United States
Environmental Protection
Agency

Office of
Emergency and
Remedial Response

EPA/ROD/R02-92/183
September 1992

EPA

Superfund
Record of Decision:

Islip Municipal Sanitary Land-fill, NY

50272-101

REPORT DOCUMENTATION PAGE	1. REPORT NO. EPA/ROD/R02-92/183	2.	3. Recipient's Accession No.

4. Title and Subtitle SUPERFUND RECORD OF DECISION Islip Municipal Sanitary Landfill, NY First Remedial Action - Final	5. Report Date 09/30/92 6.
7. Author(s)	8. Performing Organization Rept. No.
9. Performing Orgainization Name and Address	10. Project/Task/Work Unit No. 11. Contract(C) or Grant(G) No. (C) (G)
12. Sponsoring Organization Name and Address U.S. Environmental Protection Agency 401 M Street, S.W. Washington, D.C. 20460	13. Type of Report & Period Covered 800/000 14.

15. Supplementary Notes

PB93-963825

16. Abstract (Limit: 200 words)

The 107.5-acre Islip Sanitary Landfill site is located in Hauppauge, Town of Islip, Suffolk County, New York. Land use in the surrounding area is predominantly residential, with a day care center and an apartment complex located adjacent to the northern edge of the landfill. The Glacial and Magothy aquifers underlying the site are a primary source of potable water in the region, and five public supply wells are located within a 2-mile radius of the site. Two perennial surface water bodies, the Connetquot Brook and the North Branch of the Nissequogue River, are located nearby and are used for recreational purposes. From 1963 to 1990, the site was operated as a municipal landfill; an incinerator, which was constructed onsite, operated from 1963 to 1968. Landfilling activities have occurred in phases. Encompassing 55.4 acres, Phase I (unlined area) and Phase II (lined area) of the landfill received waste from the early 1960's through the early 1980's. It is believed that in 1978, sixty to seventy 55-gallon drums of waste dry-cleaning solvent were disposed of in these areas. The 13.4 acres planned for Phase III will be used for disposal of clean fill, and the remainder of the property is used for temporary storage of ash fill, sand storage and borrow areas, setback/buffer zones, vehicle storage, and other support uses. In 1979,

(See Attached Page)

17. Document Analysis a. Descriptors

Record of Decision - Islip Municipal Sanitary Landfill, NY
First Remedial Action - Final
Contaminated Media: soil, debris, gw
Key Contaminants: VOCs (benzene, PCE, TCE, toluene), other organics, metals (asenic, chromium, lead)

b. Identifiers/Open-Ended Terms

c. COSATI Field/Group

18. Availability Statement	19. Security Class (This Report) None	21. No. of Pages 94
	20. Security Class (This Page) None	22. Price

(See ANSI-Z39.18) *See Instructions on Reverse* OPTIONAL FORM 272 (4-77) (Formerly NTIS-35) Department of Commerce

the Town purchased two houses adjacent to the site because of high concentrations of methane detected in their basements. An active gas-collection system was installed to control migration of explosive gases beyond the site boundary. Ground water investigations, which were conducted in 1980, revealed VOC contamination in private wells. Public water mains or alternative water supplies were extended to affected residents. During 1987, the unlined area was capped, and a liner/leachate collection system was installed over the cell for vertical expansion of landfilling operations. In 1990, the state required the site to stop receiving municipal waste and begin implementing a complete closure program of the entire landfilled area. This ROD addresses a final remedy for the contaminated soil, debris, and ground water at the site. The primary contaminants of concern affecting the soil, debris, and ground water are VOCs, including benzene, PCE, TCE, and toluene; other organics; and metals, including arsenic, chromium and lead.

The selected remedial action for this site includes installing a modified geosynthetic membrane cap over 52 acres of the landfill; constructing a stormwater system to direct and control runoff from the site to recharge basins; allowing ground water with total VOC concentrations less than 50 ug/l to naturally attenuate; extracting and onsite treatment of ground water with total VOC concentrations greater than 50 ug/l using aeration, with discharge of the treated water onsite to a recharge basin; determining if carbon absorption will be required as a polishing treatment step to ensure compliance with state discharge limits; conducting a treatability study to determine the effectiveness of aeration in precipitating metals from the ground water, and providing for a contingency remedy that treats ground water using chemical precipitation and air stripping; evaluating the ground water treatment system to determine whether an air pollution control device is necessary; monitoring ground water and air; and implementing institutional controls including deed and ground water restrictions to prevent the installation of drinking water wells in impacted areas. The estimated present worth cost for this remedial action is $17,942,025, which includes a present worth O&M cost of $4,588,875 for 30 years.

PERFORMANCE STANDARDS OR GOALS:

Chemical-specific ground water clean-up goals, which are based on SDWA MCLs and state standards, include benzene 5 ug/l (MCL); PCE 5 ug/l (MCL); TCE 5 ug/l (MCL); toluene 5 ug/l (MCL); arsenic 0.025 mg/l (state); chromium 50 ug/l; and lead 0.02 mg/l (state).

ROD FACT SHEET

SITE

Site name:	Islip Municipal Sanitary Landfill (a.k.a. The Blydenburgh Road Landfill)
Site location:	Town of Islip
HRS score:	33.39

ROD

Date Signed:	September 30, 1992
Selected remedy:	Landfill Cap/Pump groundwater above 50 ppb total VOCs and Treat via aeration/Discharge to on-site recharge basin
Capital cost:	$13,353,150
O & M cost:	$ 4,588,875
Present worth cost:	$17,942,025

LEAD

NYSDEC

NYSDEC Primary Contact:	George Heitzman (518) 457-1641
NYSDEC Secondary Contact:	Bob Cozzy (518) 457-1641
EPA Primary Contact:	Sharon Trocher (212) 264-0722
EPA Secondary Contact:	Doug Garbarini (212) 264-0109
Main PRPs:	Town of Islip (Islip Resource Recovery Agency)

WASTE

Waste type:	Volatile Organic Compounds Inorganic Compounds
Waste origin:	Municipal and Hazardous Wastes
Estimated waste quantity:	Municipal Landfill Size: 52 acres Hazardous Wastes: 60-70 fifty-five gallon drums
Contaminated medium:	Soil, Groundwater

DECLARATION FOR THE RECORD OF DECISION

SITE NAME AND LOCATION

Islip Municipal Sanitary Landfill
(also known as Blydenburgh Road Landfill)
Town of Islip, Suffolk County, New York

STATEMENT OF BASIS AND PURPOSE

This decision document presents the selected remedial action for the Islip Municipal Sanitary Landfill Site (the Site), which was chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as amended, and to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision document explains the factual and legal bases for selecting the remedy for this Site. The information supporting this remedial action decision is contained in the administrative record for this Site. The administrative record index is attached (Appendix III).

The New York State Department of Environmental Conservation (NYSDEC) concurs with the selected remedy as per the attached letter (Appendix IV). NYSDEC also concurs with the contingency remedy, should a treatability study determine that the contingency remedy is appropriate.

ASSESSMENT OF THE SITE

Actual or threatened releases of hazardous substances from this Site, if not addressed by implementing the response action selected in this Record of Decision (ROD), may present a significant and substantial endangerment to public health, welfare, or the environment.

DESCRIPTION OF THE SELECTED REMEDY

This decision represents the entire remedial action for the Site. It addresses the principal threats to human health and the environment at the Site by controlling the source of contamination and the generation of contaminated leachate, as well as by treating contaminated groundwater.

The major components of the selected remedy include the following:

- o Installation of a modified geosynthetic membrane cap on the landfill which is designed in compliance with Part 360 of Title 6 of the New York Code of Rules and Regulations (6 NYCRR Part 360), Solid Waste Management

Facilities. The areal extent of the cap is approximately 52 acres. The synthetic membrane cap includes layers of fill material, drainage layers, an impermeable membrane, and a gas-venting system that utilizes Rolite-treated incinerator ash;

- Construction of a stormwater system that will direct and control runoff from the Site to on-site recharge basins;
- Development and implementation of an on-site groundwater extraction and treatment system. Groundwater contaminated with approximately 50 parts per billion (ppb) of total volatile organic compounds (VOCs) or more will be extracted, treated via aeration, and discharged to an on-site recharge basin;
- Implementation of a groundwater-monitoring system to monitor the groundwater contamination plume and to evaluate the effectiveness of the groundwater treatment system, including natural attenuation processes;
- Performance of a treatability study to determine the effectiveness of aeration in precipitating inorganic compounds from the groundwater. If the study demonstrates that this technology is not effective in removing inorganic compounds, then a contingency remedy which utilizes chemical precipitation and air stripping to treat groundwater will be implemented. The contingency remedy is identical to the selected remedy in all other aspects;
- Determination of whether carbon adsorption will be required as a polishing treatment step to ensure compliance with New York State Pollutant Discharge Elimination System standards;
- Evaluation of the groundwater treatment system to determine whether an air pollution control device is necessary to comply with air emission requirements;
- Collection of ambient air samples to determine whether modifications to the landfill gas control system are necessary. If ambient air samples indicate that landfill gas emissions from the three existing flares are unacceptable, and operation of the current flare system cannot be modified to reduce VOC emissions while maintaining perimeter subsurface control of explosive gas, then supplemental fuel will be provided to sustain combustion in the flares;
- Completion and evaluation of the supplemental groundwater investigation begun in June 1992 to determine whether the groundwater contamination detected at well cluster 7

(well 7M-1) is Site-related. If the contamination in well 7M-1 is determined to be attributable to the Site, then the selected remedy will be appropriately modified during the design stage to accommodate this additional volume of contaminated groundwater;

- o Development of an air-monitoring system to ensure compliance with ambient air standards; and
- o Recommendations that deed and well restrictions be imposed to prevent the installation of drinking water wells in impacted areas.

STATUTORY DETERMINATIONS

The selected remedy and the contingency remedy are protective of human health and the environment, comply with federal and state requirements that are legally applicable or relevant and appropriate to the remedial action and are cost-effective. However, because treatment of the principal threats of the Site was not found to be practicable, this remedy and the contingency remedy do not satisfy the statutory preference for treatment as a principal element for the source control portion of the remedy. The size of the landfill, the location of hazardous waste beneath an intermediate cap/liner system, and the fact that the remedial investigation did not identify on-site hot spots that represent the major sources of contamination, preclude a remedy in which contaminants could be excavated and treated effectively. However, the selected remedy and contingency remedy do call for the treatment of contaminated groundwater at the Site and hence satisfy the preference for treatment for this portion of the remedy.

The selected and contingency remedies include a groundwater extraction and treatment system which reduces the toxicity and mobility of contaminated groundwater. The permanence of reduction in contaminated groundwater toxicity will be monitored upon discontinuation of the pump and treat system.

Since either remedy will result in hazardous substances remaining on-site above health-based levels, a review will be conducted no later than five years after commencement of the remedial action, and every five years thereafter, to ensure that the remedy continues to provide adequate protection of human health and the environment.

Constantine Sidamon-Eristoff
Regional Administrator

9/30/92
Date

DECISION SUMMARY

Islip Municipal Sanitary Landfill
(also known as Blydenburgh Road Landfill)

Town of Islip
Suffolk County, New York

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region II
New York, New York

TABLE OF CONTENTS

ATTACHMENTS

SITE NAME, LOCATION AND DESCRIPTION

The Islip Municipal Sanitary Landfill (also known as Blydenburgh Road Landfill) complex is a 107.5-acre facility located in Hauppauge, Town of Islip, Suffolk County, New York. The property, which is located on the Central Islip, New York, U.S. Geological Survey (USGS) topographic quadrangle (see Figure 1), is bordered on the east by Blydenburgh Road. To the south is a Long Island Lighting Company (LILCO) transmission line and right-of-way, and approximately 200 feet beyond this right-of-way is Motor Parkway. The western boundary of the landfill property consists of privately owned lots on Hoffman Lane and Woods Edge Court. The northern end of the landfill lies adjacent to the Whiporwil School and the Town House Village North Apartments (see Figure 2).

Most of the surrounding areas immediately adjacent to the landfill are residentially zoned. The closest residence is on Blydenburgh Road, approximately 80 feet east of the landfill property boundary. The nearest residence to the western boundary of the landfill property is on Woods Edge Court and is about 150 feet from the landfill. Light industry is located southeast of the landfill on Motor Parkway, east of Blydenburgh Road. The landfill property is completely surrounded by a fence, and access is controlled by a gate and guardhouse.

The topography in the area of the landfill is hilly due to the presence of the Ronkonkoma Terminal Moraine. The top of the landfill is approximately 250 feet above mean sea level (msl), which is the highest elevation in the area. The elevation drops off rapidly in a northerly direction to approximately 50 to 60 feet above msl at Town Line Road. The land surface elevation toward the southern end of the landfill drops off more gradually than to the north. The southern boundary of the study area (at the Andrew Morrow School) is at an elevation of approximately 50 feet above msl.

Four major unconsolidated units underlie the landfill. The unconsolidated deposits, from land surface downward, include the Glacial Formation, the Magothy Formation, and the Clay and Lloyd Sand members of the Raritan Formation. The uppermost two formations (Glacial and Magothy) are of primary interest as they are hydraulically interconnected, and are sole source (Class IIa) aquifers in the region. The Glacial Formation in the landfill area ranges in thickness from 120 to 350 feet and the Magothy Formation is estimated to be about 600 feet thick. The Site is located in the deep flow recharge zone of the Long Island aquifer system, and vertical hydraulic gradients in the study area are primarily downward. The prevailing groundwater flow direction in both the Glacial and Magothy Formations is to the southeast in the vicinity of the landfill. In the area of the Site, the groundwater flow patterns converge toward the Connetquot River drainage basin.

The closest wetland south or southeast of the landfill (in the direction of groundwater flow) is a recharge basin located adjacent to and south of the eastbound service road of the Long Expressway and about 750 feet west of the well cluster at site 10. This basin is located about 4,000 feet from the center of the Site. The data generated during the Remedial Investigation (RI) indicated that wetlands are not affected by the Site.

The Connetquot Brook and the North Branch of the Nissequogue River are the two most significant perennial surface-water bodies closest to the landfill; both are used for recreational purposes. The Connetquot River which discharges into the Nicoll Bay, is located approximately 2 miles southeast of the Site and is hydraulically downgradient of the landfill; its drainage area is approximately 24 square miles. The nearest perennial surface-water body is a tributary to the northeast branch of the Nissequogue River and is located approximately 0.8 miles northeast of the landfill. The Nissequogue River discharges into the Smithtown Bay and has a drainage area of about 27 square miles.

Five public supply well fields, currently owned and maintained by the Suffolk County Water Authority (SCWA), are located within a 2-mile radius of the Site. The SCWA Liberty Street Well Field is located approximately 3,500 feet east of the landfill; the SCWA Nicholls Road Well Field is located about 6,000 feet southeast of the landfill; the SCWA Oval Drive Well Field is located about 3,500 feet south of the landfill; the SCWA Wheeler Road Well Field is located about 5,500 feet west of the landfill; and the Dolores Place Well Field is located about 9,750 feet southwest of the landfill.

SITE HISTORY AND ENFORCEMENT ACTIVITIES

Landfilling operations began in 1963 when an incinerator was constructed on-site. Prior to construction of the incinerator, sand mining was carried out on the property. In 1968, the incinerator was closed. By 1978, the landfill was the only operating public landfill in the Town of Islip.

Landfill activity at the Site has occurred in phases (cells) since 1963. Although the landfill property encompasses 107 acres, only 55.4 acres were filled during Phases I and II. As depicted in Figure 3, Phase I and Phase II reflect the unlined and lined area of the landfill, respectively. The 13.4 acres planned for Phase III will be used for disposal of clean fill. Clean fill refers to nonputrecible waste and includes concrete, steel, wood, sand, soil, glass construction demolition debris and other inert material designated by NYSDEC. The remainder of the property is used for temporary storage of ash fill, sand storage and borrow areas, setback/buffer zones, vehicle storage, and other support uses. Most of the landfilling activities in the unlined portion of the landfill were carried out from the late 1960s through the early 1980s. A schematic cross section depicting the various landfilling phases, including the unlined disposal area is shown on Figure 4. In June 1978, 60 to 70 fifty-five gallon drums containing waste dry cleaning solvent were allegedly disposed of at the Site.

In 1979, two houses on the eastern end of Woods Edge Court were purchased by the Town of Islip because high concentrations of methane suspected to have originated from the landfill were detected in their basements. In 1980, the Whiporwil School was closed due to suspected vinyl chloride contamination in the air. Subsequent air samples did not confirm this contamination, and the school was re-opened as a day care center. In 1983, an active gas-collection system was installed to control migration of explosive gases beyond the Site boundary. The gases, primarily methane and carbon dioxide, are collected in extraction wells and directed to generators, where the gas is burned to generate electricity, or to flares.

In 1980, groundwater investigations were conducted in the vicinity of the landfill. After private wells in the vicinity of the Site were found to be contaminated with vinyl chloride and tetrachloroethylene, public water mains were extended to residences in the vicinity of the Site. With the exception of a single house that is receiving bottled water, all residences in the area are served by public water. The Town of Islip intends to provide a permanent connection to public water for this residence.

The Site was proposed for listing on the National Priorities List (NPL) in January 1987. During 1987, the unlined area was capped, and a liner/leachate collection system was installed over this cell for vertical expansion of solid waste landfilling operations (see Figure 4). On September 1, 1987, the Town of Islip and NYSDEC entered into an Order on Consent to conduct a remedial program at the Site. The RI for the Site began in September 1988 and was completed in May 1991. The Feasibility Study (FS) for the Site was completed in June 1992. The Site achieved final listing status on the NPL in March 1989.

In December 1990, the Site stopped receiving municipal solid waste, pursuant to 6 NYCRR Part 360 and the Long Island Landfill Law. A complete closure program of the entire landfilled area, including capping, methane recovery, and landfill gas-monitoring activities is being implemented, as required by a NYSDEC Consent Order dated December 18, 1990. The closure plan and landfill cap design were submitted by the Town of Islip and approved by NYSDEC in March 1992. In May 1992, a contract was awarded by the Town of Islip to begin construction of the cap. Due to concerns regarding the contractor, this contract was terminated and will be re-bid in October 1992. Pursuant to the approved closure plan, clean fill and Rolite-treated ash[1] from the resource recovery facility will be placed at the Site to achieve design grades.

HIGHLIGHTS OF COMMUNITY PARTICIPATION

NYSDEC held a public meeting in July 1988 to present the Remedial RI/FS Work Plan and in October 1991 to present the results of the RI and cap selected for the landfill.

The FS report and the Proposed Plan for the Site were released to the public for comment on July 21, 1992. These documents were made available to the public at the following locations: 1) Central Islip Public Library, 33 Hawthorne Avenue, Central Islip, New York, 2) Town Clerk's Office, 655 Main Street, Islip, New York, 3) Islip Resource Recovery Agency, 40 Nassau Avenue, Islip, New York, and 4) NYSDEC Region 1 Office, Building 40 SUNY, Stony Brook, New York. In addition, the administrative record for this Site is available to the public in the administrative record file in the EPA Docket Room in Region II, New York and the information repository at the Islip Resource Recovery Agency, 40 Nassau Avenue, Islip, New York. The notice of availability for the above-referenced documents was published in Newsday on July 28, 1992 and on August 4, 1992. The public comment period on these documents was held from July 22, 1992 to August 21, 1992.

During the public comment period, NYSDEC and the U.S. Environmental Protection Agency (EPA) conducted a public meeting at the Islip Town Hall on August 11, 1992, to inform local officials and interested citizens about the Superfund process, to review current and planned remedial activities at the Site, and to respond to any questions from area residents and other attendees. At this meeting, representatives from the NYSDEC, EPA and the New York State Department of Health answered questions about concerns related to the Site and the remedial alternatives under consideration. Responses to the comments received at the public meeting are included in the Responsiveness Summary (see Appendix V). No written comments were received during the public comment period.

---

[1]Rolite-treated ash refers to a proprietary process developed by Rolite, Inc. to treat incinerator bottom and fly ash with cement and other proprietary ingredients to form an aggregate material.

SCOPE AND ROLE OF OPERABLE UNIT

This response action applies a comprehensive approach and, therefore, only one operable unit is required to remediate the Site.

This remedial action will utilize permanent solutions to the maximum extent practicable. Because the treatment of the principal threats at the Site is not practicable, this remedial action does not satisfy the statutory preference for treatment as a principal element of the source control portion of the remedy. The size of the landfill, the location of the hazardous waste beneath an intermediate cap/liner system, and the fact that the RI did not identify on-site hot spots that represent major sources of contamination, preclude a remedy in which contaminants could be excavated and treated effectively. However, the selected remedy and the contingency remedy call for the treatment of contaminated groundwater at the Site, and hence, satisfy the preference for treatment for this portion of the remedy.

NYSDEC is the lead agency for this project; EPA is the support agency.

SUMMARY OF SITE CHARACTERISTICS

The RI field investigation was initiated in September 1988 and completed in May 1991. It included sampling and analysis of groundwater, landfill gases and ambient air. The RI began by drilling four borings, in which water samples were collected at 10 or 20 foot intervals and analyzed in a field laboratory. This provided a vertical profile of contamination in the aquifer system. Based on the contaminated zones identified by the water-quality borings and the local groundwater flow patterns, a network of 44 monitoring wells was installed. The 44 monitoring wells included 32 monitoring wells that were installed between October 1988 and March 1990, and well clusters at sites 1, 2, and 3, and P-1, P-3, and P-4 which were installed prior to conducting the RI. The 32 monitoring wells that were installed for this RI are located in clusters at sites 4 through 16 as shown in Figure 2. Most of the wells were clustered in groups of two or three. The well clusters consist of at least one "shallow" well in the Upper Glacial aquifer and one "intermediate" well in the upper part of the Magothy aquifer. Well clusters at sites 17 through 21 were installed to monitor the clean fill disposal area, and are not part of the RI analytical data base. Three rounds of groundwater samples were taken during the RI from the 44 monitoring wells. The groundwater samples were analyzed for volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), pesticides and polychlorinated biphenyls (PCBs), inorganics and landfill leachate indicators during the first two rounds of groundwater sampling. During the third sampling round, VOCs, inorganics and leachate indicators were analyzed.

The investigation delineated a plume of contaminated groundwater migrating in a southeasterly direction from the landfill boundary. This groundwater plume contaminated with organic compounds is approximately 3700 feet long and 1,600 feet wide. The maximum vertical extent of the plume has been estimated to be 250 feet below the water table and is localized in the vicinity of the wells located at sites 4, 6 and 14. The groundwater contamination plume does not impact any public well fields and was defined based on levels of contaminants above applicable or relevant and appropriate requirements (ARARs) for groundwater. Chemical-specific ARARs for groundwater at the Site are state and federal drinking water standards and include EPA's Safe Drinking Water Act Maximum Contaminant Levels (MCLs), Part 5 of Title 10 of the New York Code of Rules and Regulations (10 NYCRR Part 5), and 6 NYCRR Part 703 standards. The chemical-specific ARARs are provided in Table 1. A summary of the compounds detected in the groundwater above ARARs is provided in Table 2.

Chemical components of the plume include both typical solid waste leachate constituents and hazardous waste constituents and degradation products. The groundwater contaminants that are attributed to hazardous waste disposal are VOCs, primarily chlorinated solvents such as tetrachloroethylene, trichloroethylene, dichloroethylene, trichloroethane and vinyl chloride. The highest levels of VOCs, totalling 343 ppb, were found in well cluster 6, located approximately 700 feet southeast of the landfill boundary at the radio tower off Blydenburgh Road. The New York State MCLs for individual organic compounds are 5 ppb for Principal Organic Contaminants (POCs), 50 ppb for Unspecified Organic Contaminants (UOCs), and 100 ppb for combined POCs and UOCs (total organic compounds).

At well cluster 6, contaminants were detected down to the upper portion of the Magothy aquifer. The Magothy and the overlying Glacial aquifer are separated by a less permeable clayey sand zone, that was found in varying thicknesses throughout the study area. A deeper well, 6M-1, drilled 545 feet below ground surface, did not have detectable levels of VOCs, indicating that contamination does not appear to penetrate deep into the Magothy aquifer.

High levels of VOCs were also found in the deep monitoring well located at well cluster 7. It is uncertain whether this contamination is attributable to the landfill, since the groundwater samples from well cluster 7 did not contain the inorganic contaminants typical of landfill leachate. In addition, the shallow well at this location did not contain high levels of VOCs, suggesting that the source lies upgradient. A supplemental investigation was begun in June 1992 to provide additional information as to the source and extent of this contamination.

Two SVOCs, phenols and bis(2-ethylhexyl)phthalate were detected in only the first round of groundwater sampling at concentration levels higher than ARARs. The highest concentration of bis(2-ethylhexyl)phthalate, 110 ppb, was detected in the upgradient well at site 3. The highest level of total phenols was 40 ppb and was detected in a well at cluster 6. PCBs and pesticides were not detected in groundwater samples. The predominant inorganic compounds detected during the three groundwater sampling rounds were iron, lead, manganese and zinc. Inorganics compounds were usually detected at levels exceeding ARARs in both the upgradient and downgradient wells. However, with the exception of zinc, higher concentration levels of inorganic compounds were detected in downgradient wells when compared to the upgradient well.

Between 1988 and 1991, an air-quality study at the landfill was conducted. On-site sources of landfill gases were sampled during the RI to estimate baseline emissions and potential airborne exposure to hazardous constituents. Landfill gas samples were taken on-site from the feed to the two existing flares and four uncontrolled vents located along Blydenburgh Road. During the sampling, these vents emitted landfill gas directly to the atmosphere. The results of this sampling indicated that the landfill was releasing organic vapors to the surrounding atmosphere (benzene, vinyl chloride, 1,1-dichloroethylene and tetrachloroethylene).

In order to evaluate the air impacts from the Site, an air dispersion model was used to predict the on-site and off-site VOC concentrations from the landfill gas emissions measured on-site. The modelling results indicated that concentrations of vinyl chloride and 1,1-dichloroethylene would exceed New York State Air Guide 1 concentrations (AGC) at modelled receptor locations. The receptor located directly across Blydenburgh Road from the four uncontrolled gas vents exceeded the AGC by the greatest amount. Table 3 lists the ambient air concentrations predicted by the dispersion model, and Figure 5 provides the location of the air modelling receptor locations.

The four vents along the eastern edge of the landfill were discharging directly to the atmosphere at the time when the air modelling was conducted. Since that time, the four vents have been connected to a third flare, which should result in a reduction in landfill gases released to the atmosphere. These flares only burn when enough landfill gas (methane) is present to support combustion.

SUMMARY OF SITE RISKS

A baseline risk assessment was conducted to evaluate the potential risks to human health and the environment associated with the Site. The Risk Assessment focused on contaminants in the groundwater and air which are likely to pose significant risks to human health and the environment. To evaluate the impacts from the groundwater, the groundwater sampling depths were separated into the following three zones: 1) the shallow groundwater zone which corresponds to the Upper Glacial (water-table) aquifer (40 to 45 feet above msl); 2) the intermediate groundwater zone corresponds to the lower Glacial/upper Magothy (83 to 167 feet below msl); and 3) the deep groundwater zone which is deeper in the Magothy (228 to 368 feet below msl). A summary of the contaminants present in the groundwater, along with their frequency-of-detection, range of concentration, and 95% Upper Confidence Limit concentration, are presented in Tables 4 through 6. The VOC concentrations predicted from the air dispersion model were used to evaluate the potential risks to human health from the air. The summary of the contaminants of concern (COC) in the sampled matrices is presented in Table 7. The COC in the air are those that were detected in the flare feed and the four vents.

The baseline risk assessment addressed the potential risk to human health by identifying several potential exposure pathways by which the public may be exposed to contaminant releases at the Site under current and future land-use conditions. The inhalation of impacted air by on-site landfill employees and by off-site adult and child residents was the only exposure pathway considered under the current land-use condition. Since the landfill waste is buried and public well fields are not impacted, exposure to groundwater or contaminated soil has not been identified under the current land-use condition. Under the future land use condition, the exposure pathways included the air pathway identified under the current land-use condition, and the ingestion of, dermal contact with, and inhalation of vapors from impacted groundwater by adult and child residents. Since this is a sole source aquifer from which all residents on Long Island obtain their water, the future residential exposure considered the potential for a well to be installed in either the shallow (Upper Glacial) or the deeper (Magothy) aquifer. The potential pathways of exposure to the COC are presented in Table 8. The reasonable maximum exposure scenario was evaluated.

Under current EPA guidelines, the likelihood of carcinogenic (cancer-causing) and noncarcinogenic effects due to exposure to Site chemicals are considered separately. It was assumed that the toxic effects of the Site-related chemicals would be additive. Thus, carcinogenic and noncarcinogenic risks associated with exposures to individual compounds of concern were summed to indicate the potential risks associated with mixtures of potential carcinogens and noncarcinogens, respectively.

Potential carcinogenic risks were evaluated using the cancer slope factors developed by EPA for the COC. Cancer slope factors (SFs) have been developed by EPA's Carcinogenic Risk Assessment Verification Endeavor for estimating excess lifetime cancer risks associated with exposure to potentially carcinogenic chemicals. SFs, which are expressed in units of $(mg/kg\text{-}day)^{-1}$, are multiplied by the estimated intake of a potential carcinogen, in mg/kg-day, to generate an upper-bound estimate of the excess lifetime cancer risk associated with exposure to the compound at that intake level. The term "upper bound" reflects the conservative estimate of the risks calculated from the SF. Use of this approach makes the underestimation of the risk highly unlikely. The SFs for the COC are presented in Table 9.

The risk calculations were based on the contaminants detected in the monitoring wells. It was assumed that in the future, a public supply well would be installed within the impacted groundwater in either the shallow or intermediate zone. Risk estimates were developed by taking into account various conservative assumptions about the likelihood of a person being exposed to the various contaminated media.

For known or suspected carcinogens, EPA considers excess upper-bound individual lifetime cancer risks of between 10^{-4} to 10^{-6} to be acceptable. This level indicates that an individual has approximately a one in ten thousand to one in a million chance of developing cancer as a result of Site-related exposure to a carcinogen over a 70-year period under specific exposure conditions at the Site. The New York State Department of Health considers a risk exceeding 10^{-6} to be unacceptable. The sum of the future cancer risks for the groundwater exposure pathways for adult and child residents ranged from 1×10^{-4} to 4×10^{-4}. Vinyl chloride, arsenic and beryllium are the major chemicals responsible for the carcinogenic risks from groundwater exposure pathways. The concentrations, exposure doses and the carcinogenic risks for the COC are provided in Tables 10 through 15 for the groundwater pathway and in Tables 16 through 18 for the air pathway. A summary of the carcinogenic risks evaluated across the various exposure pathways is provided in Table 19.

Noncarcinogenic risks were assessed using a hazard index (HI) approach, based on a comparison of expected contaminant intakes and safe levels of intake (Reference Doses). Reference doses (RfDs) have been developed by EPA for indicating the potential for adverse health effects. RfDs, which are expressed in units of mg/kg-day, are estimates of daily exposure levels for humans which are thought to be safe over a lifetime (including sensitive individuals). Estimated intakes of chemicals from environmental media (e.g., the amount of a chemical ingested from contaminated drinking water) are compared to the RfD to derive the hazard quotient for the contaminant in the particular medium. The reference doses for the COC at the landfill are presented in Table 9.

The HI is obtained by adding the hazard quotients for all compounds across all media that impact a particular receptor population. An HI greater than 1.0 indicates that the potential exists for noncarcinogenic health effects to occur as a result of Site-related exposures. The HI provides a useful reference point for gauging the potential significance of multiple contaminant exposures within a single medium or across media. The concentrations, exposure doses and the noncarcinogenic risks for the COC are provided in Tables 10 through 15 for the groundwater pathway and in Tables 16 through 18 for the air pathway. A summary of the noncarcinogenic and carcinogenic risks evaluated for the various exposure pathways is provided in Table 19.

It can be seen from Table 19 that the HIs for noncarcinogenic effects from the inhalation of impacted air by workers or residents was below 1. The HIs for the shallow (Upper Glacial) and intermediate (Magothy) groundwater exposure pathway were 5 and 3 for child resident, and 12 and 6 for adult resident, respectively. Therefore, noncarcinogenic risk may occur from the ingestion of groundwater under the future land-use condition. The noncarcinogenic risk was attributable to several compounds, the most significant of which were antimony, thallium and VOCs (benzene, trichloroethene, tetrachloroethene, and vinyl chloride).

More specific information concerning public health risks, including a quantitative evaluation of the degree of risk associated with various exposure pathways, is presented in the Risk Assessment Report.

Data generated during the RI indicated that wetlands, cultural/historical properties and significant agricultural lands are not affected by the Site. Several designated wetlands were identified in the surrounding area, but groundwater data indicated that the landfill contaminant plume is not impacting them.

Uncertainties

The procedures and inputs used to assess risks in this evaluation, as in all such assessments, are subject to a wide variety of uncertainties. In general, the main sources of uncertainty include:

- environmental chemistry sampling and analysis
- environmental parameter measurement
- fate and transport modeling
- exposure parameter estimation
- toxicological data.

Uncertainty in environmental sampling arises in part from the potentially uneven distribution of chemicals in the media sampled. Consequently, there is significant uncertainty as to the actual levels present. Environmental chemistry-analysis error can stem from several sources including the errors inherent in the analytical methods and characteristics of the matrix being sampled.

Uncertainties in the exposure assessment are related to estimates of how often an individual would actually come in contact with the COC, the period of time over which such exposure would occur, and in the models used to estimate the concentrations of the chemicals of concern at the point of exposure.

Uncertainties in toxicological data occur in extrapolating both from animals to humans and from high to low doses of exposure, as well as from the difficulties in assessing the toxicity of a mixture of chemicals. These uncertainties are addressed by making conservative assumptions concerning risk and exposure parameters throughout the assessment. As a result, the Risk Assessment provides upper-bound estimates of the risks to populations near the Site, and is highly unlikely to underestimate actual risks related to the Site.

Actual or threatened releases of hazardous substances from this Site, if not addressed by implementing the response action selected in the Record of Decision (ROD), may present a significant and substantial endangerment to the public health, welfare, or the environment.

REMEDIAL ACTION OBJECTIVES

Remedial action objectives are specific goals to protect human health and the environment. These objectives are based on available information and standards such as ARARs and risk-based levels established in the risk assessment.

The purpose of the response action is to: 1) minimize the infiltration of rainfall or snow melt into the landfill, thus reducing the quantity of water percolating through the landfill materials and leaching out contaminants; 2) prevent inhalation of vapors from the landfill; 3) reduce the movement and toxicity of the contaminated landfill leachate into groundwater, and subsequent downgradient migration of contaminants; 4) reduce the movement and toxicity of contaminants in the groundwater; and 5) restore the aquifer to drinking-water quality.

DESCRIPTION OF REMEDIAL ALTERNATIVES

CERCLA, as amended by SARA, requires that each selected Site remedy be protective of human health and the environment, be cost-effective, comply with other ARARs, and utilize permanent solutions, alternative treatment technologies and resource recovery technologies to the maximum extent practicable. In addition, the statute includes a preference for the use of treatment as a principal element for the reduction of toxicity, mobility, or volume of the hazardous substances.

As described below, this ROD evaluates in detail 8 remedial alternatives for addressing the contamination associated with the Site. The time to construct and the time to implement reflect only the time required to construct or implement the remedy, respectively, and do not include the time required to design the remedy or procure contracts for design and construction.

Alternative 1: No Further Action

Capital Cost:	$0
Operation and Maintenance (O & M) Cost:	$0
Present Worth Cost:	$0
Time to Implement:	0

The Superfund program requires that the "no action" alternative be considered as a baseline for comparison with the other alternatives. However, since an intermediate cap and liner/leachate collection system have already been installed in the northern section of the landfill, it would be inappropriate to term this a "no action" alternative. Therefore from this point on a "no further action" alternative is being considered as a baseline for comparison. The "no further action" alternative does not include any additional physical remedial measures that address the contamination at the Site.

Because this alternative would result in contaminants remaining on-site above health-based levels, CERCLA requires that the Site be reviewed every five years. If justified by the review, remedial actions may be implemented to remove or treat the wastes.

Alternative 2: Landfill Cap, Monitoring and Institutional Actions

Capital Cost:	$11,755,800
Present Worth O & M Cost:	$ 3,470,400
Present Worth Total Cost:	$15,226,200
Time to construct:	30 months
Time to implement:	0

This alternative consists of capping 52 acres of the landfill, groundwater- and air-monitoring programs, institutional controls, and installation of an early detection mechanism to serve as a warning system should contaminated groundwater migrate beyond the existing monitoring well network and toward the Nicholls Road Well Field. The institutional actions include the recommendations for deed and well restrictions and the contingency to provide potable water to any well determined to be impacted by the plume. The deed restriction would prohibit access to the Site. The well restrictions would prohibit the installation of wells on the Site or in the area of impacted groundwater. As part of the monitoring program, groundwater and air would be sampled annually to monitor the migration of contaminated groundwater and evaluate compliance with ambient air standards.

The cap would be a modified geosynthetic membrane cap designed in compliance with 6 NYCRR Part 360. The modified design includes supplemental elements to a conventional Part 360 cap, and is designed to improve drainage above the cap, ensure stability on slopes exceeding 3:1, and incorporate the use of Rolite-treated ash in the gas-venting layer.

Rolite-treated ash is part of a NYSDEC approved research and development program being implemented by the Town of Islip to evaluate the potential uses for ash residue. Rolite-treated ash would be obtained from the treatment of bottom and fly ash residue from the Islip Resource Recovery Facility (IRRF). The ash is currently mixed with cement in a rotary mill to form an aggregate material. The Rolite-treated ash demonstration project will evaluate the leachability and the long-term performance of the material as a gas-venting layer. The Rolite-treated ash aggregate would be utilized only in the portion of the landfill which has a double liner and leachate-collection system (northern section of the landfill) to ensure protection of the groundwater in the event that contaminants leach out of the ash. In case the Rolite gas-venting layer deteriorates, a redundant gas-venting layer would be included in the area containing the Rolite-treated ash. The redundant gas-venting layer would consist of sand.

The sections of the cap are presented in Figure 6, and include the following layers from top to bottom:

- An 18-inch sand/compost mix to support vegetation;
- A 12-inch sand layer to provide additional protection for the cap membrane and drainage;
- A drainage composite layer to enhance runoff directly above the membrane;
- A 60-mil High Density Polyethylene membrane;
- A Geotextile filter fabric to provide additional gas-venting capacity;
- A 12-inch layer of sand (southern section) or Rolite-treated incinerator ash (northern section) as the primary gas-venting layer;
- A Geotextile filter fabric to separate the primary gas-venting layer from the intermediate cover. The intermediate cover is also designed to function as the secondary gas-venting layer; and
- A 12-inch layer of intermediate cover which would be the redundant sand gas-venting layer for the area where Rolite-treated ash would be utilized.

Because this alternative would result in contaminants remaining on-site above health-based levels, CERCLA requires that the Site be reviewed every five years (five year review) to ensure that the remedy continues to provide adequate protection of human health and the environment. If justified by the review, additional remedial actions may be implemented.

ALTERNATIVE 3A: Cap, Pump and Treat All Groundwater Contaminated Above ARARs (Treatment by Aeration/Activated Carbon)

Treatment Capital Cost:	$ 1,893,900
Landfill Capital Cost:	$11,676,000
Present Worth O & M Cost:	$ 7,644,410
Present Worth Total Cost:	$21,214,310
Time to Construct:	30 months
Time to Implement:	30+ years

This alternative consists of Alternative 2 (less the early detection mechanism), extracting all impacted groundwater above drinking water standards, treating extracted groundwater by aeration, and discharging treated groundwater to an on-site recharge basin. The groundwater-monitoring program would consist of utilizing existing downgradient monitoring wells to monitor the groundwater with a contingency to add additional monitoring wells, if necessary. In addition, activated carbon would be used, if necessary, to ensure that New York State Pollutant Discharge Elimination System (SPDES) standards would be met. Air pollution control equipment would be used, if necessary, to ensure compliance with air emissions standards.

In order to capture the entire plume of contaminated groundwater, it is estimated that four extraction wells pumping a combined 300 gallons per minute would be required. Two wells would be located at the downgradient edge of the known contaminant plume in each of the two hydrogeologic zones. It is estimated that at least 30 years of pumping would be required to reduce contaminant concentrations to drinking water standards. The well locations and pumping rates would be refined based on an aquifer pump test conducted during the design phase.

The groundwater treatment facility would be located over the contaminated aquifer on property owned by the Town. Treated groundwater would be discharged to an on-site recharge basin. Site-specific discharge standards would be determined in compliance with SPDES discharge standards. Treatment of extracted groundwater by aeration was demonstrated in a treatability study to be effective in removing VOCs from groundwater. It is not known at this time whether aeration alone would reduce inorganic contaminants to levels that meet discharge standards. Additional treatability studies would be required during the design phase to determine whether these standards could be met. Any residual sludge generated by this treatment process would be disposed of in accordance with applicable regulations. If activated carbon were required to achieve SPDES standards, it would either be regenerated or disposed of in accordance with applicable regulations.

Because this alternative would result in contaminants remaining on-site above health-based levels, five year reviews would be required. If justified by the review, additional remedial actions may be implemented.

ALTERNATIVE 3B: Cap, Pump and Treat All Groundwater Contaminated Above ARARs (Treatment by Chemical Precipitation/Air Stripping)

Treatment Capital Cost:	$ 2,135,400
Landfill Capital Cost:	$11,676,000
Present Worth O & M Cost:	$12,500,310
Present Worth Total Cost:	$26,311,710
Time to Construct:	30 months
Time to Implement:	30+ years

This alternative is identical to Alternative 3A, except that extracted groundwater would be treated by chemical precipitation for removal of metals, and VOCs would be removed by air stripping and activated carbon, as necessary.

Because this alternative would result in contaminants remaining on-site above health-based levels, five year reviews would be required. If justified by the review, additional remedial actions may be implemented.

ALTERNATIVE 3C: Cap, Pump and Treat All Groundwater Contaminated Above ARARs (Treatment by Ultraviolet (UV)/Peroxidation)

Treatment Capital Cost:	$ 3,857,400
Landfill Capital Cost:	$11,676,000
Present Worth O & M Cost:	$24,612,173
Present Worth Total Cost:	$40,145,570
Time to Construct:	30 months
Time to Implement:	30+ years

This alternative is identical to Alternative 3A, except that extracted groundwater would be treated by UV/Peroxidation. In addition, pretreatment of groundwater to remove inorganic compounds would be implemented, if necessary, to meet SPDES discharge standards.

UV/Peroxidation is an innovative treatment technology that breaks apart organic compounds by exposing them to UV light in the presence of peroxide with ozone and proprietary catalysts, if necessary. The chlorinated organic contaminants of concern at this Site would be broken down to carbon dioxide and hydrochloric acid. A treatability study conducted during the FS showed that the UV/Peroxidation could effectively treat contaminated groundwater at the Site, but would require the use of a proprietary catalyst to destroy certain constituents (1,1-dichloroethane). As a result, treatment costs would be significantly higher than for conventional treatment.

Because this alternative would result in contaminants remaining on-site above health-based levels, five year reviews would be required. If justified by the review, additional remedial actions may be implemented to remove or treat the wastes.

ALTERNATIVE 4A: Cap, Pump and Treat All Groundwater Contaminated Above 50 ppb of Total VOCs (Treatment by Aeration/Activated Carbon)

Treatment Capital Cost:	$ 1,677,150
Landfill Capital Cost:	$11,676,000
Present Worth O & M Cost:	$ 4,588,875
Present Worth Total Cost:	$17,942,025
Time to Construct:	30 months
Time to Implement:	10 years

This alternative consists of Alternative 2 (less the early detection mechanism), pumping all groundwater contaminated above 50 ppb of total VOCs, treating extracted groundwater by aeration, and discharging treated groundwater to an on-site recharge basin. The groundwater-monitoring program would consist of utilizing existing downgradient monitoring wells to monitor the groundwater with a contingency to add additional monitoring wells, if necessary. It is expected that this action, in conjunction with natural attenuation processes, would restore the aquifer to drinking water quality in the long term. During the operation of the pump and treat system, the effectiveness of the system in achieving restoration of the aquifer to drinking-water quality would be evaluated to determine whether modifications to the system would be required to achieve this goal. Activated carbon would be used, if necessary, to ensure that SPDES discharge standards would be met. Air pollution control equipment would be used, if necessary, to ensure compliance with air emissions standards.

In order to capture the portion of the contaminant plume where the concentration of total VOCs exceeds 50 ppb, it is estimated that four extraction wells pumping a combined rate of 200 gallons per minute would be required. Two wells would be located at the downgradient edge of the 50 ppb contour in each of the two contaminated hydrogeologic zones. It is estimated that 6.5 years of pumping would be required to remove one pore volume of water from the portion of the aquifer contaminated above 50 ppb. Although it is difficult to estimate the number of extracted pore volumes required to restore the aquifer to drinking-water quality, EPA and NYSDEC believe that significant contaminant reduction would be achieved in 10 years (1 1/2 pore volumes). The well locations and pumping rates would be refined based on an aquifer pump test conducted during the design phase.

The groundwater treatment facility would be located over the contaminated aquifer on property owned by the Town. Treated groundwater would be discharged to an on-site recharge basin. Site-specific discharge standards would be determined in compliance with SPDES discharge standards. Treatment of extracted groundwater by aeration was demonstrated in a treatability study to be effective in removing VOCs from groundwater. It is not known at this time whether aeration alone would reduce inorganic contaminants to a level that meets discharge standards. Additional treatability studies would be required during the design phase to determine whether these standards could be met. Any residual sludge generated by this treatment process would be disposed of in accordance with applicable regulations.

Because this alternative would result in contaminants remaining on-site above health-based levels, five year reviews would be required. If justified by the review, additional remedial actions may be implemented.

ALTERNATIVE 4B: Cap, Pump and Treat Groundwater Contaminated Above 50 ppb Total VOCs (Treatment by Chemical Precipitation/Air Stripping)

Treatment Capital Cost:	$ 1,986,150
Landfill Capital Cost:	$11,676,000
Present Worth O & M Cost:	$ 6,639,230
Present Worth Total Cost:	$20,301,400
Time to Construct:	30 months
Time to Implement:	10 years

This alternative is identical to Alternative 4A, except that extracted groundwater would be treated by chemical precipitation of metals and air stripping of VOCs and activated carbon, as necessary. Sludge generated by the chemical precipitation process would be disposed of in accordance with applicable regulations. If activated carbon were required to achieve SPDES standards, it would either be regenerated or disposed of in accordance with applicable regulations.

Because this alternative would result in contaminants remaining on-site above health-based levels, five year reviews would be required. If justified by the review, additional remedial actions may be implemented.

ALTERNATIVE 4C: Cap, Pump and Treat Groundwater Contaminated Above 50 ppb Total VOCs (Treatment by UV/Peroxidation)

Treatment Capital Cost:	$ 3,279,900
Landfill Capital Cost:	$11,676,000
Present Worth O & M Cost:	$10,487,690
Present Worth Total Cost:	$25,443,590
Time to Construct:	30 months
Time to Implement:	10 years

This alternative is identical to Alternative 4A, except that extracted groundwater would be treated by UV/Peroxidation. Pretreatment of groundwater to remove inorganics would be implemented, if necessary, to meet SPDES discharge standards.

Because this alternative would result in contaminants remaining on-site above health-based levels, five year reviews would be required. If justified by the review, additional remedial actions may be implemented.

SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

During the detailed evaluation of remedial alternatives, each alternative was assessed utilizing nine evaluation criteria as set forth in the NCP and the Office of Solid Waste and Emergency Response (OSWER) Directive 9355.3-01. These criteria were developed to address the requirements of Section 121 of CERCLA to ensure all important considerations are factored into remedy selection decisions.

The following "threshold" criteria are the most important, and must be satisfied by any alternative in order to be eligible for selection:

1. Overall protection of human health and the environment addresses whether or not a remedy provides adequate protection and describes how risks posed through each exposure pathway (based on a reasonable maximum exposure scenario) are eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls.

2. Compliance with ARARs addresses whether or not a remedy would meet all of the applicable, or relevant and appropriate requirements of federal and state environmental statutes and requirements or provide grounds for invoking a waiver.

The following "primary balancing" criteria are used to make comparisons and to identify the major trade-offs between alternatives:

3. Long-term effectiveness and permanence refers to the ability of a remedy to maintain reliable protection of human health and the environment over time, once cleanup goals have been met. It also addresses the magnitude and effectiveness of the measures that may be required to manage the risk posed by treatment residuals and/or untreated wastes.

4. Reduction of toxicity, mobility, or volume through treatment is the anticipated performance of a remedial technology, with respect to these parameters, that a remedy may employ.

5. Short-term effectiveness addresses the period of time needed to achieve protection and any adverse impacts on human health and the environment that may be posed during the construction and implementation periods until cleanup goals are achieved.

6. Implementability is the technical and administrative feasibility of a remedy, including the availability of materials and services needed.

7. Cost includes estimated capital and operation and maintenance costs, and the present worth costs.

The following "modifying" criteria are considered fully after the formal public comment period on the Proposed Plan is complete:

8. State acceptance indicates whether, based on its review of the RI/FS and the Proposed Plan, the State supports, opposes, and/or has identified any reservations with the preferred alternative.

9. Community acceptance refers to the public's general response to the alternatives described in the Proposed Plan and the RI/FS reports. Factors of community acceptance to be discussed include support, reservation, and opposition by the community.

A comparative analysis of the remedial alternatives based upon the above evaluation criteria follows.

Overall Protection of Human Health and the Environment

Alternative 1 (No Action) would be the least protective alternative in terms of both human health and the environment. Alternative 2 (Capping, Monitoring and Institutional Actions) would protect human health by restricting access to contaminated groundwater and thus eliminate exposure pathways. However, EPA prefers not to substitute institutional controls for active response measures (e.g., treatment for restoration of the groundwater). The landfill cap would provide additional protection to human health by reducing the generation of landfill leachate. Continued monitoring of air emissions with a contingency for additional controls would ensure acceptable ambient air concentrations. Alternative 2 would not be protective of the environment, because the contaminants would remain in the aquifer.

Alternatives 3A, 3B and 3C would provide the greatest degree of human health and environmental protection. By pumping and treating all contaminated groundwater, the aquifer could be restored in the long term (more than 30 years). Human health would be protected in similar fashion as for Alternative 2. The different treatment methods in Alternatives 3A, 3B and 3C would all provide the same degree of health and environmental protection. Alternatives 3A and 3B would generate some air emissions that may require control measures to meet air quality criteria.

Alternatives 4A, 4B and 4C would provide a slightly lesser degree of environmental protection than Alternatives 3A, 3B and 3C because a portion of the contaminant plume would not be captured. These areas of contamination would degrade and dilute in the long term, and environmental protection would be achieved after a longer period of time than for Alternatives 3A, 3B and 3C. Human health would be protected to the same degree as for Alternatives 2, 3A, 3B and 3C. The different treatment methods in Alternatives 4A, 4B and 4C would all provide the same degree of human health and environmental protection. Alternatives 4A and 4B would generate some air emissions that may require control measures to meet air quality criteria.

Compliance with ARARs

An action-specific ARAR for this Site is the landfill capping/closure requirement of 6 NYCRR Part 360. Alternatives 2, 3A, 3B, 3C, 4A, 4B, and 4C would all fulfill the provisions of this regulation. Alternative 1 would not meet this ARAR.

Chemical-specific ARARs for groundwater at the Site are state and federal drinking water standards, including EPA MCLs, 10 NYCRR Part 5, and 6 NYCRR Part 703 standards. Alternative 2 would rely entirely on natural attenuation processes to attain chemical-specific ARARs in the aquifer and would not be expected to achieve ARARs in a reasonable amount of time. Alternatives 3A, 3B and 3C would be expected to meet groundwater ARARs in the long term (at least 30 years). Alternatives 4A, 4B and 4C would require a longer period of time to meet groundwater ARARs because it relies, in part, upon natural attenuation processes. The time frame for meeting ARARs by this alternative would be longer than Alternatives 3A, 3B and 3C, but much less than Alternative 2.

Chemical-specific discharge standards established by SPDES would be met by all treatment alternatives. ARARs associated with air emissions would be met to an equal degree by Alternatives 2, 3A, 3B, 3C, 4A, 4B and 4C. Re-sampling and annual monitoring of landfill gas emissions would ensure that adequate control of methane and VOCs is maintained. Aeration and air stripping processes under Alternatives 3A, 3B, 4A and 4B would be designed to comply with applicable air emissions criteria.

Location-specific ARARs would be met for all alternatives. Based on data generated during the RI, wetlands, cultural/ historical properties and significant agricultural lands are not affected by the Site and would not be expected to be affected by any remedial actions.

Long-Term Effectiveness and Permanence

None of the alternatives provide for treatment of contamination present in the landfill as a permanent means of eliminating or reducing the source of contamination. Alternatives 2, 3A, 3B, 3C, 4A, 4B and 4C would provide containment of the waste by capping. The cap and stormwater collection system would reduce the migration of contaminants from the landfill by reducing the amount of leachate generated. The landfill cap would require annual maintenance to ensure the impermeability of the membrane and proper functioning of the stormwater collection structures.

Based on the groundwater flow model prepared as part of the FS, Alternatives 4A, 4B and 4C would require an estimated 6.5 years to extract one pore volume of contaminated groundwater. Although it is difficult to estimate the number of extracted pore volumes required to achieve the remedial goal, EPA and DEC believe that significant contaminant reduction would be achieved in 10 years (1 1/2 pore volumes). Contaminant removal for any of the pump and treat alternatives may be enhanced during operation of the system by varying extraction rates, instituting a pulsed pumping schedule and installing additional extraction wells. The operation of the selected extraction system and the goals of the groundwater remediation may be periodically re-evaluated based on monitoring the performance of the system, including the natural attenuation of uncaptured, low-level contaminants. This approach is consistent with recent EPA and DEC groundwater remediation strategy documents.

Alternatives 4A, 4B and 4C would differ from Alternatives 3A, 3B and 3C in the location of extraction wells and the amount of contaminated groundwater extracted. Alternatives 4A, 4B and 4C would rely on natural attenuation processes to reduce the concentration of the low-level contamination left in the aquifer over time. The advantage of this approach is that a greater mass of contaminants are removed from the aquifer in the short term and not allowed to sink deeper into the Magothy Aquifer due to the location of the extraction wells. However, in the long run, it is anticipated that Alternatives 3A, 3B and 3C would remove a greater mass of contaminants.

Treatment of extracted contaminants by three options (aeration, air stripping and UV/Peroxidation) would offer differing degrees of permanence when all media are considered. UV/Peroxidation is destructive of all organic COC at this Site. Aeration and air stripping are potentially destructive technologies, if air emissions were controlled by carbon adsorption and the spent carbon were regenerated through incineration. The specific need for carbon adsorption would be determined during the design of the selected alternative.

Because waste would remain on Site under each alternative, a five-year review would be required to ensure that the selected remedy remains protective of human health and the environment. Long-term monitoring would be required to track the spread of contamination under Alternatives 1 and 2, and to monitor the effectiveness of Alternatives 3A, 3B, 3C, 4A, 4B and 4C.

Reduction in Toxicity, Mobility, or Volume through Treatment

Alternatives 2, 3A, 3B, 3C, 4A, 4B and 4C would reduce the mobility of contaminants by capping and thereby minimizing leachate generation. Alternatives 3A, 3B, 3C, 4A, 4B and 4C would also achieve a reduction in toxicity, mobility and volume of contaminants in the aquifer via extraction and treatment of the groundwater. Alternatives 3A, 3B, and 3C would differ from Alternatives 4A, 4B and 4C in the mass of contaminants potentially removed from the aquifer. Of the estimated 700 pounds of contaminants present in the groundwater plume, Alternatives 4A, 4B and 4C would remove approximately 425 pounds. Alternatives 3A, 3B and 3C would remove a greater mass of contaminants and could theoretically remove most of the estimated 700 pounds of total VOCs.

Short-Term Effectiveness

Construction of the landfill cap may generate fugitive dust during placement of the sand and Rolite gas venting layers. Strict fugitive dust standards would be enforced during construction to ensure the safety of on-site workers and off-site receptors.

Because Alternatives 4A, 4B and 4C would have pumping wells located in more heavily contaminated areas than Alternatives 3A, 3B and 3C, Alternatives 4A, 4B and 4C would remove contaminants more effectively in the short term. It is estimated that Alternatives 3A, 3B and 3C would require 5 years to begin capturing the high levels of contamination that would be captured immediately by Alternatives 4A, 4B and 4C. Alternative 1 is the least effective in the short term.

Implementability

Alternatives 2, 3A, 3B, 3C, 4A, 4B and 4C all specify construction of a landfill cap, which involves well established construction methods. However, a 52-acre cap is a relatively large construction project, and some technical problems may be encountered.

Alternatives 3A, 3B, 3C, 4A, 4B and 4C would also require installation of extraction wells, piping and treatment systems. These technologies are well developed and of moderate complexity to construct. Consequently, these alternatives would be more difficult to implement than Alternative 2. Alternatives 3A and 4A would require additional treatability testing to determine whether aeration can successfully remove inorganic constituents to levels that meet discharge requirements. Alternatives 3C and 4C involve an innovative treatment technology (UV/Peroxidation) that could potentially delay start-up times and increase cost. The technologies utilized in Alternatives 3B and 4B therefore would be easier to implement than the technologies utilized in Alternatives 3A, 3C, 4A, and 4C.

All of the alternatives would require some degree of institutional management. Long-term monitoring would be required to track the spread of contamination under Alternatives 1 and 2 and to monitor the effectiveness of Alternatives 3A, 3B, 3C, 4A, 4B and 4C. Alternatives 1 and 2 would require more coordination with state and county public health officials to ensure that the uncontrolled groundwater plume would not impact public or private water supplies. Alternatives 4A, 4B and 4C would require a lesser degree of coordination to monitor the areas of the plume that would not be captured by the extraction system. Alternatives 3A, 3B and 3C would require the least degree of institutional management.

Cost

Present worth cost estimates consider a 5 percent discount rate and a 30-year operational period. The present worth costs are as follows:

Alternative 1	$ 0
Alternative 2	$ 15,226,200
Alternative 3A	$ 21,214,310
Alternative 3B	$ 26,311,710
Alternative 3C	$ 40,145,570
Alternative 4A	$ 17,942,025
Alternative 4B	$ 20,301,400
Alternative 4C	$ 25,443,590

When compared respectively to Alternatives 4A, 4B and 4C, the higher present worth cost for Alternatives 3A, 3B and 3C reflect a higher present worth O & M cost. When comparing similar extraction rates, Alternatives 3C and 4C would have the highest present worth cost and reflect utilizing UV/Peroxidation as a treatment technology to remove VOCs.

State Acceptance

NYSDEC has been the lead for this Site and concurs with the selected remedy. NYSDEC also concurs with the contingency remedy, should it be determined that the contingency remedy, Alternative 4B, is appropriate. The NYSDEC's letter of concurrence is in Appendix IV.

Community Acceptance

In general, the community supports the selected remedy. The community's comments and concerns received during the public comment period are identified and addressed in the Responsiveness Summary which is attached as Appendix V to this document.

SELECTED REMEDY

Based upon the requirements of CERCLA, the detailed analysis of the alternatives, and public comments, both NYSDEC and EPA have determined that Alternative 4A, capping and extraction of groundwater contaminated above 50 ppb with treatment by aeration, is the appropriate remedy for the Site. The present worth cost of this alternative is $17,942,025 which represents a capital cost of $13,353,150 and a present worth O & M cost of $4,588,875. A breakdown of the cost items for Alternative 4A is presented in Table 20.

Capping the landfill will effectively isolate the source from generating leachate that would spread additional contamination into the aquifer. The alternative of extracting groundwater contaminated above 50 ppb will effectively remove contaminant mass from the aquifer, and is a practical, cost-effective approach to achieving the remedial goal of restoring the aquifer to drinking water standards. Extracting and treating the areas of highest contamination in the aquifer will provide short-term effectiveness in extracting contaminants, and, in combination with natural attenuation processes, will reduce pollutant levels to ARARs in the long term. The effectiveness of this approach will be evaluated throughout the operation of the system to determine whether any modification to the system is necessary to achieve the remedial goal. Periodic monitoring will also be used to reassess the time frame and technical practicability of achieving cleanup standards.

Deed restrictions for the Site and restrictions on the use or installation of wells within the contaminant groundwater plume will be recommended to eliminate potential human exposure to wastes and contaminated groundwater. The groundwater monitoring program will be designed to provide an early warning mechanism should contamination migrate toward the Nicholls Road Well Field.

Because the pilot treatability study did not conclusively demonstrate whether aeration would precipitate metals out of solution sufficiently to meet discharge requirements, Alternative 4B (treatment by chemical precipitation and air stripping) will be retained as a contingent remedy. Additional treatability testing will be conducted during the design of the extraction system to verify whether aeration is an acceptable treatment method for inorganics. In addition, the air emissions from the aeration process will be evaluated to determine whether an air pollution control device will be necessary to meet regulatory requirements.

In June 1992, a supplemental groundwater investigation was initiated to determine if the groundwater contamination detected in well 7M-1 were Site-related. If the contamination in well 7M-1 is attributable to the Site, the selected remedy will be appropriately modified during the design stage to accommodate this additional volume of contaminated groundwater. In addition, a supplemental ambient air investigation and evaluation of the landfill gas flares will be conducted to determine whether additional gas-control measures are necessary. If the operating schedule of the flares cannot be modified to provide adequate periods of VOC destruction, supplemental fuel to sustain continuous combustion in the flares will be provided.

The major components of the selected remedy are as follows:

- Installation of a modified geosynthetic membrane cap on the landfill in accordance with the closure requirements for New York State solid waste landfills contained in 6 NYCRR Part 360. The areal extent of the cap is approximately 52 acres. The modified geosynthetic membrane cap includes layers of fill material, drainage layers, an impermeable membrane, and a gas venting system that utilizes Rolite-treated incinerator ash;

- Construction of a stormwater system that will direct and control runoff from the Site to on-site recharge basins;

- o Development and implementation of an on-site groundwater extraction and treatment system. Groundwater contaminated with approximately 50 parts per billion (ppb) of total volatile VOCs or more will be extracted, treated via aeration, and discharged to an on-site recharge basin. Groundwater with a concentration of total VOCs below 50 ppb will be reduced to drinking-water standards through natural attenuation;

- o Implementation of a groundwater-monitoring system to monitor the groundwater contamination plume and to evaluate the effectiveness of the selected remedy;

- o Performance of a treatability study to demonstrate that aeration is effective in precipitating inorganic compounds from the groundwater. If the study demonstrates that this technology is not effective in removing inorganic compounds, then a contingency remedy which utilizes chemical precipitation and air stripping to treat groundwater will be implemented. The contingency remedy is identical to the selected remedy in all other aspects;

- o Determination of whether carbon adsorption will be required as a polishing treatment step to ensure compliance with SPDES discharge standards during treatability testing;

- o Evaluation of the groundwater treatment system to determine whether an air pollution control device will be necessary to comply with air emission requirements;

- o Collection of ambient air samples to determine whether additional landfill gas control measures will be necessary. If ambient air samples indicate that landfill gas emissions from the three existing flares are unacceptable, and operation of the current flare system cannot be modified to reduce VOC emissions while maintaining perimeter subsurface control of explosive gas, then supplemental fuel will be provided to sustain combustion in the flares;

- o Completion and evaluation of the supplemental groundwater investigation begun in June 1992, to determine whether the groundwater contamination detected at well cluster 7 (well 7M-1) is Site-related. If the contamination in well 7M-1 is attributable to the Site, then the design of the proposed remedy will be modified to address it;

- o Development of an air-monitoring system to ensure compliance with ambient air standards; and

- o Recommendations that deed and well restrictions be imposed to prevent the installation of drinking water wells in impacted areas.

The selected remedy and the contingency remedy represent the best balance of trade-offs among alternatives with respect to the evaluating criteria. NYSDEC and EPA believe that the selected remedy and the contingency remedy will be protective of human health and the environment, will comply with ARARs, will be cost-effective, and will utilize permanent solutions and treatment technologies to the maximum extent practicable. Because treatment of the principal threats of the Site was not found to be practicable, this remedy and contingency remedy do not satisfy the statutory preference for treatment as a principal element of the source control portion of the remedy. However, the selected and contingency remedy do call for the treatment of contaminated groundwater at the Site and hence satisfy the preference for treatment for this portion of the remedy.

Remediation Goals

The purpose of this response action is to reduce the present risk to human health and the environment due to contaminants leaching from the landfill. The capping of the landfill will minimize the infiltration of rainfall and snow melt into the landfill, thereby reducing the potential for contaminants leaching from the landfill and negatively impacting groundwater quality.

The goal of the groundwater portion of the selected remedy is to restore the groundwater to drinking water quality. Based on information obtained during the RI and on a careful analysis of remedial alternatives, NYSDEC and EPA believe that the selected remedy will achieve this goal. It may become apparent, during implementation or operation of the groundwater extraction system, that contaminant levels have ceased to decline and are remaining constant at levels higher than the drinking-water standards over some portion of the contaminated plume. It may also become apparent that natural attenuation processes are effective at reducing a certain level of contamination in the aquifer, in a similar time frame and lower cost than pumping and treating. In these cases, the system performance standards and/or the remedy may be re-evaluated.

The selected remedy will include groundwater extraction for a period which is presently estimated to be 10 years (but which, depending upon the degree of contaminant reduction achieved, may ultimately be a longer or shorter period), during which the system's performance will be carefully monitored on a regular basis and adjusted as warranted by the performance data collected during operation. Modifications may include any or all of the following:

- o Discontinuing pumping at individual wells where cleanup goals have been attained.
- o Alternating pumping at wells to eliminate stagnation.
- o Pulse pumping to allow aquifer equilibration and to allow adsorbed contaminants to partition into groundwater.
- o Installing additional extraction wells to facilitate or accelerate cleanup of the contaminated plume.

During the performance of the long-term monitoring, NYSDEC and EPA may determine that the remedial action objective has been met. Periodic monitoring will be used to re-assess the time frame and the technical practicability of achieving cleanup standards. Upon meeting all remedial objectives, or determining that the Site has been sufficiently purged of contaminants so that public health is no longer threatened by exposure to the Site, EPA will initiate proceedings to delete the Site from the NPL.

STATUTORY DETERMINATIONS

Under its legal authorities, EPA's primary responsibility at Superfund sites is to undertake remedial actions that are protective of human health and the environment. In addition, Section 121 of CERCLA establishes several other statutory requirements and preferences. These specify that when complete, the selected remedial action for this Site must comply with applicable, or relevant and appropriate environmental standards established under federal and state environmental laws unless a statutory waiver is justified. The selected remedy also must be cost-effective and utilize permanent solutions and alternative treatment technologies or resource-recovery technologies to the maximum extent practicable. Finally, the statute includes a preference for remedies that employ treatment that permanently and significantly reduce the volume, toxicity, or mobility of hazardous wastes, as available. The following sections discuss how the selected remedy meets these statutory requirements. The contingency remedy will also meet these requirements.

<u>Protection of Human Health and the Environment</u>

Alternative 4A and the contingency remedy (Alternative 4B) are fully responsive to this criterion and to the identified remedial response objectives. Capping the landfill protects human health and the environment by reducing the mobility of contaminated materials and the leaching of contaminants into the aquifers. The extraction and treatment of contaminants in groundwater in conjunction with natural attenuation will restore the aquifer to state and federal drinking water standards in the long term and concurrently reduce the carcinogenic and noncarcinogenic risks posed by potential exposure to the groundwater.

Compliance with ARARs

Attainment of chemical-specific ARARs for groundwater will be hastened due to reduced leaching following construction of the cap and the extraction and treatment of leachate and groundwater. The cap will comply with the action-specific ARAR for landfill capping/closure requirements. Action- and location-specific ARARs will be complied with during implementation. The specific ARARs for the selected remedy are listed below.

Action-specific ARARs:

- Federal Hazardous Waste Management Requirements (capping requirements, on-site containment, dust control, tank storage, and general closure standards) (Title 40 of the Code of Federal Regulations (40 CFR 262))
- 6 NYCRR 360: Solid Waste Management Facilities
- Federal Hazardous Waste Manifest Requirements for Off-Site Waste Transport (40 CFR 262)
- Department of Transportation (DOT) Rules for Hazardous Materials Transport (49 CFR 171).
- Resource Conservation and Recovery Act (RCRA) Land Disposal Restrictions (40 CFR 268)
- Occupational Safety and Health Administration (OSHA) Standards for Hazardous Material Response (29 CFR 1904, 1910, 1926).
- Standards for Hazardous Waste Transporters (40 CFR 263)
- USEPA Clean Air Act (CAA)
- 6 NYCRR 370: Hazardous Waste Management System - General
- 6 NYCRR 371: Identification and Listing of Hazardous Waste
- 6 NYCRR 372: Hazardous Waste Manifest System and Related Standards for Generators, Transporters, and Facilities
- 6 NYCRR 373: Hazardous Waste Management Facilities

- 6 NYCRR 373-1: Hazardous Waste Treatment, Storage, and Disposal Facility Permitting Requirements
- 6 NYCRR Part 200 - General Air Provisions
- 6 NYCRR Part 201 - Air Permits and Certificates
- 6 NYCRR Part 211 - General Prohibitions
- 6 NYCRR Part 212 - General Process Emission Sources
- 6 NYCRR Part 257 - Air Quality Standards
- 6 NYCRR Part 50 - National Primary and Secondary Ambient Air Quality Standards
- National Historic Preservation Act (16 U.S.C. 470-470 et seq.)
- Endangered Species Act (16 U.S.C. 1531 et seq.)
- Farmland Protection Policy Act

Chemical-specific ARARs:

- USEPA Safe Drinking Water Act (SDWA), MCLs and MCL Goals (40 CFR Part 141)
- NYSDEC Groundwater Quality Regulations (6 NYCRR Parts 700-705)
- NYSDOH Maximum Contaminant Levels, Public Water Supplies (10 NYCRR Subpart 5-1)
- USEPA National Emission Standards for Hazardous Air Pollutants (40 CFR Part 61)

Location-Specific ARARs

- Executive Order 11990 - Protection of Wetlands
- Clean Water Act (33 U.S.C. 1251 et seq.), Section 404

Other Criteria, Advisories, or Guidance to be Considered

- NYSDEC Air Guide-1 (draft, 1991 Edition)
- NYSDEC Technical and Operational Guidance Series (TOGS)
- Executive Order 11988 (Floodplain Management)

- EPA Statement of Policy on Floodplains and Wetlands Assessments for CERCLA Actions

- New York State Air Cleanup Criteria, January 1990

Cost-Effectiveness

The selected remedy provides overall effectiveness proportional to its cost. The estimated present worth cost of the selected remedy is $17,942,025, which represents capital and present worth O & M costs of $13,353,150 and $4,588,875, respectively. The estimated present worth cost of the contingency remedy is $20,301,400, which represents capital and present worth costs of $13,662,150 and $6,639,230, respectively.

Utilization of Permanent Solutions and Alternative Treatment Technologies to the Maximum Extent Practicable

The selected remedy and the contingency remedy utilize permanent solutions and treatment technologies to the maximum extent practicable. The selected remedy represents the best balance of trade-offs among the alternatives with respect to the evaluation criteria.

The extraction and subsequent treatment of groundwater will permanently and significantly reduce the toxicity, mobility, and volume of contaminants in the groundwater. A treatability study will be performed to demonstrate whether the selected remedy will also be effective in treating inorganic contaminants in the groundwater. If the treatability study indicates that this technology is not effective, then the contingency remedy, Alternative 4B, shall be implemented.

The construction of the landfill cap will reduce the mobility of contaminated material and the leaching of contaminants into the aquifer. No major technological problems should arise since the technologies for capping the landfill are readily available.

Preference for Treatment as a Principal Element

The statutory preference for remedies that employ treatment as a principal element cannot be satisfied for the landfill itself, since treatment of the landfill material is not practicable. The size of the landfill, the location of the hazardous waste beneath an intermediate landfill cap and leachate collection system, and the fact that there are no identified on-site hot spots that represent the major sources of contamination preclude a remedy in which contaminants could be excavated and treated effectively. However, the selected remedy and the contingency remedy call for the treatment of contaminated groundwater at the Site and, hence, satisfy the preference for treatment for this portion of the remedy.

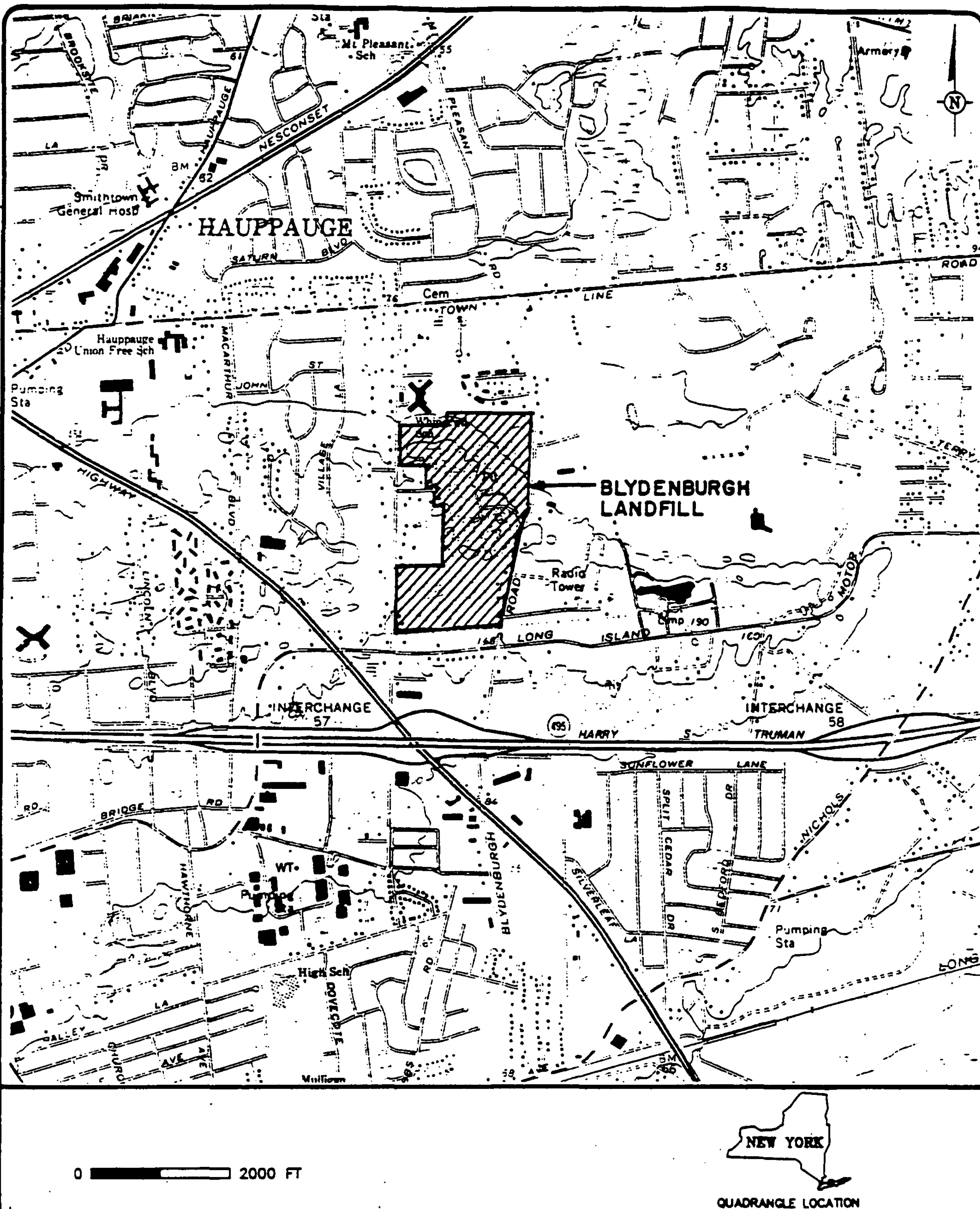
DOCUMENTATION OF SIGNIFICANT CHANGES

There are no significant changes from the preferred alternative presented in the Proposed Plan.

APPENDIX I

FIGURES

FIGURES



GERAGHTY & MILLER, INC.
Environmental Services

LOCATION OF THE BLYDENBURGH LANDFILL, HAUPPAUGE, NEW YORK

TOWN OF ISLIP
ISLIP, NEW YORK

FIGURE 1

DRAFTER: V. CARUNCHO | APPROVED: B.B. | CHECKED: A.N. | DRAWING: TOPO | FILE NO.: 1400 | PRJCT NO.: NY18405 | DWG DATE: 5/91

POOR QUALITY ORIGINAL

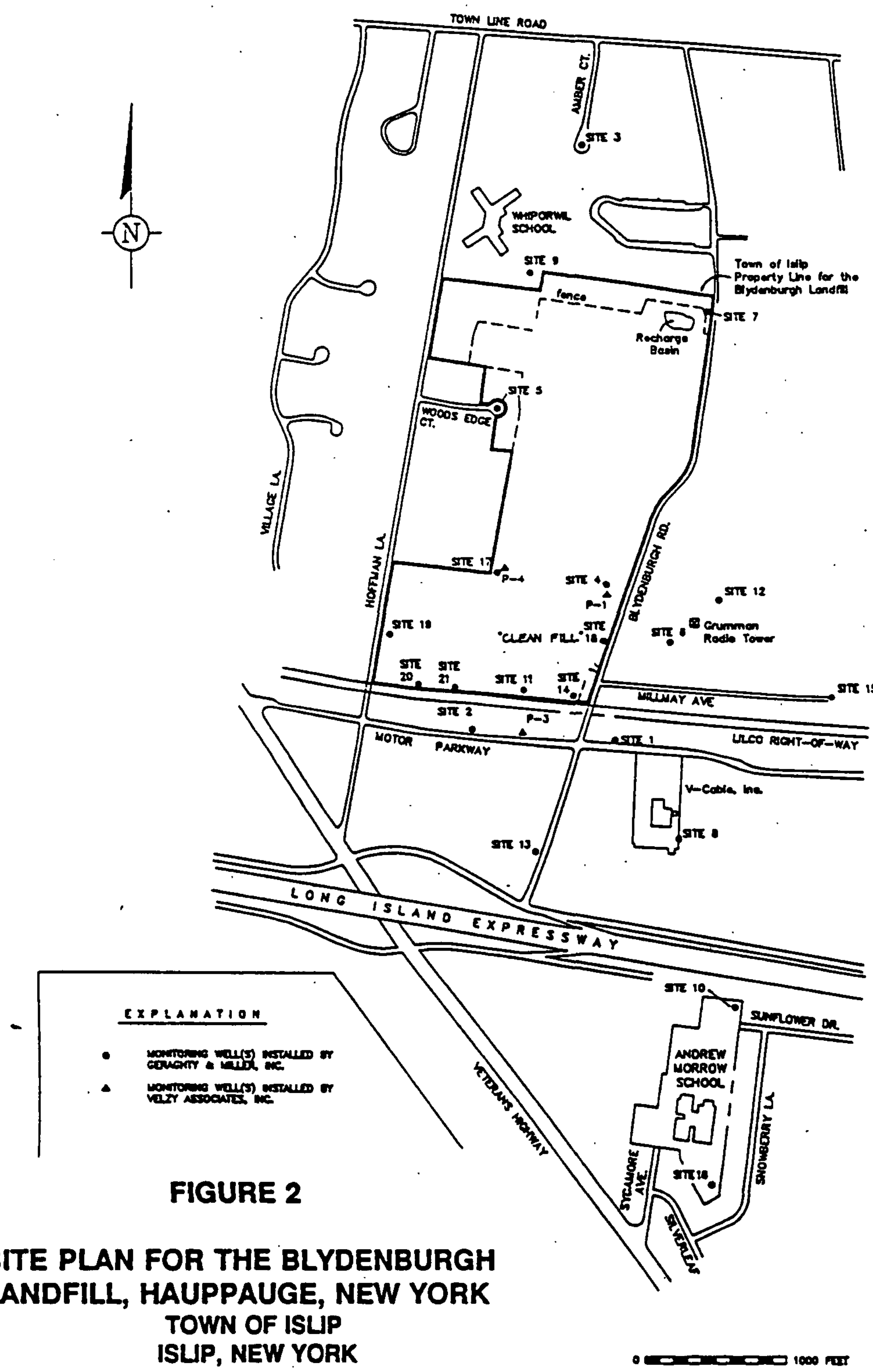
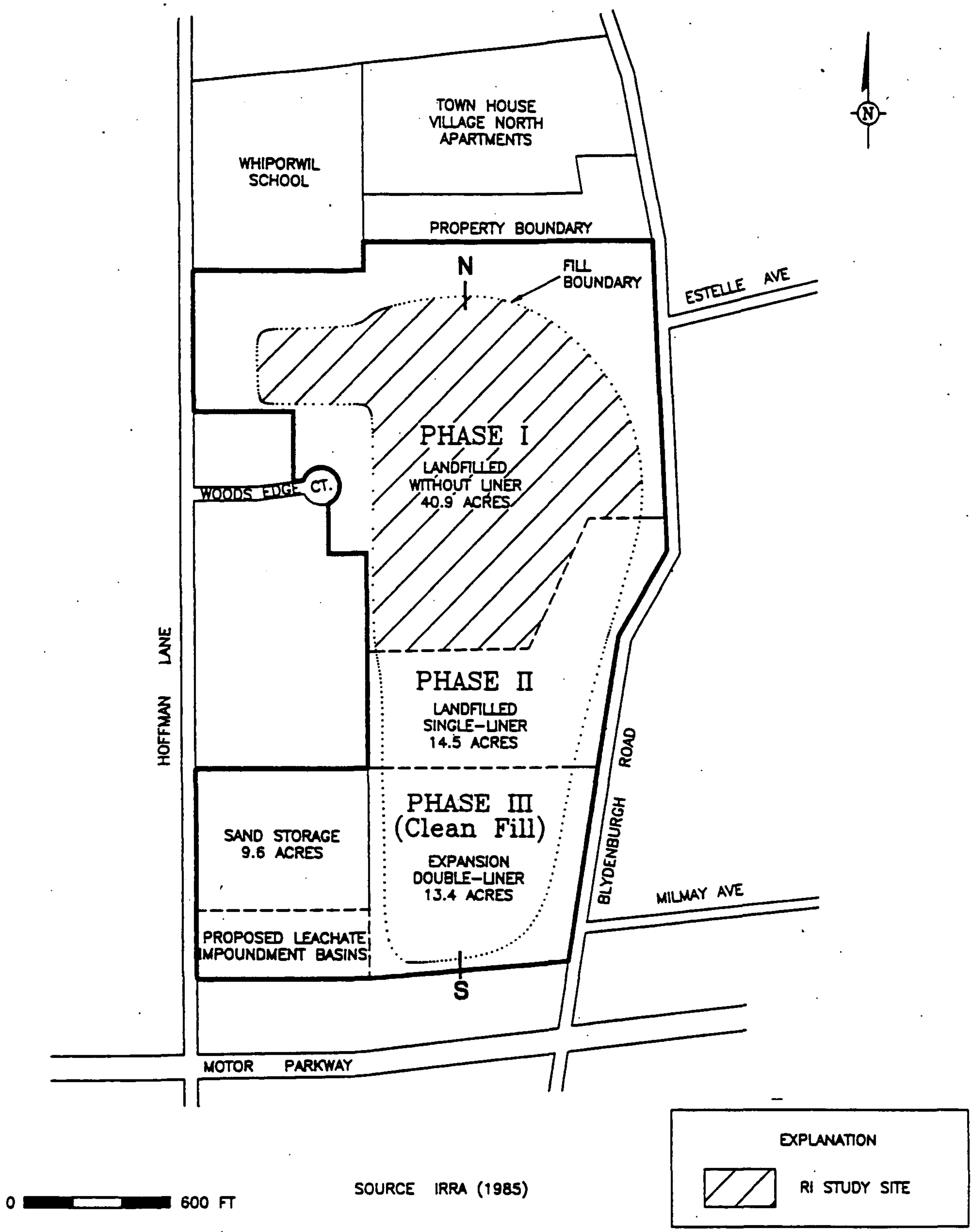


FIGURE 2

SITE PLAN FOR THE BLYDENBURGH LANDFILL, HAUPPAUGE, NEW YORK
TOWN OF ISLIP
ISLIP, NEW YORK



DRAFTER: GS | APPROVED: BB | CHECKED: MW | DRAWING: BLY-LAND | FILE NO.: 1400 | PRJCT NO.: NY16405 | DWG DATE: 6-11-91

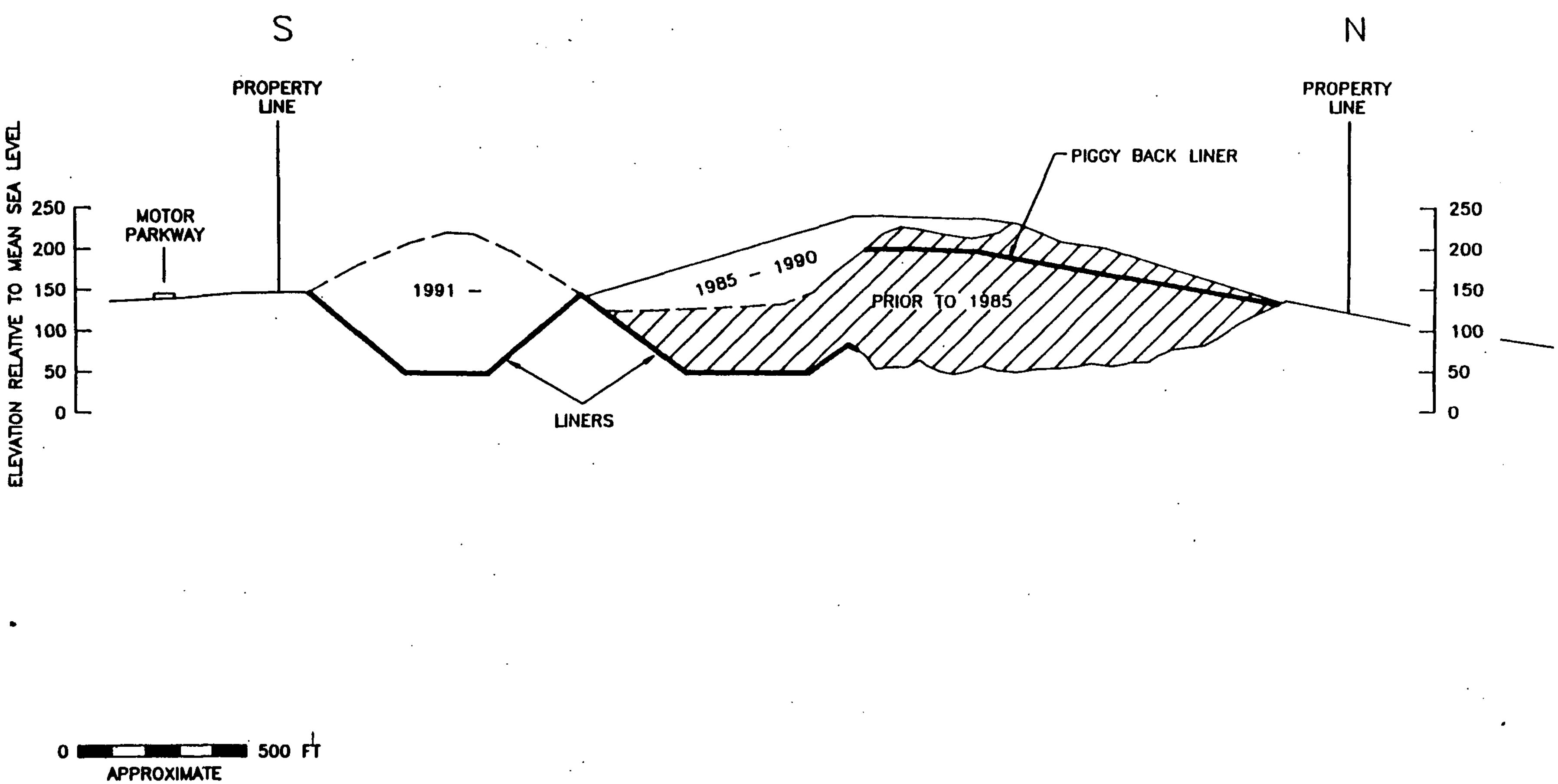
GERAGHTY & MILLER, INC.
Environmental Services

LANDFILLING PHASES AND ACREAGE
BLYDENBURGH LANDFILL, HAUPPAUGE, NEW YORK

TOWN OF ISLIP
ISLIP, NEW YORK

FIGURE
3

DWG DATE: 9-6-91 | PRJCT NO.: NY16405 | FILE NO.: 1400 | DRAWING: BLY-X | CHECKED: MW | APPROVED: BB | DRAFTER: GS

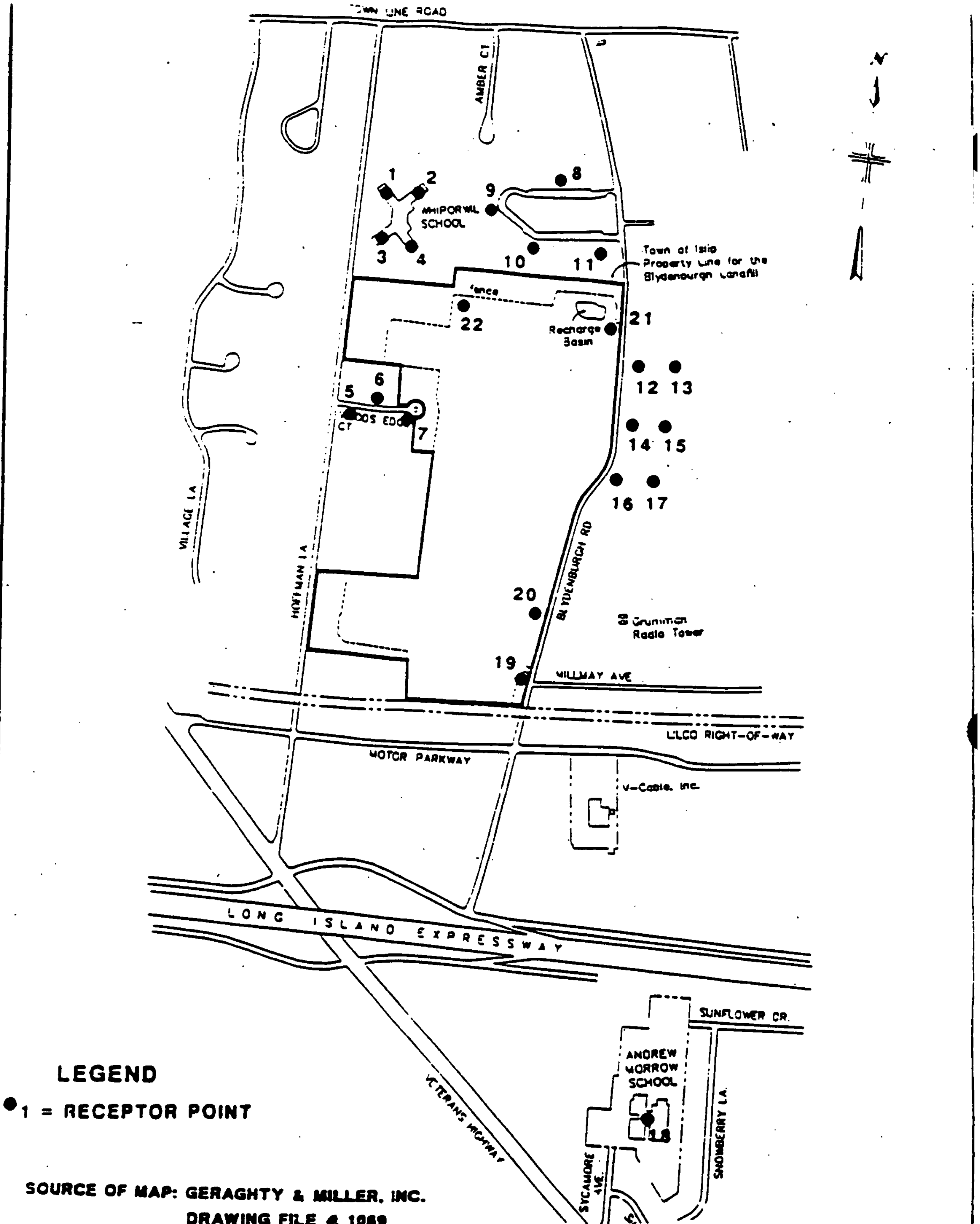


GERAGHTY & MILLER, INC.
Environmental Services

SCHEMATIC CROSS SECTION OF LANDFILLING PHASES, BLYDENBURGH LANDFILL, HAUPPAUGE, NEW YORK

TOWN OF ISLIP
ISLIP, NEW YORK

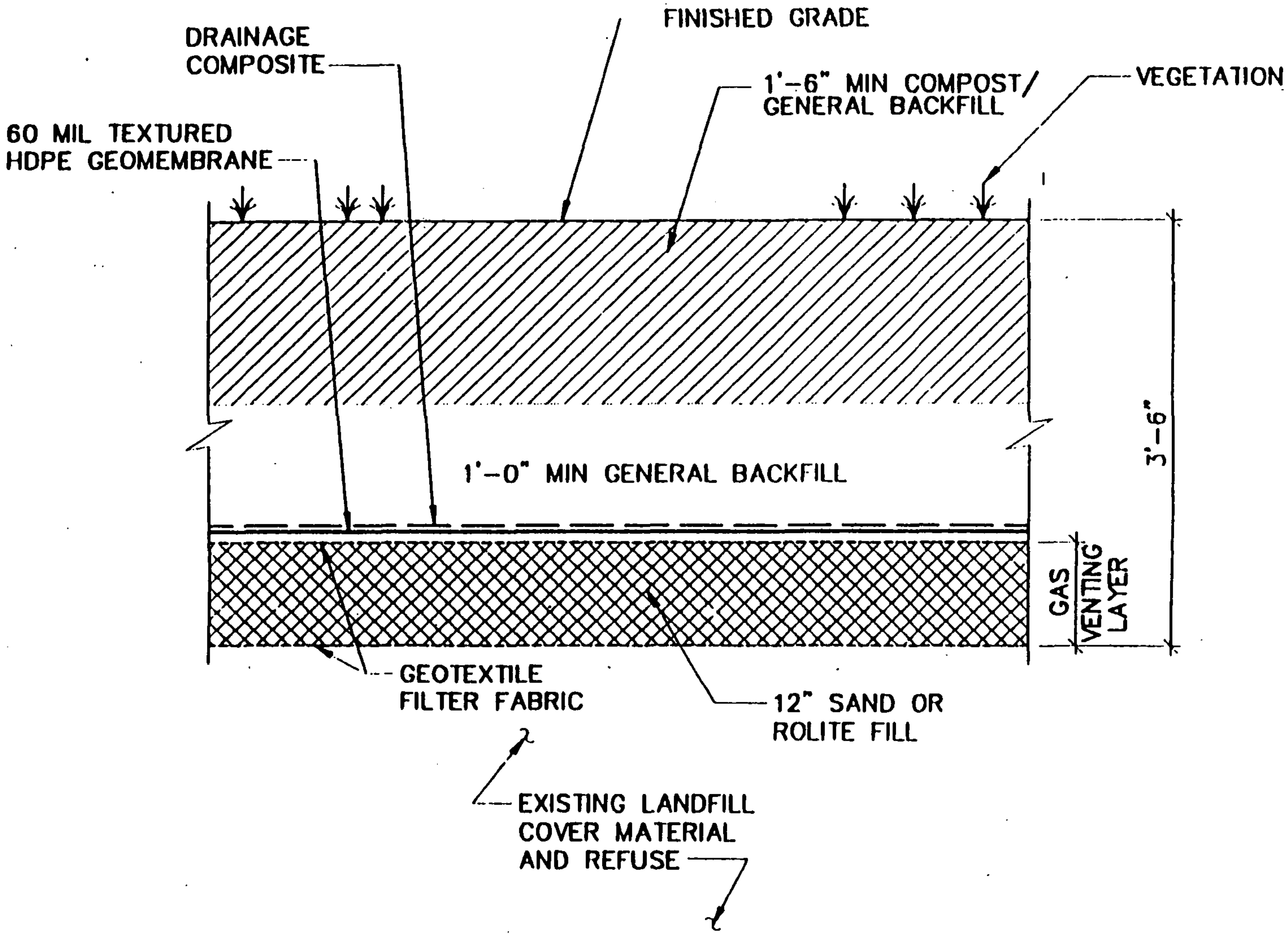
FIGURE 4



MALCOLM PIRNIE

Figure 5 Location of Air Modeling Receptor Points (adapted from Malcolm Pirnie, 1990).

MALCOLM PIRNIE, INC.



MALCOLM PIRNIE	BLYDENBURGH SANITARY LANDFILL CLOSURE ISLIP, NEW YORK	ALTERNATIVE 3 MODIFIED PART 360 CAP	MALCOLM PIRNIE, INC. FIGURE 6

APPENDIX II

TABLES

TABLES

TABLE 1

Chemical-Specific Applicable or Relevant and Appropriate Requirements Identified for the Blydenburgh Landfill, Hauppauge, New York. (a)

A. Preliminary Ground-Water ARARs

Parameters	USEPA MCL	Revised 10NYCRR Subpt 5-1	6NYCRR Part 703
Inorganics:			
Aluminum	--	--	--
Antimony	0.006	--	--
Arsenic	0.05	0.05	0.025
Barium	2.0	1.0	1.0
Beryllium	0.004	--	--
Cadmium	0.005	0.01	0.01
Calcium	--	--	--
Chromium	0.10	0.05	--
Chromium (VI)	--	--	0.05
Cobalt	--	--	--
Copper*	AL	1.0	1.0
Iron*	--	0.3 (c)	0.3 (c)
Lead	AL	0.05	0.025
Magnesium	--	--	--
Manganese*	--	0.3 (c)	0.3 (c)
Mercury	0.002	0.002	0.002
Nickel	0.10	--	--
Potassium	--	--	--
Selenium	0.01	0.01	0.02
Silver	0.10	0.05	0.05
Sodium	--	--	--
Thallium	0.002	--	--
Vanadium	--	--	--
Zinc*	--	5.0	5
Cyanide	0.2	--	0.2

All ARARs are given in milligrams per liter unless indicated (mg/L).

AL - The action level is 1.3 mg/L for copper and 0.015 mg/L for lead.

ARARs Applicable or Relevant and Appropriate Requirements.

MCL Maximum Contaminant Levels.

TOGS New York State Department of Environmental Conservation Technical and Operational Guidance Series.

PCBs Polychlorinated biphenyls.

SPDES State Pollutant Discharge Elimination System.

ND Not detected.

-- No standard available.

(a) Currently there are no federal or New York State standards for soil or sediment samples.

(c) Combined concentration of iron and manganese must not exceed 0.5 mg/L.

(d) Total trihalomethanes must not exceed 0.1 mg/L.

(e) Total phenolic compounds.

(f) Applies to total of para (i.e., 1,4-) and ortho (i.e., 1,2-) isomers only.

(g) MCL for styrene will be set after public comment period.

TABLE 1

Chemical-Specific Applicable or Relevant and Appropriate Requirements Indentified for the Blydenburgh Landfill, Hauppauge, New York. (a)

Ground-Water ARARs

Parameters	USEPA MCL		Revised 10NYCRR Subpt 5-1		6NYCRR Part 703
Volatile Organics					
Chloromethane	-		0.005		-
Bromomethane	-		0.005		-
Vinyl chloride	0.002		0.002		0.005
Chloroethane	-		0.005		-
Methylene chloride	-		0.005		-
Acetone	-		0.05		-
Carbon disulfide	-		0.05		-
1,1-Dichloroethene	0.007		0.005		-
1,1-Dichloroethane	-		0.005		-
1,2-Dichloroethene	-		0.005		-
Chloroform	0.1	(c)	0.1	(c)	0.1
1,2-Dichloroethane	0.005		0.005		-
2-Butanone	-		0.05		-
1,1,1-Trichloroethane	0.2		0.005		-
Carbon tetrachloride	0.005		0.005		0.005
Vinyl acetate	-		0.05		-
Bromodichloromethane	0.1	(c)	0.1	(c)	-
1,1,2,2-Tetrachloroethane	-		0.005		-
1,2-Dichloropropane	-		0.005		-
trans-1,2-Dichloropropene	-		0.005		-
Trichloroethene	0.005		0.005		0.010
Dibromochloromethane	0.1	(c)	0.1	(c)	-

All ARARs are given in milligrams per liter (mg/L) unless indicated.

USEPA U.S. Environmental Protection Agency.
ARARs Applicable or relevant and appropriate requirements.
MCL Maximum contaminant levels.
TOGS New York State Department of Environmental Conservation Technical and Operational Guidance Series.
PCBs Polychlorinated biphenyls.
ND Not detected.
\- No standard available.
(a) Currently, there are no Federal or New York State standards for soil or sediment.
(b) Combined concentration of iron and manganese must not exceed 0.5 mg/L.
(c) Total trihalomethanes must not exceed 0.1 mg/L.
(d) Total phenolic compounds. (b)
(e) Applies to total of para (i.e., 1,4-) and ortho (i.e., 1,2-) isomers only.
(f) MCL for styrene will be set after public comment period.

Chemical-Specific Applicable or Relevant and Appropriate Requirements Indentified for the Blydenburgh Landfill, Hauppauge, New York. (a)

Ground-Water ARARs

Parameters	USEPA MCL	Revised 10NYCRR Subpt 5-1	6NYCRR Part 703
Volatile Organics (continued)			
1,1,2-Trichloroethane	0.005	0.005	-
Benzene	0.005	0.005	ND
cis-1,3-Dichloropropene	-	0.005	-
Bromoform	0.1 (c)	0.1 (c)	-
2-Hexanone	-	0.05	-
4-Methyl-2-pentanone	-	0.05	-
Tetrachloroethene	0.005	0.005	-
Toluene	1.0	0.005	-
Chlorobenzene	-	0.005	-
Ethylbenzene	0.7	0.005	-
Styrene(c)	0.1	0.005	0.931
Total Xylenes	10	0.005	-
Pesticides/PCBs			
alpha-BHC	-	0.005	ND
beta-BHC	-	0.005	ND
delta-BHC	-	0.005	ND
gamma-BHC(Lindane)	0.004	0.004	ND
Heptachlor	-	0.005	ND
Aldrin	-	0.005	ND
Heptachlor epoxide	-	0.005	ND
Endosulfan I	-	0.005	-
Dieldrin	-	0.005	ND
4,4'-DDE	-	0.005	ND

All ARARs are given in milligrams per liter (mg/L) unless indicated.

USEPA U.S. Environmental Protection Agency.
ARARs Applicable or relevant and appropriate requirements.
MCL Maximum contaminant levels.
TOGS New York State Department of Environmental Conservation Technical and Operational Guidance Series.
PCBs Polychlorinated biphenyls.
ND Not detected.
\- No standard available.
(a) Currently, there are no Federal or New York State standards for soil or sediment.
(b) Combined concentration of iron and manganese must not exceed 0.5 mg/L.
(c) Total trihalomethanes must not exceed 0.1 mg/L.
(d) Total phenolic compounds.
(e) Applies to total of para (i.e., 1,4-) and ortho (i.e., 1,2-) isomers only.
(f) MCL for styrene will be set after public comment period.

TABLE 1

Chemical-Specific Applicable or Relevant and Appropriate Requirements Indentified for the Blydenburgh Landfill, Hauppauge, New York. (a)

Ground-Water ARARs

Parameters	USEPA MCL	Revised 10NYCRR Subpt 5-1	6NYCRR Part 703
Pesticides/PCBs (continued)			
Endrin	0.002	0.0002	ND
Endosulfan II	–	0.005	–
4,4'-DDD	–	0.005	ND
Endosulfan sulfate	–	0.005	–
4,4'-DDT	–	0.005	ND
Methoxychlor	0.04	0.05	0.035
Chlordane(alpha and/or gamma)	–	0.005	0.0001
Toxaphene	0.003	0.005	ND
Aroclor 1016	–	0.001	0.0001
Aroclor 1221	–	0.001	0.0001
Aroclor 1232	–	0.001	0.0001
Aroclor 1242	–	0.001	0.0001
Aroclor 1248	–	0.001	0.0001
Aroclor 1254	–	0.001	0.0001
Aroclor 1260	–	0.001	0.0001
Endrin ketone	–	0.005	–

All ARARs are given in milligrams per liter (mg/L) unless indicated.

USEPA U.S. Environmental Protection Agency.
ARARs Applicable or relevant and appropriate requirements.
MCL Maximum contaminant levels.
TOGS New York State Department of Environmental Conservation Technical and Operational Guidance Series.
PCBs Polychlorinated biphenyls.
ND Not detected.
– No standard available.
(a) Currently, there are no Federal or New York State standards for soil or sediment.
(b) Combined concentration of iron and manganese must not exceed 0.5 mg/L.
(c) Total trihalomethanes must not exceed 0.1 mg/L.
(d) Total phenolic compounds.
(e) Applies to total of para (i.e., 1,4-) and ortho (i.e., 1,2-) isomers only.
(f) MCL for styrene will be set after public comment period.

TABLE 1

Chemical-Specific Applicable or Relevant and Appropriate Requirements Indentified for the Blydenburgh Landfill, Hauppauge, New York. (a)

Ground-Water ARARs

Parameters	USEPA MCL	Revised 10NYCRR Subpt 5-1	6NYCRR Part 703
Semivolatiles			
Phenol(s)	-	0.05	0.001 (d)
bis(-2-Chloroethyl)ether	-	0.005	0.001
2-Chlorophenol	-	0.005	0.001 (d)
1,3-Dichlorobenzene	-	0.005	-
1,4-Dichlorobenzene	0.075	0.005	4.7 (e)
Benzyl alcohol	-	0.05	-
1,2-Dichlorobenzene	-	0.005	4.7 (e)
2-Methylphenol	-	0.05	0.001 (d)
bis(2-Chloroisopropyl)ether	-	0.005	-
4-Methylphenol	-	0.05	0.001 (d)
N-Nitroso-di-propylamine	-	0.05	-
Hexachloroethane	-	0.005	-
Nitrobenzene	-	0.005	-
Isophorone	-	0.05	-
2-Nitrophenol	-	0.005	0.001 (d)
2,4-Dimethylphenol	-	0.05	0.001 (d)
Benzoic acid	-	0.05	-
bis(-2-Chloroethoxy)methane	-	0.005	-
2,4-Dichlorophenol	-	0.005	0.001 (d)
1,2,4-Trichlorobenzene	0.07	0.005	-
Naphthalene	-	0.05	-
4-Chloroaniline	-	0.005	-

All ARARs are given in milligrams per liter (mg/L) unless indicated.

USEPA U.S. Environmental Protection Agency.
ARARs Applicable or relevant and appropriate requirements.
MCL Maximum contaminant levels.
TOGS New York State Department of Environmental Conservation Technical and Operational Guidance Series.
PCBs Polychlorinated biphenyls.
ND Not detected.
\- No standard available.
(a) *Currently, there are no Federal or New York State standards for soil or sediment.*
(b) Combined concentration of iron and manganese must not exceed 0.5 mg/L.
(c) Total trihalomethanes must not exceed 0.1 mg/L.
(d) Total phenolic compounds.
(e) Applies to total of para (i.e., 1,4-) and ortho (i.e., 1,2-) isomers only.
(f) MCL for styrene will be set after public comment period.

TABLE 1

Chemical-Specific Applicable or Relevant and Appropriate Requirements Indentified for the Blydenburgh Landfill, Hauppauge, New York. (a)

Ground-Water ARARs

Parameters	USEPA MCL	Revised 10NYCRR Subpt 5-1	6NYCRR Part 703
Semivolatiles (continued)			
Hexachlorobutadiene	–	0.005	–
4-Chloro-3-methylphenol	–	0.005	0.001 (d)
2-Methylnaphthalene	–	0.05	–
Hexachlorocyclopentadiene	–	0.005	–
2,4,6-Trichlorophenol	–	0.005	0.001 (d)
2,4,5-Trichlorophenol	–	0.005	0.001 (d)
2-Chloronaphthalene	–	0.005	–
2-Nitroaniline	–	0.005	–
Dimethylphthalate	–	0.05	–
Acenaphthylene	–	0.05	–
3-Nitroaniline	–	0.005	–
Acenaphthene	–	0.05	–
2,4-Dinitrophenol	–	0.005	0.001 (d)
4-Nitrophenol	–	0.005	0.001 (d)
Dibenzofuran	–	0.05	–
2,4-Dinitrotoluene	–	0.005	–
2,6-Dinitrotoluene	–	0.005	–
Diethylphthalate	–	0.05	–
4-Chlorophenyl-phenylether	–	0.005	–
Fluorene	–	0.05	–
4-Nitroaniline	–	0.005	–
4,6-Dinitro-2-methylphenol	–	0.005	0.001 (d)

All ARARs are given in milligrams per liter (mg/L) unless indicated.

USEPA U.S. Environmental Protection Agency.
ARARs Applicable or relevant and appropriate requirements.
MCL Maximum contaminant levels.
TOGS New York State Department of Environmental Conservation Technical and Operational Guidance Series.
PCBs Polychlorinated biphenyls.
ND Not detected.
– No standard available.
(a) Currently, there are no Federal or New York State standards for soil or sediment.
(b) Combined concentration of iron and manganese must not exceed 0.5 mg/L.
(c) Total trihalomethanes must not exceed 0.1 mg/L.
(d) Total phenolic compounds.
(e) Applies to total of para (i.e., 1,4-) and ortho (i.e., 1,2-) isomers only.
(f) MCL for styrene will be set after public comment period.

TABLE 1

Chemical-Specific Applicable or Relevant and Appropriate Requirements Indentified for the Blydenburgh Landfill, Hauppauge, New York. (a)

Ground-Water ARARs

Parameters	USEPA MCL	Revised 10NYCRR Subpt 5-1	6NYCRR Part 703
<u>Semivolatiles (continued)</u>			
N-Nitrosodiphenylamine	-	0.005	-
4-Bromophenyl-phenylether	-	0.005	-
Hexachlorobenzene	0.001	0.005	0.00035
Penta-chlorophenol	-	0.005	0.021
Phenanthrene	-	0.05	-
Anthracene	-	0.05	-
Di-n-butylphthalate	-	0.05	0.77
Fluoranthene	-	0.05	-
Pyrene	-	0.05	-
Butylbenzylphthalate	-	0.05	-
3,3'-Dichlorobenzidine	-	0.005	-
Benzo(a)anthracene	-	0.05	-
bis(2-Ethylhexyl)phthalate	-	0.05	4.2
Chrysene	-	0.05	-
Di-n-octyl phthalate	-	0.05	-
Benzo(b)fluoranthene	-	0.05	-
Benzo(k)fluoranthene	-	0.05	-
Benzo(a)pyrene	0.0002	0.05	ND
Indeno(1,2,3-c d)pyrene	-	0.05	-
Dibenz(g,h)anthracene	-	0.05	-
Benzo(g,h,i)perylene	-	0.05	-

All ARARs are given in milligrams per liter (mg/L) unless indicated.

USEPA U.S. Environmental Protection Agency.
ARARs Applicable or relevant and appropriate requirements.
MCL Maximum contaminant levels.
TOGS New York State Department of Environmental Conservation Technical and Operational Guidance Series.
PCBs Polychlorinated biphenyls.
ND Not detected.
- No standard available.
(a) Currently, there are no Federal or New York State standards for soil or sediment.
(b) Combined concentration of iron and manganese must not exceed 0.5 mg/L.
(c) Total trihalomethanes must not exceed 0.1 mg/L.
(d) Total phenolic compounds.
(e) Applies to total of para (i.e., 1,4-) and ortho (i.e., 1,2-) isomers only.
(f) MCL for styrene will be set after public comment period.

Table 2. Summary of Compounds/Analytes Detected above ARARs at the Blydenburgh Landfill, Hauppauge, New York.

Parameter	ARAR (ug/L)	Well Designation	Concentration (ug/L) 4/90	7/90	10/90
Volatile Organic Compounds					
		6G-1	--	--	5
Vinyl chloride	2	6G-2	--	21	17
		6G-3	--	4 J[3J]	4J[4J]
		P-1	--	3 J	--
Methylene chloride	5	4G-1	7	11	13
		4M-2	--	6 3	--
		6G-1	--	--	5J
		6G-2	8	51 J	27
Acetone	50	6G-3	92 [100J]	--	--
1,1-Dichloroethene	5	6G-3	--	--	7[6]
		7M-1	--	7	10
1,1-Dichloroethane	5	4G-1	9	7 J	7
		4M-1	--	6	5J
		6G-1	--	12	17
		6G-2	--	80	70
		6G-3	10 [10J]	23 [22]	27[22]
		7M-1	--	8 J	11
		P-1	5	10	8
1,2-Dichloroethene(total)	5	4G-1	12	25	23
		4G-2	12	11	12
		4M-1	--	6	--
		6G-1	--	11	24
		6G-2	6	110	130
		6G-3	14 [14J]	25 [22]	40[35]
		12M-1	--	6 J	9
		P-1	--	12	12
1,2-Dichloroethane	5	4G-1	8	9	10

[ ] Replicate sample.
-- Concentration below ARAR Limits.
* Sample was filtered in the field through a 0.45 um membrane.
ug/L Micrograms per liter.
B Compound also found in laboratory method blank.
E Compound concentrations exceeded the analysis calibration range.
J Estimated value.
ARARs Applicable or relevant and appropriate requirements

Table 2. Summary of Compounds/Analytes Detected above ARARs at the Blydenburgh Landfill, Hauppauge, New York.

Parameter	ARAR (ug/L)	Well Designation	Concentration (ug/L)* 4/90	7/90	10/90
Volatile Organic Compounds					
2-Butanone	50	6G-3	250 EJ[190J]	--	--
1,1,1-Trichloroethane	5	4G-1	11	--	--
		6G-1	--	6	6
		6G-2	--	9	6
		6G-3	12 [12J]	24 [24]	26[21]
		7M-1	6	87	120
		13G-1	15	8	7
Trichloroethene	5	4G-1	14	9	11
		6G-1	--	6	10
		6G-2	--	15	13
		6G-3	20 [18J]	39 [37]	50[57]
		7M-1	23	66	71
Benzene	5	6G-2	--	8	7
		6G-3	28 [27J]	5 [6]	--
Tetrachloroethene	5	GM-1I	5 J	21 J	25
		4G-1	23	19	22
		4G-2	18	20	20
		6G-1	13	22	23
		6G-2	4 J	39	30
		12M-1	--	3 J	--
		14G-1	5 J	8	3J
		14G-2	6	7	3J

[ ] Replicate sample.
-- Concentration below ARAR Limits.
* Sample was filtered in the field through a 0.45 um membrane.
ug/L Micrograms per liter.
B Compound also found in laboratory method blank.
E Compound concentrations exceeded the analysis calibration range.
J Estimated value.
ARARs Applicable or relevant and appropriate requirements

Table 2. Summary of Compounds/Analytes Detected above ARARs at the Blydenburgh Landfill, Hauppauge, New York.

Parameter	ARAR (ug/L)	Well Designation	Concentration (ug/L) 4/90	7/90	10/90
Volatile Organic Compounds					
Toluene	5	4G-1	--	8	--
		6G-2	--	5 J	5
		6G-3	29 [25J]	10 [10]	16[13]
		10G-1	--	6	--
		10M-1	--	11	--
		10M-2	--	6	--
Semivolatile Organic Compouns					
Phenols (total)	1	GM-1S	20	--	--
		4M-1	[20]	--	--
		4M-2	20	--	--
		6G-3	40 [30]	--	--
		10M-1	20	--	--
		12G-1	20	--	--
		12M-1	20	--	--
		P-1	30	--	--
bis(2-Ethylhexyl)phthalate	50	GM-3D	110	--	--
		6G-3	53 B[52B]	--	--

[ ] Replicate sample.
-- Concentration below ARAR Limits.
* Sample was filtered in the field through a 0.45 um membrane.
ug/L Micrograms per liter.
B Compound also found in laboratory method blank.
E Compound concentrations exceeded the analysis calibration range.
J Estimated value.
ARARs Applicable or relevant and appropriate requirements

Table 2. Summary of Compounds/Analytes Detected above ARARs at the Blydenburgh Landfill, Hauppauge, New York.

Parameter	ARAR (ug/L)	Well Designation	Concentration (ug/L) 4/90	7/90	10/90
Inorganic Compounds/Analytes					
Antimony	6	4M-1	10.5 BJ[9.6BJ]	12	---
		6G-3	[11.4] BJ	-	-
		8G-1	13.6 BJ*	-	-
		8M-2	12.2 B*	-	-
		10G-1	11.6 BJ*	-	-
		10M-2	11.6 B*	-	-
		13G-1	12.0 BJ*	-	-
		14G-2	-	10.6 BJ*	-
Beryllium	4	P-4	5.0 B	-	--
Cadmium	5	6M-2I	--	6.0J	--
		7M-1	6.2	--	--
		8M-2	--	6.0BJ	--
		9M-1	--	12.0	--
		10G-1	--	8.0*	--
		11M-1	--	5.0*	--
		12G-1	--	--	12
		13M-1	6.2	--	--
		15G-1	6.2*	--	--
Chromium	50	6G-3	58.8 [62.5]	-	
		P-4	61.2	-	
		8G-1	-	-	76.0
Iron	300	GM-1S	1260 J	-	-
		GM-1I	708J	532	-
		GM-1D	920 J	-	-
		GM-2S	2110 J	1320	-
		GM-2I	2940 J	643	-
		GM-2D	830 J	1550	-
		GM-3S	3180	525	921
		GM-3I	441	-	-
		GM-3D	399	-	-
		4G-1	1150	459	453
		4G-2	2210	699	356
		4M-1	2380 [2350]	2600	1,700

[ ] Replicate sample.
– Concentration below ARAR Limits.
* Sample was filtered in the field through a 0.45 um membrane.
ug/L Micrograms per liter.
B The reported value was obtained from a reading that was less than the Contract Required Detection Limit (CRDL), but greater than or equal to the Instrument Detection Limit (IDL).
E Compound concentrations exceeded the analysis calibration range.
J Estimated value.
ARARs Applicable or relevant and appropriate requirements

Table 2. Summary of Compounds/Analytes Detected above ARARs at the Blydenburgh Landfill, Hauppauge, New York.

Parameter	ARAR (ug/L)	Well Designation	Concentration (ug/L) 4/90	7/90	10/90
Inorganic Compounds/Analytes					
Iron (con't)	300	4M-2	1260	2100	411
		5G-1	8220 [8420]	10500 [6820]	2,130[2,140]
		6G-1	20200	8310 301*	1,590
		6G-2	976	--	--
		6G-3	1690 [1710]	689 [873][334]*	583[724]
		6M-1	2340	773	--
		7M-1	390	--	--
		8G-1	2290	857	6,470
		8M-1	334	--	--
		8M-2	5200	6350	1,260
		9G-1	3040	336	--
		9M-1	--	1780	--
		10G-1	1690	388 J*	--
		10M-1	499 J	--	--
		10M-2	2340	761	--
		11G-1	12800 J	2850	2,160
		11M-1	1690 J	623	934
		12G-1	5110 B	1150	6,020
		12M-1	1000	519	--
		13G-1	669	533	--
		13M-1	2820	1050	307
		14G-1	980 J	--	--
		14G-2	4540 J	2490	825
		14M-1	2260 J	470	321
		15G-1	16900 [16400]	8000	1,220
		15M-1	1070	554	645
		16G-1	349	317	1,040

[ ] Replicate sample.
-- Concentration below ARAR Limits.
* Sample was filtered in the field through a 0.45 um membrane.
ug/L Micrograms per liter.

E Compound concentrations exceeded the analysis calibration range.
J Estimated value.
ARARs Applicable or relevant and appropriate requirements (from Table 10).
B The reported value was obtained from a reading that was less than the Contract Required Detection Limit (CRDL), but greater than or equal to the Instrument Detection Limit (IDL).

Table Summary of Compounds/Analytes Detected above ARARs at the Blydenburgh Landfill, Hauppauge, New York.

Parameter	ARAR (ug/L)	Well Designation	Concentration (ug/L) 4/90	7/90	10/90
Inorganic Compounds/Analytes					
Iron (con't)	300	16M-1	1010 [876]	1050	--
		P-1	21500[20600] 610*	21000	31,500
		P-3	20000 J	16400	6,380
		P-4	181000 J	95700	65,900
Lead	25	GM-2I	--	168 *	--
		GM-3S	135 J	187 J	178
		4M-2	--	84	29.4
		7M-1	--	31.6 *	--
		15G-1	34.5 J[33.8J]	--	--
		16G-1	--	1410 J	51.7
		P-4	262 J	123 J	193.0
		9M-1	--	--	39.2
		16M-1	--	--	39.2
Manganese	300	4G-1	604	--	562
			586 *	--	--
		5G-1	18100 [17100]	15500 J[14600J]	11,600
			15200 *[14800]*	12700 *[1200]*	[12,200]
		6G-1	2090	2300	1,980
			1540 *	2050 *	
		9G-1	310	--	
		11G-1	458	--	--
		15G-1	618 [615]	395	--
		P-1	496 [485]	748	645
			448 *[339]*	518 *	
		P-3	759	489	315
		P-4	1850	846	712

[ ] Replicate sample.
-- Concentration below ARAR Limits.
* Sample was filtered in the field through a 0.45 um membrane.
ug/L Micrograms per liter.

E Compound concentrations exceeded the analysis calibration range.
J Estimated value.
ARARs Applicable or relevant and appropriate requirements

B The reported value was obtained from a reading that was less than the Contract Required Detection Limit (CRDL), but greater than or equal to the Instrument Detection Limit (IDL).

Table 2. Summary of Compounds/Analytes Detected above ARARs at the Blydenburgh Landfill, Hauppauge, New York.

Parameter	ARAR (ug/L)	Well Designation	Concentration (ug/L) 4/90	7/90	10/90
Inorganic Compounds/Analytes					
Selenium	10	GM-3D	16.2 BJ	-	-
		7G-1	17.5 BJ*	-	-
		14M-1	13.8 BJ*	-	-
		16G-1	17.5 BJ	-	-
Thallium	2	GM-3D	--	3.8BJ	--
		5G-1	--	10.0BJ*	--
		6G-1	--	2.4BJ	--
		6G-2	20.0J	2.2BJ	--
		8M-2	--	2.2BJ	--
		9G-1	--	3.4BJ	--
		10G-1	--	4.4BJ	--
		13G-1	--	7.0BJ	--
		14G-2	--	2.2BJ	--
		15G-1	--	6.8BJ	--
		16G-1	--	4.4BJ	--
		P-4	--	2.2BJ	--
Zinc	500	GM-3S	6870	2900	5,250
			3250 *	2070 J*	-
		4G-1	1030	-	-
			756 *	-	

[ ] Replicate sample.
- Concentration below ARAR Limits.
* Sample was filtered in the field through a 0.45 um membrane.
ug/L Micrograms per liter.
B The reported value was obtained from a reading that was less than the Contract Required Detection Limit (CRDL), but greater than or equal to the Instrument Detection Limit (IDL).
E Compound concentrations exceeded the analysis calibration range.
J Estimated value.
ARARs Applicable or relevant and appropriate requirements (from Table 10).

Table 2. Summary of Compounds/Analytes Detected above ARARs at the Blydenburgh Landfill, Hauppauge, New York.

Parameter	ARAR (ug/L)	Well Designation	Concentration (ug/L) 4/90	7/90	10/90
Inorganic Compounds/Analytes					
Zinc (con't)	500	14G-2	938	--	--
		15G-1	1390 [1420]	--	--
			[330] *	--	
		P-4	511	--	--

[ ] Replicate sample.
-- Concentration below ARAR Limits.
* Sample was filtered in the field through a 0.45 um membrane.
ug/L Micrograms per liter.

E Compound concentrations exceeded the analysis calibration range.
J Estimated value.
ARARs Applicable or relevant and appropriate requirements
B The reported value was obtained from a reading that was less than the Contract Required Detection Limit (CRDL), but greater than or equal to the Instrument Detection Limit (IDL).

Table 3. Constituent Air Concentrations Predicted at Discrete Receptors in the Area of the Blydenburgh Landfill

Discrete Receptors	CONSTITUENTS									
	Benzene	Toluene	Ethyl Benzene	Vinyl Chloride	1,1-DCE	1,2-DCE	1,1-DCA	Chlorobenzene	Xylene (m,p)	Xylene (o)
Whiporwil										
1-NW wing	0.004593	0.017537	0.033639	0.008385	0.003206	0.006081	0.003866	0.001550	0.018849	0.009020
2-NE wing	0.005572	0.021374	0.040160	0.009885	0.003978	0.007129	0.004493	0.001770	0.022562	0.010811
3-SW wing	0.006255	0.023982	0.045376	0.011249	0.004444	0.008162	0.005192	0.002065	0.025470	0.012209
4-SE wing	0.008535	0.033116	0.060749	0.015024	0.006336	0.010870	0.006875	0.002683	0.034162	0.016479
Woods Edge Court										
5-South side	0.007749	0.030501	0.056798	0.014896	0.005895	0.010929	0.007891	0.003273	0.031737	0.015495
6-North side	0.010046	0.040195	0.072753	0.019382	0.008009	0.014192	0.010227	0.004210	0.040592	0.020020
7-South side	0.014799	0.061818	0.105796	0.030098	0.013142	0.021676	0.016115	0.006633	0.058491	0.029721
Townhouses										
8-North side	0.012063	0.045406	0.086303	0.020176	0.008191	0.014399	0.008676	0.003320	0.048840	0.023059
9-West side	0.013273	0.050786	0.089610	0.019650	0.009763	0.013817	0.008558	0.003051	0.051450	0.024365
10-South side	0.022966	0.088192	0.155304	0.034597	0.017036	0.024149	0.014655	0.005195	0.088896	0.042253
11-South side	0.020321	0.075103	0.165245	0.045418	0.011812	0.033029	0.017751	0.007513	0.089814	0.042797
Vicinity of Riding Stable										
Receptor #12	0.072736	0.244126	0.702092	0.209143	0.022191	0.156444	0.105154	0.050187	0.368882	0.171308
Receptor #13	0.043714	0.150282	0.404261	0.115427	0.016973	0.088812	0.059803	0.028060	0.217578	0.101216
Receptor #14	0.072971	0.241587	0.688262	0.180960	0.025342	0.153030	0.136138	0.065399	0.386073	0.175332
Receptor #15	0.050572	0.173628	0.471034	0.134300	0.019590	0.104977	0.083628	0.039734	0.254568	0.118348
Receptor #16	0.083285	0.214433	0.592297	0.161871	0.024152	0.132320	0.117279	0.056125	0.327590	0.150708
Receptor #17	0.046400	0.159697	0.427410	0.117489	0.019272	0.095068	0.082261	0.039110	0.235935	0.109217
Andrew Morrow School										
Receptor #18	0.002195	0.008113	0.017797	0.004750	0.001311	0.003600	0.002646	0.001174	0.009850	0.004674
On-Site										
19-Office	0.009502	0.037170	0.075147	0.021525	0.006860	0.016052	0.012063	0.005296	0.041153	0.020241
20-Scale House	0.017010	0.070156	0.129009	0.038860	0.014518	0.028510	0.021675	0.009324	0.070248	0.035781
21-Garage	0.060199	0.206850	0.564090	0.169195	0.021423	0.122735	0.042467	0.018861	0.294642	0.138094
22-Flare Pump Bldg.	0.017635	0.070062	0.124803	0.032250	0.013962	0.023348	0.014740	0.005752	0.069731	0.034225
AGC (ug/m3)	0.12	2,000	1,000	0.02	0.02	1,900	500	20	700	300

Adapted from Malcolm Pirnie, Inc. (1991).
All concentrations in micrograms per cubic meter (ug/m3).

AGC Air guideline concentration from NYS Air Guide-1 (1991 Edition).
1,1-DCE 1,1-Dichloroethene.
1,2-DCE 1,2-Dichloroethene.
1,1-DCA 1,1-Dichloroethane.

Table 4 Occurrence of Constituents in the Shallow Ground-Water Zone, Blydenburgh Landfill, Hauppauge, New York.

Constituent	Frequency of Detection	Range	Mean	95% UCL	Background 95% UCL[a]
Inorganics					
Aluminum	29/33	39 - 13,000	2,200	3,300	1,500
Ammonia (NH_3)	4/33	80 - 410	179	210	-
Antimony	1/33	4.0 - 4.0	3.4	3.7	-
Arsenic	6/32	1.9 - 8.8	1.3	1.8	-
Barium	29/33	1.0 - 110	38	46	30
Beryllium	2/33	1.0 - 2.5	0.80	0.94	-
Boron	30/33	17 - 760	97	140	23
Cadmium	2/33	4.0 - 12	2.4	3.0	-
Calcium	33/33	5,800 - 100,000	29,000	36,000	6,800
Chromium	16/33	4.0 - 30	9.1	12	15
Cobalt	5/33	21 - 71	14	19	17
Copper	15/33	7.0 - 63	17	21	9.5
Cyanide	2/33	10 - 10	5.3	5.7	-
Iron	32/33	140 - 20,000	3,000	4,400	2,500
Lead	31/33	2.3 - 24	12	13	160
Magnesium	33/33	2,100 - 22,000	9,000	11,000	2,000
Manganese	30/33	8.0 - 18,000	1,700	3,000	170
Mercury	2/33	0.20 - 0.30	0.11	0.12	0.15
Nickel	2/33	24 - 33	13	15	-
Nitrate (NO_3)	26/33	50 - 27,000	2,400	4,100	3,000
Potassium	30/33	620 - 12,000	3,400	4,400	2,200
Silver	1/33	9.0 - 9.0	4.6	5.1	-
Sodium	33/33	6,000 - 50,000	16,000	20,000	10,000
Sulfates	33/33	640 - 76,000	21,000	27,000	20,000
Thallium	6/31	2.2 - 20	4.5	6.0	3.0
Vanadium	11/33	5.0 - 28	8.2	10	-
Zinc	27/33	17 - 1,000	130	200	5,000
Volatiles					
Acetone	1/33	8.0 - 8.0	5.1	5.2	-
Benzene	4/12	0.80 - 8.0	1.8	3.3	-
Chloroethane	1/33	3.0 - 3.0	3.0	3.0	-
Chloroform	3/33	1.0 - 2.0	1.9	2.0	-
1,1-Dichloroethane	11/33	4.0 - 80	8.3	13	-
1,1-Dichloroethene	5/11	0.60 - 2.9	0.85	1.4	-
1,2-Dichloroethane	6/14	1.1 - 14	2.8	4.9	-
1,2-Dichloroethene (total)	12/33	4.0 - 130	13	22	-
1,2-Dichloropropane	1/33	1.0 - 1.0	1.0	1.0	-
Methylene chloride	8/33	4.0 - 51	5.8	8.5	-
Tetrachloroethene	20/24	0.50 - 39	12	16	-
Toluene	4/33	2.0 - 8.0	2.8	3.1	-

All footnotes appear on page 2.

Table 4 Occurrence of Constituents in the Shallow Ground-Water Zone, Blydenburgh Landfill, Hauppauge, New York.

Constituent	Frequency of Detection	Range	Mean	95% UCL	Background 95% UCL[a]
Volatiles (continued)					
1,1,1-Trichloroethane	11/33	3.0 - 15	4.1	4.9	-
Trichloroethene	12/19	2.0 - 15	5.0	7.1	-
Vinyl chloride	4/13	2.0 - 21	3.6	7.1	-
Xylenes (total)	1/33	3.0 - 3.0	2.5	2.5	-
Semivolatiles					
Benzoic acid	1/19	6.0 - 6.0	5.1	5.2	-
Bis(2-ethylhexyl)phthalate	1/22	9.0 - 9.0	5.5	5.8	-
Di-n-butylphthalate	1/22	5.0 - 5.0	5.0	5.0	-
n-Nitrosodiphenylamine*	1/22	2.0 - 2.0	2.0	2.0	-

All concentrations are reported in micrograms per liter (µg/L).

95% UCL 95 percent upper confidence limit on the arithmetic mean.

a 95 percent upper confidence limit on the arithmetic mean or the maximum detected value, whichever is less.

* Detected at estimated value once; value reported is less than one-half the detection limit.

\- Background concentrations not available.

Table 5. Occurrence of Constituents in the Intermediate Ground-Water Zone, Blydenburgh Landfill, Hauppauge, New York.

Constituent	Frequency of Detection	Range	Mean	95% UCL	Background 95% UCL[a]
Inorganics					
Aluminum	31/39	39 - 3,900	570	790	400
Ammonia (NH_3)	6/39	70 - 20,000	1,300	2,400	200
Antimony	4/39	4.1 - 12	4.3	5.0	-
Arsenic	11/39	1.2 - 11	1.4	1.9	-
Barium	33/39	2.0 - 62	15	18	30
Beryllium	3/39	1.0 - 5.0	0.91	1.1	-
Boron	34/39	10 - 1,100	160	230	24
Cadmium	4/39	4.0 - 6.2	2.4	2.7	7.1
Calcium	39/39	8,200 - 96,000	36,000	44,000	14,000
Chromium	23/39	4.0 - 63	12	16	11
Cobalt	6/39	49 - 740	41	75	18
Copper	17/39	5.0 - 200	20	28	17
Cyanide	1/39	15 - 15	5.3	5.7	-
Iron	38/39	82 - 180,000	12,000	22,000	1,000
Lead	36/39	3.3 - 260	25	39	25
Magnesium	39/39	2,900 - 60,000	19,000	24,000	5,000
Manganese	35/39	6.0 - 1,900	220	320	33
Nickel	7/39	27 - 85	19	23	41
Nitrate (NO_3)	26/39	30 - 21,000	1,900	2,800	2,200
Potassium	37/39	750 - 130,000	9,000	15,000	1,300
Silver	1/39	9.0 - 9.0	4.7	5.2	-
Sodium	39/39	4,600 - 270,000	57,000	78,000	10,000
Sulfates	39/39	2,700 - 160,000	25,000	33,000	22,000
Thallium	2/36	1.8 - 2.2	1.4	1.6	-
Vanadium	15/39	5.0 - 34	9.4	11	-
Zinc	34/39	8.0 - 510	100	130	100
Volatiles					
Acetone	1/39	100 - 100	7.4	12	-
Benzene	3/15	1.3 - 28	2.6	5.8	-
2-Butanone	1/27	250 - 250	14	30	-
Carbon disulfide	1/39	5.0 - 5.0	2.6	2.7	-
Chloroform	1/39	0.80 - 0.80	0.80	0.80	-
1,1-Dichloroethane	16/39	2.0 - 27	4.9	6.3	-
1,1-Dichloroethene	5/16	3.0 - 29	3.5	6.7	-
1,2-Dichloroethane	5/13	0.5 - 2.0	0.58	0.85	-
1,2-Dichloroethene (total)	12/39	1.0 - 40	5.1	7.1	-
2-Hexanone	1/39	3.0 - 3.0	3.0	3.0	-
Tetrachloroethene	18/23	0.5 - 25	4.6	7.2	-
Toluene	5/39	2.0 - 29	3.7	5.0	-
1,1,1-Trichloroethane	6/39	6.0 - 120	9.2	15	-

All footnotes appear on page 2.

Table 5. Occurrence of Constituents in the Intermediate Ground-Water Zone, Blydenburgh Landfill, Hauppauge, New York.

Constituent	Frequency of Detection	Range	Mean	95% UCL	Background 95% UCL[a]
Volatiles (continued)					
Trichloroethene	18/23	0.70	-	71	1422-
Vinyl chloride	6/15	0.60	-	4.0	1.21.8-
Semivolatiles					
Benzoic acid	4/26	2.0 - 4.0	3.9	4.1	-
Bis(2-ethylhexyl)phthalate	5/25	2.0 - 53	9.0	12.8	-
1,2-Dichlorobenzene*	1/25	0.90 - 0.90	0.90	0.90	-
1,4-Dichlorobenzene*	1/25	2.0 - 2.0	2.0	2.0	-
Fluoranthene*	1/25	1.0 - 1.0	1.0	1.0	-
Phenol*		1/26 3.0 -	3.0	3.0	3.0-
Pyrene*	1/25	0.70 - 0.70	0.70	0.70	-

All concentrations are reported in micrograms per liter (µg/L).

95% UCL 95 percent upper confidence limit on the arithmetic mean.

a 95 percent upper confidence limit on the arithmetic mean or the maximum detected value, whichever is less.

* Detected at estimated value once; value reported is less than one-half the detection limit.

\- Background concentrations not available.

Table 6. Occurrence of Constituents in the Deep Ground-Water Zone, Blydenburgh Landfill, Hauppauge, New York.

Constituent	Frequency of Detection	Range	Mean	95% UCL	Background 95% UCL[a]
Inorganics					
Aluminum	11/12	120 - 14,000	2,600	4,800	320
Ammonia (NH_3)	1/12	50 - 50	40	50	90
Arsenic	7/12	1.5 - 14	3.6	5.5	-
Barium	11/12	1.0 - 31	10	15	3.8
Boron	10/12	10 - 240	39	73	13
Cadmium	1/12	6.0 - 6.0	2.5	3.2	-
Calcium	12/12	5,900 - 12,000	7,700	8,600	5,700
Chromium	7/12	4.0 - 25	9.5	14	11
Cobalt	1/12	19 - 19	10	14	22
Copper	7/12	10 - 55	23	32	5*
Cyanide*	1/11	18 - 18	18	18	-
Iron	12/12	98 - 6,400	1,800	2,800	400
Lead	11/12	4.4 - 83	20	31	17
Magnesium	12/12	2,700 - 4,000	3,300	3,500	1,500
Manganese	12/12	2 - 150	62	90	39
Nickel	2/12	22 - 34	15	19	-
Nitrate (NO_3)	6/12	170 - 3,100	1,100	1,700	2,200
Potassium	8/12	630 - 5,100	1,700	2,600	1,200
Silver	1/12	9.0 - 9.0	5.1	6.3	-
Sodium	12/12	4,300 - 94,000	16,000	30,000	6,000
Sulfates	12/12	1,500 - 32,000	7,900	12,000	11,000
Thallium	1/11	2.2 - 2.2	1.5	1.9	3.8
Vanadium	5/12	5.0 - 23	10	13	-
Zinc	11/12	24 - 380	130	190	120

All concentrations are reported in micrograms per liter (µg/L).

95% UCL 95 percent upper confidence limit on the arithmetic mean.

a 95 percent upper confidence limit on the arithmetic mean or the maximum detected value, whichever is less.

* Detected at estimated value once; value reported is less than one-half the detection limit.

\- Background concentrations not available.

Table 7. Constituents of Concern at the Blydenburgh Landfill, Hauppauge, New York.

Constituent	Ground Water	Air
Inorganics		
Antimony	x	
Arsenic	x	
Beryllium	x	
Boron	x	
Cadmium	x	
Chromium	x	
Copper	x	
Lead	x	
Manganese	x	
Mercury	x	
Nickel	x	
Nitrate	x	
Thallium	x	
Vanadium	x	
Zinc	x	

x Constituent of concern.

Table 7. Constituents of Concern at the Blydenburgh Landfill, Hauppauge, New York.

Constituent	Ground Water	Air
Volatiles		
Acetone	x	
Benzene	x	x
Chlorobenzene		x
Chloroform	x	
1,1-Dichloroethane	x	x
1,2-Dichloroethane	x	x
1,1-Dichloroethene	x	x
1,2-Dichloroethene	x	x
Ethyl benzene		x
Methylene chloride	x	
Tetrachloroethene	x	
Toluene	x	x
1,1,1-Trichloroethane	x	
Trichloroethene	x	
Vinyl chloride	x	x
Xylenes		x
Semivolatiles		
Benzoic Acid	x	
Bis(2-ethylhexyl)phthalate	x	

x Constituent of concern.

Table 8. Potential Pathways of Exposure to Constituents of Concern, Blydenburgh Landfill, Hauppauge, New York.

Medium	Pathway/Route	Potentially Exposed Population	Comments
Ground Water	Ingestion of, dermal contact with, and inhalation of vapors from impacted ground water.	None currently identified. Potable and non-potable water for the Site and immediate local area is provided by public supply wells. Bottled water is currently provided to one residence. Hypothetical future residential exposure considers the potential for a well to be installed at the property boundary in the Glacial or Magothy aquifer.	The nearest public supply wells (Suffolk County Water Authority, Liberty Street Station) are located approximately 3,500 feet to the east of the landfill and are not in the ground-water flow path. The Nicholls Road well field (the closest downgradient well field) is located more than a mile from the site.
Soil	Ingestion of, and dermal contact with, affected soils and inhalation of affected dusts.	None currently identified. None identified for foreseeable future.	The site is capped and buried below another landfill cell.
Surface Water/ Sediment	Ingestion of, dermal contact with, and inhalation of vapors from affected surface water/sediments.	None identified. Runoff at the Site does not contact the source material. The closest downgradient drainage systems (the Connetquot Brook and the Northeast Branch of the Nisseqogue River) are located approximately 1.5 miles southeast of the landfill.	The site is capped and buried below another landfill cell.
Air	Inhalation of airborne (vapor phase) chemicals.	Current and future potential for worker (on-site) and surrounding populations (off-site) to inhale (1) vapors emitted from the General Energy Development, Inc. (GED), facility; (2) vapors from flares; (3) vapors released from wells along the eastern perimeter of the landfill; and (4) vapors released from soils.	Off-site receptor locations potentially affected by vapors released from the landfill include the Whiporwil School, the Andrew Morrow School, the riding stables on Blydenburgh Road, the townhouses to the north of the landfill, and Woods Edge Court residences.

Table 9. Reference Doses (RfDs), Cancer Slope Factors (CSFs), and Cancer Classifications for Constituents of Concern, Blydenburgh Landfill, Hauppauge, New York.

Constituent	RfD (mg/kg/day) Oral	RfD (mg/kg/day) Inhalation	CSF $(mg/kg/day)^{-1}$ Oral	CSF $(mg/kg/day)^{-1}$ Inhalation	EPA Cancer Class.*
Inorganics					
Antimony	4.0E-04[a]	(4.0E-04)	NA	NA	D
Arsenic	1.0E-03[b]	(1.0E-03)	1.75[c]	50[a]	A
Beryllium	5.0E-03[a]	(5.0E-03)	4.9[d]	8.4[a]	B2
Boron	9.0E-02[a]	(9.0E-02)	NA	NA	D
Cadmium	5.0E-04[a]	(5.0E-04)	NA	6.1[a]	B1
Chromium	5.0E-03[a]	(5.0E-03)	NA	41[a]	A
Copper	3.7E-02[b]	(3.7E-02)	NA	NA	D
Cyanide	2.0E-02[a]	(2.0E-02)	NA	NA	D
Lead	ND	ND	ND	ND	B2
Manganese	1.0E-01[a]	3.0E-04[b]	NA	NA	D
Mercury	3.0E-04[b]	8.6E-05[b]	NA	NA	D
Nickel	2.0E-02[a]	(2.0E-02)	NA	0.84[a]	A
Nitrate	1.0E+0[a,f]	(1.0E+0)	NA	NA	D
Thallium	8.0E-05[a,e]	(8.0E-05)	NA	NA	D
Vanadium	7.0E-03[b]	(7.0E-03)	NA	NA	D
Zinc	2.0E-01[b]	(2.0E-01)	NA	NA	D

Value in parentheses indicates inhalation value not available; oral value was used as a surrogate.

a IRIS (1990).
b USEPA (1990).
c ATSDR (1989a) (arsenic).
d ATSDR (1988a) (beryllium).
e Value shown is for thallium chloride.
f Oral RfD for nitrate was recently withdrawn.
g ATSDR (1987) (benzene).
h ATSDR (1989b) (1,2-DCA).
i USEPA (1987).
j ATSDR (1988b) (vinyl chloride).

mg/kg Milligrams per kilogram.
NA Not applicable.
ND Not determined.

*EPA Cancer Class
A - Human carcinogen
B1- Probable human carcinogen -- limited evidence in humans
B2- Probable human carcinogen -- inadequate evidence in humans
C - Possible human carcinogen
D - Inadequate evidence to classify
E - No evidence of carcinogenicity

Table 9. Reference Doses (RfDs), Cancer Slope Factors (CSFs), and Cancer Classifications for Constituents of Concern, Blydenburgh Landfill, Hauppauge, New York.

Constituent	RfD (mg/kg/day) Oral	RfD (mg/kg/day) Inhalation	CSF $(mg/kg/day)^{-1}$ Oral	CSF $(mg/kg/day)^{-1}$ Inhalation	EPA Cancer Class
Volatiles					
Acetone	1.0E-01[a]	(1.0E-01)	NA	NA	D
Benzene	7.0E-04[g]	(7.0E-04)	0.029[a]	0.029[a]	A
Chlorobenzene	2.0E-02[a]	5.0E-03[b]	NA	NA	D
Chloroform	1.0E-02[a]	(1.0E-02)	0.0061[a]	0.081[a]	B2
1,1-Dichloroethane	1.0E-01[b]	1.0E-01[b]	ND	ND	C
1,2-Dichloroethane	2.5E-01[h]	2.5E-02[h]	0.091[a]	0.091[a]	B2
1,1-Dichloroethene	9.0E-03[a]	(9.0E-03)	0.6[a]	1.2[a]	C
1,2-Dichloroethene	2.0E-02[a]	(2.0E-02)	NA	NA	D
Ethyl benzene	1.0E-01[a]	(1.0E-01)	NA	NA	D
Methylene chloride	6.0E-02[a]	9.0E-01[b]	0.0075[a]	0.014[a]	B2
Tetrachloroethene	1.0E-02[a]	(1.0E-02)	0.051[c]	0.0018[c]	B2
Toluene	2.0E-01[b]	5.7E-01[b]	NA	NA	D
1,1,1-Trichloroethane	9.0E-02[a]	3.0E-01[b]	NA	NA	D
Trichloroethene	7.4E-03[i]	(7.4E-03)	0.011[b]	0.017[b]	B2
Vinyl chloride	1.3E-03[j]	(1.3E-03)	1.9[b]	0.29[b]	A
Xylenes	2.0E+00[a]	9.0E-02[b]	NA	NA	D

Value in parentheses indicates inhalation value not available; oral value was used as a surrogate.

a IRIS (1990).
b USEPA (1990).
c ATSDR (1989a) (arsenic).
d ATSDR (1988a) (beryllium).
e Value shown is for thallium chloride.
f Oral RfD for nitrate was recently withdrawn.
g ATSDR (1987) (benzene).
h ATSDR (1989b) (1,2-DCA).
i USEPA (1987).
j ATSDR (1988b) (vinyl chloride).

mg/kg Milligrams per kilogram.
NA Not applicable.
ND Not determined.

Table 9. Reference Doses (RfDs), Cancer Slope Factors (CSFs), and Cancer Classifications for Constituents of Concern, Blydenburgh Landfill, Hauppauge, New York.

Constituent	RfD (mg/kg/day) Oral	RfD (mg/kg/day) Inhalation	CSF $(mg/kg/day)^{-1}$ Oral	CSF $(mg/kg/day)^{-1}$ Inhalation	EPA Cancer Class
Semivolatiles					
Benzoic Acid	4.0E+0[a]	(4.0E+0)	NA	NA	D
Bis(2-ethylhexyl) phthalate	2.0E-02[a]	9.0E-02[b]	0.014[a]	(0.014)	B2
Phenols	6.0E-01[a]	(6.0E-01)	NA	NA	D

Value in parentheses indicates inhalation value not available; oral value was used as a surrogate.

a IRIS (1990).
b USEPA (1990).
c ATSDR (1989a) (arsenic).
d ATSDR (1988a) (beryllium).
e Value shown is for thallium chloride.
f Oral RfD for nitrate was recently withdrawn.
g ATSDR (1987) (benzene).
h ATSDR (1989b) (1,2-DCA).
i USEPA (1987).
j ATSDR (1988b) (vinyl chloride).

mg/kg Milligrams per kilogram.
NA Not applicable.
ND Not determined.

Table 10 Risk Assessment for Hypothetical Future Adult and Child Residents, Ingestion of Ground Water from the Shallow Zone, Blydenburgh Landfill, Hauppauge, New York.

Constituent	Cgw (ug/L)	OED (mg/kg-day) Child	OED (mg/kg-day) Adult	Toxicity Value	Risk Estimate Child	Risk Estimate Adult
CANCER EFFECTS				CSF (kg-day/mg)	ELCR	
Volatiles						
Benzene	3.3	1.81E-05	3.87E-05	0.029	5E-07	1E-06
Chloroform	2	1.10E-05	2.35E-05	0.0061	7E-08	1E-07
1,1-Dichloroethane	13	7.12E-05	1.53E-04	ND	-	-
1,2-Dichloroethane	4.9	2.68E-05	5.75E-05	0.091	2E-06	5E-06
1,1-Dichloroethene	1.4	7.67E-06	1.64E-05	0.6	5E-06	1E-05
Methylene chloride	8.5	4.66E-05	9.98E-05	0.0075	3E-07	7E-07
Tetrachloroethene	16	8.77E-05	1.88E-04	0.051	4E-06	1E-05
Trichloroethene	7.1	3.89E-05	8.34E-05	0.011	4E-07	9E-07
Vinyl chloride	7.1	3.89E-05	8.34E-05	1.9	7E-05	2E-04
Inorganics						
Arsenic	1.8	9.86E-06	2.11E-05	1.8	2E-05	4E-05
Beryllium	0.94	5.15E-06	1.10E-05	4.3	2E-05	5E-05
				ELCR	**1E-04**	**3E-04**
NON-CANCER EFFECTS				RfD (mg/kg-day)	Hazard Quotients	
Volatiles						
Benzene	3.3	2.11E-04	9.04E-05	0.0007	3E-01	1E-01
Chloroform	2	1.28E-04	5.48E-05	0.01	1E-02	5E-03
1,1-Dichloroethane	13	8.31E-04	3.56E-04	0.1	8E-03	4E-03
1,2-Dichloroethane	4.9	3.13E-04	1.34E-04	0.25	1E-03	5E-04
1,1-Dichloroethene	1.4	8.95E-05	3.84E-05	0.009	1E-02	4E-03
1,2-Dichloroethene	22	1.41E-03	6.03E-04	0.01	1E-01	6E-02
Methylene chloride	8.5	5.43E-04	2.33E-04	0.06	9E-03	4E-03
Tetrachloroethene	16	1.02E-03	4.38E-04	0.01	1E-01	4E-02
Toluene	3.1	1.98E-04	8.49E-05	0.2	1E-03	4E-04
1,1,1-Trichloroethane	4.9	3.13E-04	1.34E-04	0.09	3E-03	1E-03
Trichloroethene	7.1	4.54E-04	1.95E-04	0.0075	6E-02	3E-02
Vinyl chloride	7.1	4.54E-04	1.95E-04	0.0013	3E-01	1E-01

Cgw Upper 95 percent confidence limit of the mean ground-water concentration.
CSF Cancer slope factor.
ELCR Excess lifetime cancer risk (DWED x SF).
HI Hazard index (sum of hazard quotients).
mg/kg-day Milligrams per kilogram per day.
OED Average daily oral exposure dose.
RfD Reference dose.
ug/L Micrograms per liter.

Table 10 Risk Assessment for Hypothetical Future Adult and Child Residents, Ingestion of Ground Water from the Shallow Zone, Blydenburgh Landfill, Hauppauge, New York.

Constituent	Cgw (ug/L)	OED (mg/kg-day) Child	OED (mg/kg-day) Adult	Toxicity Value	Risk Estimate Child	Risk Estimate Adult
NON-CANCER EFFECTS (continued)				RfD (mg/kg-day)	Hazard Quotients	
Inorganics						
Arsenic	1.8	1.15E-04	4.93E-05	0.001	1E-01	5E-02
Beryllium	0.94	6.01E-05	2.58E-05	0.005	1E-02	5E-03
Boron	142	9.08E-03	3.89E-03	0.09	1E-01	4E-02
Cadmium	3	1.92E-04	8.22E-05	0.0005	4E-01	2E-01
Copper	21	1.34E-03	5.75E-04	0.037	4E-02	2E-02
Cyanide	5.7	3.64E-01	1.56E-01	0.02	2E-01	8E-03
Manganese	2,990	1.91E-01	8.19E-02	0.1	2E+00	8E-01
Mercury	0.12	7.67E-06	3.29E-06	0.0003	3E-02	1E-02
Nickel	15	9.59E-04	4.11E-04	0.02	5E-02	2E-02
Nitrate	4,100	2.62E-01	1.12E-01	1	3E-01	1E-01
Thallium	6	3.84E-04	1.64E-04	0.00007	5E+00	2E+00
Vanadium	10	6.39E-04	2.74E-04	0.007	9E-02	4E-02
Zinc	197	1.26E-02	5.40E-03	0.2	6E-02	3E-02
				HI	10E+00	4E+00

Cgw	Upper 95 percent confidence limit of the mean ground-water concentration.
CSF	Cancer slope factor.
ELCR	Excess lifetime cancer risk (DWED x SF).
HI	Hazard index (sum of hazard quotients).
mg/kg-day	Milligrams per kilogram per day.
OED	Average daily oral exposure dose.
RfD	Reference dose.
ug/L	Micrograms per liter.

Table 11 Risk Assessment for Hypothetical Future Adult and Child Residents, Dermal Contact (Shower or Bath) with Ground Water from the Shallow Zone, Blydenburgh Landfill, Hauppauge, New York.

Constituent	Cgw (ug/L)	PC (cm/hr)	DAED (mg/kg/day) Child	DAED (mg/kg/day) Adult	Toxicity Value	Risk Estimate Child	Risk Estimate Adult
CANCER EFFECTS					CSF (kg-day/mg)	ELCR	
Volatiles							
Benzene	3.3	0.024	1.49E-06	1.69E-06	0.029	4E-08	5E-08
Chloroform	2.0	0.021	7.92E-07	8.95E-07	0.0061	5E-09	5E-09
1,1-Dichloroethane	13.0	0.015	3.68E-06	4.16E-06	ND	-	-
1,2-Dichloroethane	4.9	0.0098	9.05E-07	1.02E-06	0.091	8E-08	9E-08
1,1-Dichloroethene	1.4	0.015	3.96E-07	4.48E-07	0.6	2E-07	3E-07
Methylene chloride	8.5	0.015	2.40E-06	2.72E-06	0.0075	2E-08	2E-08
Tetrachloroethene	16.0	0.074	2.23E-05	2.52E-05	0.051	1E-06	1E-06
Trichloroethene	7.1	0.034	4.55E-06	5.14E-06	0.011	5E-08	6E-08
Vinyl chloride	7.1	0.0084	1.12E-06	1.27E-06	1.9	2E-06	2E-06
Inorganics							
Arsenic	1.8	0.0008	2.71E-08	3.07E-08	1.8	5E-08	6E-08
Beryllium	0.9	0.0008	1.42E-08	1.60E-08	4.3	6E-08	7E-08
					ELCR	**4E-06**	**4E-06**
NON-CANCER EFFECTS					RfD (mg/kg-day)	Hazard	Quotients
Volatiles							
Benzene	3.3	0.024	1.74E-05	3.94E-06	0.0007	2E-02	6E-03
Chloroform	2.0	0.021	9.24E-06	2.09E-06	0.01	9E-04	2E-04
1,1-Dichloroethane	13.0	0.015	4.29E-05	9.70E-06	0.1	4E-04	1E-04
1,2-Dichloroethane	4.9	0.0098	1.06E-05	2.39E-06	0.25	4E-05	1E-05
1,1-Dichloroethene	1.4	0.015	4.62E-06	1.04E-06	0.009	5E-04	1E-04
1,2-Dichloroethene	22.0	0.018	8.71E-05	1.97E-05	0.01	9E-03	2E-03
Methylene chloride	8.5	0.015	2.80E-05	6.34E-06	0.06	5E-04	1E-04
Tetrachloroethene	16.0	0.074	2.60E-04	5.89E-05	0.01	3E-02	6E-03
Toluene	3.1	0.048	3.27E-05	7.40E-06	0.2	2E-04	4E-05
1,1,1-Trichloroethane	4.9	0.039	4.20E-05	9.50E-06	0.09	5E-04	1E-04
Trichloroethene	7.1	0.034	5.31E-05	1.20E-05	0.0075	7E-03	2E-03
Vinyl chloride	7.1	0.0084	1.31E-05	2.97E-06	0.0013	1E-02	2E-03

Cgw Upper 95 percent confidence limit of the mean ground-water concentration.
cm/hr Centimeters per hour.
CSF Cancer slope factor.
DAED Average daily dermal exposure dose.
ELCR Excess lifetime cancer risk (DAED x SF).
HI Hazard index (sum of hazard quotients).
mg/kg-day Milligrams per kilogram per day.
PC Permeability constant.
RfD Reference dose.
ug/L Micrograms per liter.

Table 11 Risk Assessment for Hypothetical Future Adult and Child Residents, Dermal Contact (Shower or Bath) with Ground Water from the Shallow Zone, Blydenburgh Landfill, Hauppauge, New York.

Constituent	Cgw (ug/L)	PC (cm/hr)	DAED (mg/kg/day) Child	DAED (mg/kg/day) Adult	Toxicity Value	Risk Estimate Child	Risk Estimate Adult
NON-CANCER EFFECTS (continued)					RfD (mg/kg-day)	Hazard	Quotients
Inorganics							
Arsenic	1.8	0.0008	3.17E-07	7.16E-08	0.001	3E-04	7E-05
Beryllium	0.9	0.0008	1.65E-07	3.74E-08	0.005	3E-05	7E-06
Boron	142	0.0008	2.50E-05	5.65E-06	0.09	3E-04	6E-05
Cadmium	3.0	0.0008	5.28E-07	1.19E-07	0.0005	1E-03	2E-04
Copper	21.0	0.0008	3.69E-06	8.35E-07	0.037	1E-04	2E-05
Cyanide	5.7	0.0008	1.00E-03	2.27E-04	0.02	5E-05	1E-05
Manganese	2,990	0.0008	5.26E-04	1.19E-04	0.1	5E-03	1E-03
Mercury	0.1	0.0008	2.11E-08	4.77E-09	0.0003	7E-05	2E-05
Nickel	15.0	0.0008	2.64E-06	5.97E-07	0.02	1E-04	3E-05
Nitrate	4,100	0.0008	7.21E-04	1.63E-04	1	7E-04	2E-04
Thallium	6.0	0.0008	1.06E-06	2.39E-07	0.00007	2E-02	3E-03
Vanadium	10.0	0.0008	1.76E-06	3.98E-07	0.007	3E-04	6E-05
Zinc	197	0.0008	3.47E-05	7.84E-06	0.2	2E-04	4E-05
					HI	1E-01	2E-02

Cgw	Upper 95 percent confidence limit of the mean ground-water concentration.
cm/hr	Centimeters per hour.
CSF	Cancer slope factor.
DAED	Average daily dermal exposure dose.
ELCR	Excess lifetime cancer risk (DAED x SF).
HI	Hazard index (sum of hazard quotients).
mg/kg-day	Milligrams per kilogram per day.
PC	Permeability constant.
RfD	Reference dose.
ug/L	Micrograms per liter.

Table 12 Risk Assessment for Hypothetical Future Adult and Child Residents, Inhalation Exposure to Constituents detected in the Shallow Zone, Blydenburgh Landfill, Hauppauge, New York.

Constituent	Cgw (ug/L)	IED (mg/kg-day) Child	IED (mg/kg-day) Adult	Toxicity Value	Risk Estimate Child	Risk Estimate Adult
CANCER EFFECTS				CSFi (kg-day/mg)	ELCR	
Volatiles						
Benzene	3.3	3.62E-05	7.75E-05	0.029	1E-06	2E-06
Chloroform	2	2.19E-05	4.70E-05	0.081	2E-06	4E-06
1,1-Dichloroethane	13	1.42E-04	3.05E-04	ND	-	-
1,2-Dichloroethane	4.9	5.37E-05	1.15E-04	0.091	5E-06	1E-05
1,1-Dichloroethene	1.4	1.53E-05	3.29E-05	0.6	9E-06	2E-05
Methylene chloride	8.5	9.32E-05	2.00E-04	0.014	1E-06	3E-06
Tetrachloroethene	16	1.75E-04	3.76E-04	0.0018	3E-07	7E-07
Trichloroethene	7.1	7.78E-05	1.67E-04	0.017	1E-06	3E-06
Vinyl chloride	7.1	7.78E-05	1.67E-04	0.29	2E-05	5E-05
				ELCR	**4E-05**	**9E-05**
NON-CANCER EFFECTS				RfDi (mg/kg-day)	Hazard	Quotients
Volatiles						
Benzene	3.3	4.22E-04	1.81E-04	0.0007	6E-01	3E-01
Chloroform	2	2.56E-04	1.10E-04	0.01	3E-02	1E-02
1,1-Dichloroethane	13	1.66E-03	7.12E-04	0.1	2E-02	7E-03
1,2-Dichloroethane	4.9	6.26E-04	2.68E-04	0.025	3E-02	1E-02
1,1-Dichloroethene	1.4	1.79E-04	7.67E-05	0.009	2E-02	9E-03
1,2-Dichloroethene	22	2.81E-03	1.21E-03	0.01	3E-01	1E-01
Methylene chloride	8.5	1.09E-03	4.66E-04	0.9	1E-03	5E-04
Tetrachloroethene	16	2.05E-03	8.77E-04	0.01	2E-01	9E-02
Toluene	3.1	3.96E-04	1.70E-04	0.6	7E-04	3E-04
1,1,1-Trichloroethane	4.9	6.26E-04	2.68E-04	0.3	2E-03	9E-04
Trichloroethene	7.1	9.08E-04	3.89E-04	0.0075	1E-01	5E-02
Vinyl chloride	7.1	9.08E-04	3.89E-04	0.0013	7E-01	3E-01
				HI	**2E+00**	**9E-01**

Cgw	Upper 95 percent confidence limit of the mean ground-water concentration.
CSFi	Inhalation cancer slope factor.
ELCR	Excess lifetime cancer risk (IED x SFi).
HI	Hazard index (sum of hazard quotients).
IED	Average daily inhalation exposure dose.
mg/kg-day	Milligrams per kilogram per day.
RfDi	Inhalation reference dose.
ug/L	Micrograms per liter.

Table 13 Risk Assessment for Hypothetical Future Adult and Child Residents, Ingestion of Ground Water from the Intermediate Zone, Blydenburgh Landfill, Hauppauge, New York.

Constituent	Cgw (ug/L)	OED (mg/kg-day) Child	OED (mg/kg-day) Adult	Toxicity Value	Risk Estimate Child	Risk Estimate Adult
CANCER EFFECTS				CSF (kg-day/mg)	ELCR	
Volatiles						
Benzene	5.8	3.18E-05	6.81E-05	0.029	9E-07	2E-06
1,1-Dichloroethane	6.3	3.45E-05	7.40E-05	ND	-	-
1,2-Dichloroethane	0.85	4.66E-06	9.98E-06	0.091	4E-07	9E-07
1,1-Dichloroethene	6.7	3.67E-05	7.87E-05	0.6	2E-05	5E-05
Tetrachloroethene	7.2	3.95E-05	8.45E-05	0.051	2E-06	4E-06
Trichloroethene	22	1.21E-04	2.58E-04	0.011	1E-06	3E-06
Vinyl chloride	1.8	9.86E-06	2.11E-05	1.9	2E-05	4E-05
Semivolatiles						
Bis(2-ethylhexyl)phthalate	12.8	7.01E-05	1.50E-04	0.014	1E-06	2E-06
Inorganics						
Arsenic	1.9	1.04E-05	2.23E-05	1.75	2E-05	4E-05
Beryllium	1.1	6.03E-06	1.29E-05	4.3	3E-05	6E-05
				ELCR	**9E-05**	**2E-04**
NON-CANCER EFFECTS				RfD (mg/kg-day)	Hazard	Quotients
Volatiles						
Acetone	12	7.67E-04	3.29E-04	0.1	8E-03	3E-03
Benzene	5.8	3.71E-04	1.59E-04	0.0007	5E-01	2E-01
1,1-Dichloroethane	6.3	4.03E-04	1.73E-04	0.1	4E-03	2E-03
1,2-Dichloroethane	0.85	5.43E-05	2.33E-05	0.25	2E-04	9E-05
1,1-Dichloroethene	6.7	4.28E-04	1.84E-04	0.009	5E-02	2E-02
1,2-Dichloroethene	7.1	4.54E-04	1.95E-04	0.01	5E-02	2E-02
Tetrachloroethene	7.2	4.60E-04	1.97E-04	0.01	5E-02	2E-02
Toluene	5	3.20E-04	1.37E-04	0.2	2E-03	7E-04
1,1,1-Trichloroethane	15	9.59E-04	4.11E-04	0.09	1E-02	5E-03
Trichloroethene	22	1.41E-03	6.03E-04	0.0075	2E-01	8E-02
Vinyl chloride	1.8	1.15E-04	4.93E-05	0.0013	9E-02	4E-02

Cgw Upper 95 percent confidence limit of the mean ground-water concentration.
CSF Cancer slope factor.
ELCR Excess lifetime cancer risk (DWED x SF).
HI Hazard index (sum of hazard quotients).
mg/kg-day Milligrams per kilogram per day.
OED Average daily oral exposure dose.
RfD Reference dose.
ug/L Micrograms per liter.

Table 13 Risk Assessment for Hypothetical Future Adult and Child Residents, Ingestion of Ground Water from the Intermediate Zone, Blydenburgh Landfill, Hauppauge, New York.

Constituent	Cgw (ug/L)	OED (mg/kg-day) Child	OED (mg/kg-day) Adult	Toxicity Value	Risk Estimate Child	Risk Estimate Adult
NON-CANCER EFFECTS (continued)				RfD (mg/kg-day)	Hazard Quotients	
Semivolatiles						
Benzoic acid	4.1	2.62E-04	1.12E-04	4	7E-05	3E-05
Bis(2-ethylhexyl)phthalate	12.8	8.18E-04	3.51E-04	0.02	4E-02	2E-02
Inorganics						
Antimony	5	3.20E-04	1.37E-04	0.0004	8E-01	3E-01
Arsenic	1.9	1.21E-04	5.21E-05	0.001	1E-01	5E-02
Beryllium	1.1	7.03E-05	3.01E-05	0.005	1E-02	6E-03
Boron	231	1.48E-02	6.33E-03	0.09	2E-01	7E-02
Chromium	16	1.02E-03	4.38E-04	0.005	2E-01	9E-02
Copper	28	1.79E-03	7.67E-04	0.037	5E-02	2E-02
Lead	39	2.49E-03	1.07E-03	ND	-	-
Manganese	315	2.01E-02	8.63E-03	0.1	2E-01	9E-02
Nitrate	2,800	1.79E-01	7.67E-02	1	2E-01	8E-02
Thallium	1.6	1.02E-04	4.38E-05	0.00007	1E+00	6E-01
Vanadium	11	7.03E-04	3.01E-04	0.007	1E-01	4E-02
Zinc	133	8.50E-03	3.64E-03	0.2	4E-02	2E-02
				HI	4E+00	2E+00

Cgw Upper 95 percent confidence limit of the mean ground-water concentration.
CSF Cancer slope factor.
ELCR Excess lifetime cancer risk (DWED x SF).
HI Hazard index (sum of hazard quotients).
mg/kg-day Milligrams per kilogram per day.
OED Average daily oral exposure dose.
RfD Reference dose.
ug/L Micrograms per liter.

Table 14 Risk Assessment for Hypothetical Future Adult and Child Residents, Dermal Contact (Shower or Bath) with Ground Water from the Intermediate Zone, Blydenburgh Landfill, Hauppauge, New York.

Constituent	Cgw (ug/L)	PC (cm/hr)	DAED (mg/kg/day) Child	DAED (mg/kg/day) Adult	Toxicity Value	Risk Estimate Child	Risk Estimate Adult
CANCER EFFECTS					CSF (kg-day/mg)	ELCR	
Volatiles							
Benzene	5.8	0.024	2.62E-06	2.97E-06	0.029	8E-08	9E-08
1,1-Dichloroethane	6.3	0.015	1.78E-06	2.01E-06	ND	-	-
1,2-Dichloroethane	0.85	0.0098	1.57E-07	1.78E-07	0.091	1E-08	2E-08
1,1-Dichloroethene	6.7	0.015	1.89E-06	2.14E-06	0.6	1E-06	1E-06
Tetrachloroethene	7.2	0.074	1.00E-05	1.14E-05	0.051	5E-07	6E-07
Trichloroethene	22	0.034	1.41E-05	1.59E-05	0.011	2E-07	2E-07
Vinyl chloride	1.8	0.0084	2.85E-07	3.22E-07	1.9	5E-07	6E-07
Semivolatiles							
Bis(2-ethylhexyl)phthalate	12.8	0.098	2.36E-05	2.67E-05	0.014	3E-07	4E-07
Inorganics							
Arsenic	1.9	0.0008	2.87E-08	3.24E-08	1.75	5E-08	6E-08
Beryllium	1.1	0.0008	1.66E-08	1.88E-08	4.3	7E-08	8E-08
					ELCR	**3E-06**	**3E-06**
NON-CANCER EFFECTS					RfD (mg/kg-day)	Hazard	Quotients
Volatiles							
Acetone	12	0.00055	1.45E-06	3.28E-07	0.1	1E-05	3E-06
Benzene	5.8	0.024	3.06E-05	6.92E-06	0.0007	4E-02	1E-02
1,1-Dichloroethane	6.3	0.015	2.08E-05	4.70E-06	0.1	2E-04	5E-05
1,2-Dichloroethane	0.85	0.0098	1.83E-06	4.14E-07	0.25	7E-06	2E-06
1,1-Dichloroethene	6.7	0.015	2.21E-05	5.00E-06	0.009	2E-03	6E-04
1,2-Dichloroethene	7.1	0.018	2.81E-05	6.35E-06	0.01	3E-03	6E-04
Tetrachloroethene	7.2	0.074	1.17E-04	2.65E-05	0.01	1E-02	3E-03
Toluene	5	0.048	5.28E-05	1.19E-05	0.2	3E-04	6E-05
1,1,1-Trichloroethane	15	0.039	1.29E-04	2.91E-05	0.09	1E-03	3E-04
Trichloroethene	22	0.034	1.64E-04	3.72E-05	0.0075	2E-02	5E-03
Vinyl chloride	1.8	0.0084	3.33E-06	7.52E-07	0.0013	3E-03	6E-04

Cgw	Upper 95 percent confidence limit of the mean ground-water concentration.
cm/hr	Centimeters per hour.
CSF	Cancer slope factor.
DAED	Average daily dermal exposure dose.
ELCR	Excess lifetime cancer risk (DAED x SF).
HI	Hazard index (sum of hazard quotients).
mg/kg-day	Milligrams per kilogram per day.
PC	Permeability constant.
RfD	Reference dose.
ug/L	Micrograms per liter.

Table 14. Risk Assessment for Hypothetical Future Adult and Child Residents, Dermal Contact (Shower or Bath) with Ground Water from the Intermediate Zone, Blydenburgh Landfill, Hauppauge, New York.

Constituent	Cgw (ug/L)	PC (cm/hr)	DAED (mg/kg/day) Child	DAED (mg/kg/day) Adult	Toxicity Value	Risk Estimate Child	Risk Estimate Adult
NON-CANCER EFFECTS (continued)					RfD (mg/kg-day)	Hazard	Quotients
Semivolatiles							
Benzoic acid	4.1	0.018	1.62E-05	3.67E-06	4	4E-06	9E-07
Bis(2-ethylhexyl)phthalate	12.8	0.098	2.76E-04	6.24E-05	0.02	1E-02	3E-03
Inorganics							
Antimony	5	0.0008	8.80E-07	1.99E-07	0.0004	2E-03	5E-04
Arsenic	1.9	0.0008	3.34E-07	7.56E-08	0.001	3E-04	8E-05
Beryllium	1.1	0.0008	1.94E-07	4.38E-08	0.005	4E-05	9E-06
Boron	231	0.0008	4.06E-05	9.19E-06	0.09	5E-04	1E-04
Chromium	16	0.0008	2.81E-06	6.36E-07	0.005	6E-04	1E-04
Copper	28	0.0008	4.93E-06	1.11E-06	0.037	1E-04	3E-05
Lead	39	0.0008	6.86E-06	1.55E-06	ND	-	-
Manganese	315	0.0008	5.54E-05	1.25E-05	0.1	6E-04	1E-04
Nitrate	2,800	0.0008	4.93E-04	1.11E-04	1	5E-04	1E-04
Thallium	1.6	0.0008	2.81E-07	6.36E-08	0.00007	4E-03	9E-04
Vanadium	11	0.0008	1.94E-06	4.38E-07	0.007	3E-04	6E-05
Zinc	133	0.0008	2.34E-05	5.29E-06	0.2	1E-04	3E-05
					HI	**1E-01**	**2E-02**

Cgw	Upper 95 percent confidence limit of the mean ground-water concentration.
cm/hr	Centimeters per hour.
CSF	Cancer slope factor.
DAED	Average daily dermal exposure dose.
ELCR	Excess lifetime cancer risk (DAED x SF).
HI	Hazard index (sum of hazard quotients).
mg/kg-day	Milligrams per kilogram per day.
PC	Permeability constant.
RfD	Reference dose.
ug/L	Micrograms per liter.

Table . 15 Risk Assessment for Hypothetical Future Adult and Child Residents, Inhalation Exposure to Ground Water from the Intermediate Zone, Blydenburgh Landfill, Hauppauge, New York.

Constituent	Cgw (ug/L)	IED (mg/kg-day) Child	IED (mg/kg-day) Adult	Toxicity Value	Risk Estimate Child	Risk Estimate Adult
CANCER EFFECTS				CSFi (kg-day/mg)	ELCR	
Volatiles						
Benzene	5.8	6.36E-05	1.36E-04	0.029	2E-06	4E-06
1,1-Dichloroethane	6.3	6.90E-05	1.48E-04	ND	-	-
1,2-Dichloroethane	0.85	9.32E-06	2.00E-05	0.091	8E-07	2E-06
1,1-Dichloroethene	6.7	7.34E-05	1.57E-04	1.2	9E-05	2E-04
Tetrachloroethene	7.2	7.89E-05	1.69E-04	0.0018	1E-07	3E-07
Trichloroethene	22	2.41E-04	5.17E-04	0.017	4E-06	9E-06
Vinyl chloride	1.8	1.97E-05	4.23E-05	0.29	6E-06	1E-05
Semivolatiles						
Bis(2-ethylhexyl)phthalate	12.8	1.40E-04	3.01E-04	0.014	2E-06	4E-06
				ELCR	**1E-04**	**2E-04**
NON-CANCER EFFECTS				RfDi (mg/kg-day)	Hazard Quotients	
Volatiles						
Acetone	12	1.53E-03	6.58E-04	0.1	2E-02	7E-03
Benzene	5.8	7.42E-04	3.18E-04	0.0007	1E+00	5E-01
1,1-Dichloroethane	6.3	8.05E-04	3.45E-04	0.1	8E-03	3E-03
1,2-Dichloroethane	0.85	1.09E-04	4.66E-05	0.025	4E-03	2E-03
1,1-Dichloroethene	6.7	8.57E-04	3.67E-04	0.009	1E-01	4E-02
1,2-Dichloroethene	7.1	9.08E-04	3.89E-04	0.01	9E-02	4E-02
Tetrachloroethene	7.2	9.21E-04	3.95E-04	0.01	9E-02	4E-02
Toluene	5	6.39E-04	2.74E-04	0.6	1E-03	5E-04
1,1,1-Trichloroethane	15	1.92E-03	8.22E-04	0.3	6E-03	3E-03
Trichloroethene	22	2.81E-03	1.21E-03	0.0075	4E-01	2E-01
Vinyl chloride	1.8	2.30E-04	9.86E-05	0.0013	2E-01	8E-02
Semivolatiles						
Benzoic acid	4.1	5.24E-04	2.25E-04	4	1E-04	6E-05
Bis(2-ethylhexyl)phthalate	12.8	1.64E-03	7.01E-04	0.02	8E-02	4E-02
				HI	**2E+00**	**9E-01**

Cgw Upper 95 percent confidence limit of the mean ground-water concentration.
CSFi Inhalation cancer slope factor.
ELCR Excess lifetime cancer risk (IED x SFi).
HI Hazard index (sum of hazard quotients).
IED Average daily inhalation exposure dose.
mg/kg-day Milligrams per kilogram per day.
RfDi Inhalation reference dose.
ug/L Micrograms per liter.

Table 16 Air Concentrations, Air Pathway Inhalation Exposure Doses, and Risks for Landfill Employee, Blydenburgh Landfill, Hauppauge, New York.

Constituent	Air concentration ($\mu g/m^3$)	AExD (mg/kg/day)	Cancer Risk and Hazard Quotient
Cancer Effects			
Benzene	0.06	5.4E-06	2E-07
1,1-Dichloroethene	0.02	1.8E-06	2E-06
Vinyl chloride	0.17	1.5E-05	5E-06
		ELCR	**7E-06**
Non-Cancer Effects			
Benzene	0.06	9.4E-06	0.01
Chlorobenzene	0.02	3.1E-06	0.0006
1,1-Dichloroethane	0.04	6.3E-06	0.00006
1,1-Dichloroethene	0.02	3.1E-06	0.0003
1,2-Dichloroethene	0.12	1.9E-05	0.0009
Ethyl benzene	0.56	8.8E-05	0.0009
Toluene	0.21	3.3E-05	0.00006
Xylenes	0.43	6.7E-05	0.0007
Vinyl chloride	0.17	2.7E-05	0.02
		HI	**0.04**

AExD Air pathway inhalation exposure dose.
ELCR Excess lifetime cancer risk.
HI Hazard index.

mg/kg Milligrams per kilogram.
$\mu g/m^3$ Micrograms per cubic meter.

Table 17 Air Concentrations, Air Pathway Inhalation Exposure Doses, and Risks for Adult Resident, Blydenburgh Landfill, Hauppauge, New York.

Constituent	Air concentration ($\mu g/m^3$)	AExD (mg/kg/day)	Cancer Risk and Hazard Quotient
Cancer Effects			
Benzene	0.07	1.5E-05	4E-07
1,1-Dichloroethene	0.03	6.2E-06	7E-06
Vinyl chloride	0.18	3.7E-05	1E-05
		ELCR	2E-05
Non-Cancer Effects			
Benzene	0.07	3.4E-05	0.05
Chlorobenzene	0.07	3.4E-05	0.007
1,1-Dichloroethane	0.14	6.8E-05	0.0007
1,1-Dichloroethene	0.03	1.5E-05	0.002
1,2-Dichloroethene	0.15	7.3E-05	0.004
Ethyl Benzene	0.69	3.3E-04	0.003
Toluene	0.24	1.1E-04	0.0002
Xylenes	0.57	2.7E-04	0.003
Vinyl Chloride	0.18	8.7E-05	0.07
		HI	0.1

AExD Air pathway inhalation exposure dose.
ELCR Excess lifetime cancer risk.
HI Hazard index.

mg/kg Milligrams per kilogram.
$\mu g/m^3$ Micrograms per cubic meter.

Table 18 Air Concentrations, Air Pathway Inhalation Exposure Doses, and Risks for Child Resident, Blydenburgh Landfill, Hauppauge, New York.

Constituent	Air concentration ($\mu g/m^3$)	AExD (mg/kg/day)	Cancer Risk and Hazard Quotient
Cancer Effects			
Benzene	0.07	1.3E-05	4E-07
1,1-Dichloroethene	0.03	5.8E-06	7E-06
Vinyl chloride	0.18	3.4E-05	1E-05
		ELCR	**2E-05**
Non-Cancer Effects			
Benzene	0.07	1.6E-04	0.2
Chlorobenzene	0.07	1.6E-04	0.03
1,1-Dichloroethane	0.14	3.1E-04	0.003
1,1-Dichloroethene	0.03	6.7E-05	0.007
1,2-Dichloroethene	0.15	3.3E-04	0.02
Ethyl benzene	0.69	1.5E-03	0.02
Toluene	0.24	5.3E-04	0.0009
Xylenes	0.57	1.3E-03	0.01
Vinyl chloride	0.18	4.0E-04	0.3
		HI	**0.6**

AExD Air pathway inhalation exposure dose.
ELCR Excess lifetime cancer risk.
HI Hazard index.

mg/kg Milligrams per kilogram.
$\mu g/m^3$ Micrograms per cubic meter.

Table - 19 Risk Assessment Summary, Blydenburgh Landfill, Hauppauge, New York.

Pathway*	Receptor	HI	ELCR
<u>Air</u>	Landfill employee	0.04	7×10^{-6}
	Adult resident	0.1	2×10^{-5}
	Child resident	0.6	2×10^{-5}
<u>Shallow Ground Water</u>			
Ingestion	Adult resident	4	3×10^{-4}
Dermal contact	Adult resident	0.02	4×10^{-6}
Inhalation	Adult resident	0.9	9×10^{-5}
	Total	5	4×10^{-4}
Ingestion	Child resident	10	1×10^{-4}
Dermal contact	Child resident	0.1	4×10^{-6}
Inhalation	Child resident	2	4×10^{-5}
	Total	12	1×10^{-4}
<u>Intermediate Ground Water</u>			
Ingestion	Adult resident	2	2×10^{-4}
Dermal contact	Adult resident	0.02	3×10^{-6}
Inhalation	Adult resident	0.9	2×10^{-4}
	Total	3	4×10^{-4}
Ingestion	Child resident	4	9×10^{-5}
Dermal contact	Child resident	0.1	3×10^{-6}
Inhalation	Child resident	2	1×10^{-4}
	Total	6	2×10^{-4}

* Air pathway represents current and future risk estimates; ground-water pathways represent hypothetical future risk estimates. No current exposure pathways were identified for ground water.

ECLR Excess lifetime cancer risk.

HI Hazard index.

Table 20 Cost Estimate - Alternative 4a --- Extraction, Aeration, [With Off-Gas Treatment], Polishing, Discharge to Recharge Basin, Site Cap, and Air Monitoring), Feasibility Study for the Blydenburgh Landfill, Hauppauge, New York.

A. CAPITAL COSTS

ITEMS	QUANTITY	UNIT	UNIT COST	TOTAL COST
Ground-Water Extraction System	1	L.S.	$195,000	$195,000
Equaliztion Tank	1	L.S.	$18,000	$18,000
Aeration Unit	1	L.S.	$35,000	$35,000
Vapor Phase Carbon Treatment(a)	1	L.S.	$33,000	$33,000
Clarifier	1	L.S.	$150,000	$150,000
Liquid Phase Carbon Treatment	1	L.S.	$100,000	$100,000
Backwash Tank	1	L.S.	$8,000	$8,000
Sludge Holding Tank	1	L.S.	$6,000	$6,000
Filter Press	1	L.S.	$100,000	$100,000
Transfer Pumps	8	EA.	$1,250	$10,000
Discharge Pumps	2	EA.	$7,000	$14,000
Treatment Building	1700	S.F.	$75	$127,500
Foundation	140	C.Y.	$150	$21,000
Site Preparation	1	L.S.	$50,000	$50,000
Discharge System to Recharge Basin	1	L.S.	$115,600	$115,600
Pavement Restoration	1	L.S.	$15,000	$15,000
Electric Work	1	L.S.	$120,000	$120,000
		Subtotal		$1,118,100
		Engineering Design	10%	$111,810
		Construction Supervisor	10%	$111,810
		Subtotal		$1,341,720
		Contingency	25%	$335,430
		TOTAL CAPITAL COST - TREATMENT		$1,677,150
Modified Part 360 Cap(b)	1	L.S.	$11,676,000	$11,676,000
TOTAL CAPITAL COST - ALTERNATIVE -4a				$13,353,150

(a) If needed.
(b) Based on information provided by Malcolm Pirnie, Inc.
(Administration, engineering and contingency costs, not included for the Modified Part 360 Cap).

a: ALT-6CC.XLS

Table 20 - Cost Estimate - Alternative 4a (Extraction, Aeration, [With Off-Gas Treatment], Polishing, Discharge to Recharge Basin, Site Cap, and Air Monitoring), Feasibility Study for the Blydenburgh Landfill, Hauppauge, New York.

B. O&M Cost

Monitoring Costs (years 1-30)		$ 3,321,200
Annual Pump & Treat Cost	$ 114,205	
Administration (15%)	$ 17,131	
Subtotal	$ 131,336	
Contingency (25%)	$ 32,834	
Total	$ 164,170	
Present Value, Years 1-10 (5% discount rate)		$ 1,267,675

GRAND TOTAL - ALTERNATIVE 4a	**$ 17,942,025**