 61[a]	See discussion under Air Stripping.
Containment (Construction of New Surface Impoundment Onsite) (See Closure with Waste in Place and Clean Closure)	Use two liners below the waste, a top liner that prevents waste migration into the liner, and a bottom liner that prevents waste migration through the liner throughout the post-closure period.	RCRA hazardous waste (listed or characteristic) currently being placed in a surface impoundment. Soil/debris being managed as RCRA hazardous waste.	40 CFR 264.220	If a new, onsite surface impoundment is constructed to hold influent and/or effluent from a treatment process, or to hold groundwater, surface water or leachate that is not a hazardous waste, these requirements are relevant and appropriate to construction, operation, and maintenance of the impoundment.
Dike Stabilization	Design and operate facility to prevent overtopping due to overfilling; wind and wave action; rainfall; run-on; malfunctions of level controllers, alarms, or other equipment; and human error.	Existing surface impoundment containing hazardous waste or creation of new surface impoundments.	40 CFR 264.221	These requirements would be relevant and appropriate to the construction and operation of a new surface impoundment or the operation and maintenance of an existing surface impoundment onsite to contain groundwater, surface water, leachate, or the influent or effluent of a treatment system that is not a hazardous waste.
Direct Discharge of Treatment System Effluent	Applicable federal water quality criteria for the protection of aquatic life must be complied with when environmental factors are being considered.	Surface discharge of treated effluent.	50 FR 30784 (July 29, 1985)	
	Applicable federally approved state water quality standards must be complied with. These standards may be in addition to or more stringent than other federal standards under the CWA.	Surface discharge of treated effluent.	40 CFR 122.44 and state regulations approved under 40 CFR 131	If state regulations are more stringent than federal water quality standards, the state standards will be applicable to direct discharge. The state has authority under 40 CFR 131 to implement direct discharge requirements within the state, and should be contacted on a case-by-case basis when direct discharges are contemplated.
	The discharge must be consistent with the requirement of a Water Quality Management plan approved by EPA under Section 208(b) of the Clean Water Act.		CWA Section 208(b)	Discharge must comply with substantive but not administrative requirements of the management plan.
	Use of best available technology (BAT) economically achievable is required to control toxic and nonconventional pollutants. Use of best conventional pollutant control technology (BCT) is required to control conventional pollutants. Technology-based limitations may be determined on a case-by-case basis.	Surface discharge of treated effluent.	40 CFR 122.44(a)	If treated effluent is discharged to surface waters, these treatment requirements will be applicable. Permitting and reporting requirements will be applicable only if the effluent is discharged at an offsite location. The permitting authority should be contacted on a case-by-case basis to determine effluent standards.
	The discharge must conform to applicable water quality requirements when the discharge affects a state other than the certifying state.	Surface water discharge affecting waters outside certifying state.	40 CFR 122.44(d)(4)	No discharge is expected to affect surface water outside certifying state.

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Table 5-3
POTENTIAL FEDERAL ACTION-SPECIFIC ARARs FOR MUNICIPAL LANDFILL SITES

Actions	Requirement	Prerequisites	Citation	Comments
Direct Discharge of Treatment System Effluent (cont'd.)	Discharge limitations must be established for all toxic pollutants that are or may be discharged at levels greater than those that can be achieved by technology-based standards.	Surface discharge of treated effluent.	40 CFR 122.44(e)	Exact limitations are based on review of the proposed treatment system and receiving water characteristics, and are usually determined on a case-by-case basis. The permitting authority should be contacted to determine effluent limitations.
	Discharger must be monitored to assure compliance. Discharge will monitor: • The mass of each pollutant discharged. • The volume of effluent discharged. • Frequency of discharge and other measurements as appropriate.	Surface discharge of treated effluent.	40 CFR 122.44(i)	These requirements are generally incorporated into permits, which are not required for onsite discharges. The substantive requirements are applicable, however, in that verifiable evidence must be offered that the discharge standards are being met. The permitting authority should be contacted to determine monitoring and operational requirements.
	Approved test methods for waste constituents to be monitored must be followed. Detailed requirements for analytical procedures and quality controls are provided. Permit application information must be submitted, including a description of activities, listing of environmental permits, etc. Monitor and report results as required by permit (at least annually).		40 CFR 122.21 40 CFR 122.44(i)	
	Comply with additional permit conditions such as: • Duty to mitigate any adverse effects of any discharge. • Proper operation and maintenance of treatment systems.		40 CFR 122.41(i)	
	Develop and implement a Best Management Practices (BMP) program and incorporate in the NPDES permit to prevent the release of toxic constituents to surface waters. The BMP program must: • Establish specific procedures for the control of toxic and hazardous pollutant spills. • Include a prediction of direction, rate of flow, and total quantity of toxic pollutants where experience indicates a reasonable potential for equipment failure. • Assure proper management of solid and hazardous waste in accordance with regulations promulgated under RCRA.	Surface water discharge.	40 CFR 125.100 40 CFR 125.104	These issues are determined on a case-by-case basis by the NPDES permitting authority for any proposed surface discharge of treated wastewater. Although a CERCLA site remediation is not required to obtain an NPDES permit for onsite discharges to surface waters, the substantive requirements of the NPDES permit program must be met by the remediation action if possible. The permitting authority should be consulted on a case-by-case basis to determine BMP requirements.

Table 5-3
POTENTIAL FEDERAL ACTION-SPECIFIC ARARs FOR MUNICIPAL LANDFILL SITES

Actions	Requirement	Prerequisites	Citation	Comments
Direct Discharge of Treatment System Effluent (cont'd.)	Sample preservation procedures, container materials, and maximum allowable holding times are prescribed.	Surface water discharge.	40 CFR 136.1-136.4	These requirements are generally incorporated into permits, which are not required for onsite discharges. The substantive requirements are applicable, however, in that verifiable evidence must be offered that standards are being met. The permitting authority should be consulted on a case-by-case basis to determine analytical requirements.
Discharge to POTW[d]	Pollutants that pass through the POTW without treatment, interfere with POTW operation, or contaminate POTW sludge are prohibited.		40 CFR 403.5	If any liquid is discharged to a POTW, these requirements are applicable. In accordance with guidance, a discharge permit will be required even for an onsite discharge, since permitting is the only substantive control mechanism available to a POTW.
	Specific prohibitions preclude the discharge of pollutants to POTWs that: • Create a fire or explosion hazard in the POTW. • Are corrosive (pH<5.0). • Obstruct flow resulting in interference. • Are discharged at a flow rate and/or concentration that will result in interference. • Increase the temperature of wastewater entering the treatment plant that would result in interference, but in no case raise the POTW influent temperature above 104°F (40°C). Discharge must comply with local POTW pretreatment program, including POTW-specific pollutants, spill prevention program requirements, and reporting and monitoring requirements. RCRA permit-by-rule requirements must be complied with for discharges of RCRA hazardous wastes to POTWs by truck, rail, or dedicated pipe.		40 CFR 403.5 and local POTW regulations 40 CFR 264.71 and 40 CFR 264.72	Categorical standards have not been promulgated for CERCLA sites, so discharge standards must be determined on a case-by-case basis, depending on the characteristics of the waste stream and the receiving POTW. Some municipalities have published standards for non-categorical, non-domestic discharges. Changes in the composition of the waste stream due to pretreatment process changes or the addition of new waste streams will require renegotiation of the permit conditions.

Table 5-3

POTENTIAL FEDERAL ACTION-SPECIFIC ARARs FOR MUNICIPAL LANDFILL SITES

Actions	Requirement	Prerequisites	Citation	Comments
Discharge of Dredge and Fill Material to Navigable Waters	The five conditions that must be satisfied before dredge and fill is an allowable alternative are: • There must be no practicable alternative. • Discharge of dredged or fill material must not cause a violation of state water quality standards, violate any applicable toxic effluent standards, jeopardize an endangered species, or injure a marine sanctuary. • No discharge shall be permitted that will cause or contribute to significant degradation of the water. • Appropriate steps to minimize adverse effects must be taken. • Determine long- and short-term effects on physical, chemical, and biological components of the aquatic ecosystem.		40 CFR 230.10 33 CFR 320-330	This action is not envisioned as part of the site remediation.
Dredging	Removal of all contaminated sediment.	Disposal by disturbance of hazardous waste and moving it outside the unit or area of contamination.	See discussions under Clean Closure, Consolidation, Capping	
Excavation	Area from which materials are excavated may require cleanup to levels established by closure requirements.	Disposal by disturbance of hazardous waste and moving it outside the unit or area of contamination.	40 CFR 264 Disposal and Closure Requirements	If contaminated materials that are not hazardous wastes are excavated from the site during remediation, the RCRA requirements for disposal and site closure (of the excavated area) may become relevant and appropriate. See discussions under Capping, Clean Closure, Closure with Waste In-Place, etc. If the excavated materials can be classified as hazardous wastes, the disposal and closure requirements would be applicable.
	Movement of excavated materials to a previously uncontaminated, onsite location, and placement in or on land may trigger land disposal restrictions.	Materials containing RCRA hazardous wastes subject to land disposal restrictions.	40 CFR 268 (Subpart D)	The land disposal restrictions restrict disposal of certain hazardous wastes. Some municipal landfill wastes may be derived from or may be sufficiently similar to restricted wastes to make the land disposal restrictions relevant and appropriate. For wastes that can be classified as restricted hazardous wastes, land disposal is prohibited unless they are treated to defined standards. Chemical characterization of the wastes will be necessary to determine the applicability or relevance of this requirement.
	All listed and characteristic hazardous wastes or soils and debris contaminated by a RCRA hazardous waste and removed from a CERCLA site may not be land disposed until treated as required by Land Ban. If alternative treatment technologies can achieve treatment similar to that required by Land Ban, and if this achievement can be documented, then a variance may not be required.	Waste disposed was RCRA waste.	40 CFR 268	If soil is a characteristic waste, and if waste disposed prior to November 1980 is now designated as a RCRA waste, then soils/sediment and leachate contamination from those wastes must be managed as a RCRA waste.

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Table 5-3
POTENTIAL FEDERAL ACTION-SPECIFIC ARARs FOR MUNICIPAL LANDFILL SITES

Actions	Requirement	Prerequisites	Citation	Comments
Excavation (cont'd.)	Develop fugitive and odor emission control plan for this action if existing site plan is inadequate.		CAA Section 101[a] and 40 CFR 52[a]	See discussions under Consolidation.
	File an Air Pollution Emission Notice (APEN) with state to include estimation of emission rates for each pollutant expected.		40 CFR 52[a]	See discussions under Consolidation.
	Include with the filed APEN the following: • Modeled impact analysis of source emissions. • A Best Available Control Technology (BACT) review for the source operation.	This additional work and information is normally applicable to sources meeting the "major" criteria and/or to sources proposed for nonattainment areas.	40 CFR 52[a]	See discussions under Consolidation.
	Predict total emissions of volatile organic compounds (VOCs) to demonstrate emissions do not exceed 450 lb/hr, 3,000 lb/day, 10 gal/day, or allowable emission levels from similar sources using Reasonably Available Control Technology (RACT).	Source operation must be in an ozone nonattainment area.	40 CFR 52[a]	See discussions under Consolidation.
	Verify through emission estimates and dispersion modeling that hydrogen sulfide emissions do not create an ambient concentration greater than or equal to 0.10 ppm.		40 CFR 61[a]	See discussions under Consolidation.
	Verify that emissions of mercury, vinyl chloride, and benzene do not exceed levels expected from sources in compliance with hazardous air pollution regulations.		40 CFR 61[a]	See discussions under Consolidation.
Gas Collection	*Proposed* standards for control of emissions of volatile organics (CAA requirements to be provided).	Proposed standard; not yet ARAR.	52 FR 3748 (February 5, 1987)	This is a proposed rule. If the requirement is finalized in its proposed form, it may be applicable or relevant and appropriate to some of the remedial actions at municipal landfill sites. The proposed standard would impose restrictions on RCRA treatment, storage, and disposal facilities that would limit the allowable emissions of volatile organics from these facilities. If this requirement is finalized, it will be closely examined with respect to remedial alternatives at municipal landfill sites.
	Design system to provide odor-free operation.		CAA Section 101[a] and 40 CFR 52[a]	See discussions under Consolidation.
	File an Air Pollution Emission Notice (APEN) with state to include estimation of emission rates for each pollutant expected		40 CFR 52[a]	See discussions under Consolidation.
	Include with the filed APEN the following: • Modeled impact analysis of source emissions. • A Best Available Control Technology (BACT) review for the source operation.	This additional work and information is normally applicable to sources meeting the "major" criteria and/or to sources proposed for nonattainment areas.	40 CFR 52[a]	See discussions under Consolidation.

Table 5-3
POTENTIAL FEDERAL ACTION-SPECIFIC ARARs FOR MUNICIPAL LANDFILL SITES

Actions	Requirement	Prerequisites	Citation	Comments
Gas Collection (cont'd.)	Predict total emissions of volatile organic compounds (VOCs) to demonstrate emissions do not exceed 450 lb/hr, 3,000 lb/day, 10 gal/day, or allowable emission levels from similar sources using Reasonably Available Control Technology (RACT).	Source operation must be in an ozone nonattainment area.	40 CFR 52[a]	See discussions under Consolidation.
	Verify through emission estimates and dispersion modeling that hydrogen sulfide emissions do not create an ambient concentration greater than or equal to 0.10 ppm.		40 CFR 61[a]	
	Verify that emissions of mercury, vinyl chloride, and benzene do not exceed levels expected from sources in compliance with hazardous air pollution regulations.		40 CFR 61[a]	See discussions under Consolidation.
Groundwater Diversion	Excavation of soil for construction of slurry wall may trigger cleanup or land disposal restrictions.	Disposal by disturbance of hazardous waste and moving it outside the unit or area of contamination.	See Consolidation, Excavation in this table.	If waste materials or contaminated soil that are not hazardous wastes are excavated or otherwise disturbed during the construction of a groundwater diversion structure, the requirements of this section would be relevant and appropriate. If the excavated wastes or contaminated soil can be classified as hazardous wastes, these requirements would be applicable.
Incineration (Onsite)	Analyze the waste feed.	RCRA hazardous waste.	40 CFR 264.341	If incineration is selected as one of the remedial alternatives for site remediation, these requirements would be relevant and appropriate to the disposal by incineration of potentially nonhazardous site wastes. The wastes would have to be analyzed prior to incineration to insure that the wastes cannot be classified as hazardous wastes.
	Dispose of all hazardous waste and residues, including ash, scrubber water, and scrubber sludge.		40 CFR 264.351	
	No further requirements apply to incinerators that only burn wastes listed as hazardous solely by virtue of the characteristic of ignitability, corrosivity, or both; or the characteristic of reactivity if the wastes will not be burned when other hazardous wastes are present in the combustion zone; and if the waste analysis shows that the wastes contain none of the hazardous constituents listed in Appendix VIII which might reasonably be expected to be present.		40 CFR 264.340	If wastes to be incinerated can be classified as hazardous wastes, the requirements of 40 CFR 264.341, 351, and 340 would be applicable.
	Performance standards for incinerators:			
	• Achieve a destruction and removal efficiency of 99.99 percent for each principal organic hazardous constituent in the waste feed and 99.9999 percent for PCBs and dioxins.		40 CFR 264.343	
	• Particulate emissions must be less than 180 mg/dscf (.08 grains/dscf) corrected to 7% O_2.		40 CFR 264.342	
	• Reduce hydrogen chloride emissions to 1.8 kg/hr or 1 percent of the HCl in the stack gases before entering any pollution control devices.			

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POTENTIAL FEDERAL ACTION-SPECIFIC ARARs FOR MUNICIPAL LANDFILL SITES

Actions	Requirement	Prerequisites	Citation	Comments
Incineration (Onsite) (cont'd.)	Monitoring of various parameters during operation of the incinerator is required. These parameters include: • Combustion temperature. • Waste feed rate. • An indicator of combustion gas velocity. • Carbon monoxide.		40 CFR 264.343	
Land Treatment	Ensure that hazardous constituents are degraded, transformed, or immobilized within the treatment zone.	RCRA hazardous waste.	40 CFR 264.271	See discussions under Consolidation.
	Maximum depth of treatment zone must be no more than 1.5 meters (5 feet) from the initial soil surface, and more than 1 meter (3 feet) above the seasonal high water table.		40 CFR 264.271	
	Demonstrate that hazardous constituents for each waste can be completely degraded, transformed, or immobilized in the treatment zone.		40 CFR 264.272	
	Minimize run-off of hazardous constituents.		40 CFR 264.273	
	Maintain run-on/run-off control and management system.		40 CFR 264.273	
	Special application conditions if food-chain crops are grown in or on treatment zone.		40 CFR 264.276	
	Unsaturated zone monitoring.		40 CFR 264.278	
	Special requirements for ignitable or reactive waste.		40 CFR 264.281	
	Special requirements for incompatible wastes.		40 CFR 264.282	
	Special requirements for RCRA hazardous wastes.	RCRA waste No's. F020, F021, F022, F023, F026, F027.	40 CFR 264.283	
	Design system to operate odor free.		CAA Section 101[a] and 40 CFR 52[a]	
	File an Air Pollution Emission Notice (APEN) with state to include estimation of emission rates for each pollutant expected.		40 CFR 52[a]	See discussions under Consolidation.
	Include with the filed APEN the following: • Modeled impact analysis of source emissions. • A Best Available Control Technology (BACT) review for the source operation.	This additional work and information is normally applicable to sources meeting the "major" criteria and/or to sources proposed for nonattainment areas.	40 CFR 52[a]	See discussions under Consolidation.

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Table 5-3

POTENTIAL FEDERAL ACTION-SPECIFIC ARARs FOR MUNICIPAL LANDFILL SITES

Actions	Requirement	Prerequisites	Citation	Comments
Land Treatment (cont'd.)	Predict total emissions of volatile organic compounds (VOCs) to demonstrate emissions do not exceed 450 lb/hr, 3,000 lb/day, 10 gal/day, or allowable emission levels from similar sources using Reasonably Available Control Technology (RACT).	Source operation must be in an ozone nonattainment area.	40 CFR 52[a]	See discussions under Consolidation.
	Verify through emission estimates and dispersion modeling that hydrogen sulfide emissions do not create an ambient concentration greater than or equal to 0.10 ppm.		40 CFR 61[a]	See discussions under Consolidation.
	Verify that emissions of mercury, vinyl chloride, and benzene do not exceed levels expected from sources in compliance with hazardous air pollution regulations.		40 CFR 61[a]	See discussion under Consolidation.
Operation and Maintenance (O&M)	Post-closure care to ensure that site is maintained and monitored.		40 CFR 264.118 (RCRA, Subpart G)	Post-closure requirements for operation and maintenance of municipal landfill sites are relevant and appropriate to new disposal units with nonhazardous waste, or existing units capped in-place. In cases where municipal landfill site wastes are determined to be hazardous wastes, and new disposal units are created, the post-closure requirements will be applicable.
Removal	General performance standard requires minimization of need for further maintenance and control; minimization or elimination of post-closure escape of hazardous waste, hazardous constituents, leachate, contaminated runoff, or hazardous waste decomposition products.	Disturbance of RCRA hazardous waste (listed or characteristic) and movement outside the unit or area of contamination. May apply to surface impoundment or to contaminated soil, including soil from dredging or soil disturbed in the course of drilling or excavation and returned to land.	40 CFR 264.111	Clean closure removal of contaminated materials does not appear to be feasible for municipal landfill sites in general due to the lack of suitable offsite treatment or disposal facilities to accept the large volume of wastes typically found at municipal landfill sites and the impossibility of meeting the requirement at a site with contaminated groundwater. However, clean closure removal may be considered for portions (hot spots) of municipal landfill sites. The RCRA clean closure requirements would be considered relevant and appropriate to contaminated wastes which are not hazardous, but which are similar to hazardous wastes.
	Disposal or decontamination of equipment, structures, and soils.		40 CFR 264.111	
	Removal or decontamination of all waste residues, contaminated containment system components (e.g., liners, dikes), contaminated subsoils, and structures and equipment contaminated with waste and leachate, and management of them as hazardous waste.	Not applicable to undisturbed material. Disposal of RCRA hazardous waste (listed or characteristic) after disturbance and movement outside the unit or area of contamination.	40 CFR 264.228(a)(1) and 40 CFR 264.258	In the event that the wastes being removed are determined to be hazardous wastes, the requirements of this section would be applicable.
	Meet health-based levels at unit.		40 CFR 244.111	
	RCRA hazardous wastes are subject to land disposal restrictions. Land disposal restrictions set performance requirements on treatment of the wastes before land disposal. The effective date for final group of RCRA wastes is May 8, 1990. Extensions to the effective dates have been granted for specific RCRA wastes that are contained in soil and/or debris.	Management of listed hazardous waste.	40 CFR 268	If the wastes found at the municipal landfill site are found to be RCRA wastes, the Land Disposal Restrictions will be applicable. If the wastes are not RCRA wastes but contain the same or similar constituents to those in RCRA wastes, then the Land Disposal Restrictions may be relevant and appropriate.

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Table 5-3
POTENTIAL FEDERAL ACTION-SPECIFIC ARARs FOR MUNICIPAL LANDFILL SITES

Actions	Requirement	Prerequisites	Citation	Comments
Slurry Wall	Excavation of soil for construction of slurry wall may trigger cleanup or land disposal restrictions.	Disposal by disturbance of hazardous waste and moving it outside the unit or area of contamination.	See Consolidation, Excavation in this table	See discussions under Consolidation and Excavation.
Surface Water Control	Prevent run-on, and control and collect runoff from a 24-hour, 25-year storm (waste piles, land treatment facilities, landfills).	Land based treatment, storage, or disposal units.	40 CFR 264.251(c)(d) 40 CFR 264.273(c)(d) 40 CFR 264.301(c)(d)	The requirements for control of run-on and run-off will be relevant and appropriate to all remediation alternatives that manage nonhazardous waste and include onsite land-based treatment, storage, or disposal. The requirements will be applicable to any remediation measures that include land-based treatment, storage, or disposal of hazardous wastes.
	Prevent over-topping of surface impoundment.		40 CFR 264.221(c)	This requirement will be relevant and appropriate to the construction and operation of an onsite surface impoundment, or to operation of an existing onsite surface impoundment managing nonhazardous wastes. These requirements would be applicable to the construction or operation of a surface impoundment for the storage or treatment of hazardous waste.
Treatment	Standards for miscellaneous units (long-term retrievable storage, thermal treatment other than incinerators, open burning, open detonation, chemical, physical, and biological treatment units using other than tanks, surface impoundments, or land treatment units) require new miscellaneous units to satisfy environmental performance standards by protection of groundwater, surface water, and air quality, and by limiting surface and subsurface migration.	Use of other units for treatment of hazardous wastes. These units do not meet the definitions for units regulated elsewhere under RCRA.	40 CFR 264 (Subpart X)	The requirement will be relevant and appropriate to the construction, operation, maintenance, and closure of any miscellaneous treatment unit (a treatment unit that is not elsewhere regulated) constructed on municipal landfill site for treatment and/or disposal of nonhazardous wastes. These requirements would be applicable to the construction and operation of a miscellaneous treatment unit for the treatment and/or disposal of hazardous wastes.
	Treatment of wastes subject to ban on land disposal must attain levels achievable by best demonstrated available treatment technologies (BDAT) for each hazardous constituent in each listed waste.	Effective date for CERCLA actions is November 8, 1988, for F001-F005 hazardous wastes, dioxin wastes, and certain "California List" wastes. Other restricted wastes have different effective dates as promulgated in 40 CFR 268.	40 CFR 268 (Subpart D)	These regulations are applicable to the disposal of any municipal landfill site waste that can be defined as restricted wastes. These requirements are relevant and appropriate to the treatment prior to land disposal of any wastes that contain components of restricted wastes in concentrations that make the site wastes sufficiently similar to the regulated wastes. The requirements specify levels of treatment that must be attained prior to land disposal.
	Prepare fugitive and odor emission control plan for this action.		CAA Section 101[a] and 40 CFR 52[a]	See discussions under Consolidation.
	File an Air Pollution Emission Notice (APEN) with state to include estimation of emission rates for each pollutant expected.		40 CFR 52[a]	See discussions under Consolidation.
	Include with the filed APEN the following: • Modeled impact analysis of source emissions. • A Best Available Control Technology (BACT) review for the source operation.	This additional work and information is normally applicable to sources meeting the "major" criteria and/or to sources proposed for nonattainment areas.	40 CFR 52[a]	See discussions under Consolidation.

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POTENTIAL FEDERAL ACTION-SPECIFIC ARARs FOR MUNICIPAL LANDFILL SITES

Actions	Requirement	Prerequisites	Citation	Comments
Treatment (cont'd.)	Predict total emissions of volatile organic compounds (VOCs) to demonstrate emissions do not exceed 450 lb/hr, 3,000 lb/day, 10 gal/day, or allowable emission levels from similar sources using Reasonably Available Control Technology (RACT).	Source operation must be in an ozone nonattainment area.	40 CFR 52[a]	See discussions under Consolidation.
	Verify through emission estimates and dispersion modeling that hydrogen sulfide emissions do not create an ambient concentration greater than or equal to 0.10 ppm.		40 CFR 61[a]	See discussions under Consolidation.
	Verify that emissions of mercury, vinyl chloride, and benzene do not exceed levels expected from sources in compliance with hazardous air pollution regulations.		40 CFR 61[a]	See discussions under Consolidation.
Underground Injection of Wastes and Treated Groundwater	UIC program prohibits: • Injection activities that allow movement of contaminants into underground sources of drinking water (USDW) and result in violations of MCLs or adversely affect health. • Construction of new Class IV wells, and operation and maintenance of existing wells.		40 CFR 144.12 40 CFR 144.13	
	Wells used to inject contaminated groundwater that has been treated and is being reinjected into the same formation from which it was withdrawn are not prohibited if activity is part of CERCLA or RCRA actions.		40 CFR 144.14	
	All hazardous waste injection wells must also comply with the RCRA requirements.		40 CFR 144.16	
Waste Pile	Use liner and leachate collection and removal system.	RCRA hazardous waste, non-containerized accumulation of solid, nonflammable hazardous waste that is used for treatment or storage.	40 CFR 264.251	

Notes:

[a]All of the Clean Air Act ARARs that have been established by the federal government may be covered by matching state regulations. The state may have the authority to manage these programs through the approval of its implementation plans (40 CFR 52 Subpart G).

[b]Action alternatives from ROD keyword index.

[c]Bulk storage requires the preparation and implementation of a spill prevention, control, countermeasures (SPCC) plan (see 40 CFR 761.65(c)(7)(ii) for specification of container sizes that are considered "bulk" storage containers). Substantive requirements may be ARARs if bulk storage is performed onsite.

[d]These regulations apply regardless of whether the remedial action discharges into the sewer or trucks the waste to an inlet to the sewage conveyance system located "upstream" of the POTW.

[e]An *approved incinerator* (under Section 761.70) can be used to destroy any concentration of PCBs; a *high-efficiency boiler* approved under Section 761.60(a)(2)(iii) can be used for mineral oil dielectric fluid from PCB-contaminated electrical equipment containing PCBs in concentrations greater than or equal to 50 ppm but less than 500 ppm; and a *RCRA-approved incinerator* (under RCRA paragraph 3005(a)) can be used for PCBs that and not subject to the incineration requirements of TSCA.

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