ETE Sanitation And Landfill

Town Of Gainesville, New York

Final Feasibility Study Report

NYSDEC Site #9-61-005
Work Assignment #D002925-24

Prepared For:

New York State
Department Of Environmental Conservation
50 Wolf Road, Albany, New York 12233

John P. Cahill
Commissioner

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March 1999

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April 1, 1999

Mr. Shive Mittal, P.E.
Project Manager
Division of Environmental Remediation
New York State Department of Environmental Conservation
50 Wolf Road
Albany, New York 12233-7010

Subject: ETE Sanitation and Landfill Site RI/FS
Site No. 9-61-005
Final Feasibility Study Report

Dear Mr. Mittal:

In accordance with your direction, Camp Dresser and McKee (CDM) is providing you with the enclosed seven copies of the Draft Feasibility Report. The following report addresses the comments concerning the draft Feasibility Report as presented in the NYSDEC letter dated February 9, 1999 as well as subsequent requests from your department.

If you have any questions please do not hesitate to call.

Very truly yours,

CAMP DRESSER & MCKEE

Thomas P. Fox P.G.
Project Manager

cc: M. Maimone
L. Guterman

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Executive Summary

Camp Dresser & McKee (CDM) has been retained by the New York State Department of Environmental Conservation (NYSDEC) to prepare this Feasibility Study (FS) Report for the ETE Sanitation and Landfill under the New York State Superfund Standby Contract (Work Assignment #D002925-24). This FS Report discusses the basis and procedures used in identifying remedial alternatives which address contamination at the ETE Sanitation and Landfill site. The primary purpose of the FS is to provide NYSDEC with sufficient data to select a feasible cost-effective remedial alternative that protects public health and the environment from the potential risks posed by the contamination associated with the ETE Sanitation and Landfill site.

Because waste in landfills usually is present in large volumes and is a heterogeneous mixture of municipal waste frequently co-disposed with industrial and/or hazardous waste, treatment usually is impracticable. In such a case, U.S. Environmental Protection Agency (EPA) generally considers capping, containment, and collection and treatment of leachate and landfill gas to be the appropriate response action or the "presumptive remedy" for municipal landfill sites (EPA, 1993).

Presumptive remedies are preferred technologies for common categories of sites, based on historical patterns of remedy selection and EPA/NYSDEC scientific and engineering evaluation of performance data on technology application. Presumptive remedies for municipal landfill sites primarily address containment of the landfill mass, source area control, and collection/treatment of landfill leachate and gas, as required. The use of presumptive remedies speeds up cleanup actions by using the program's past experiences to streamline site investigations.

Site Description and Background

The ETE Sanitation and Landfill site is located in a rural agricultural area on Broughton Road, in the Town of Gainesville, Wyoming County, New York, approximately 1 mile north of the village of Gainesville. The twenty acre site is surrounded by woodland buffer which separates the landfill from undeveloped agricultural land on all sides of the landfill. Two ponds are located within the study area, the first being situated at the southern property line, referred to as South Pond, and the second located on the northern property line, referred to as North Pond. The extent of waste accounts for approximately seven acres of the twenty acre site.

The ETE Sanitation and Landfill site was operated by the ETE Corporation from 1972 to 1979. Currently, the site is listed as a class 2 landfill on the State Registry of Inactive Hazardous Waste Sites due to the documented presence of hazardous. The ETE Site was a non-permitted (operated without a NYSDEC permit to operate) private landfill which accepted municipal and industrial waste from surrounding towns in Wyoming County and local industries.

Based on site history, findings of NYSDEC site inspections and sample results, NYSDEC elected to perform a Preliminary Site Assessment (PSA) of the site in 1990 and a Second Phase PSA in May of 1993. The PSAs included the collection of onsite sediment, leachate and soil samples in addition to the installation and sampling of seven groundwater monitoring wells. These investigations confirmed that hazardous wastes were disposed onsite, groundwater standards were violated, and the contaminants have migrated into nearby surface waters.

The disposal of industrial waste including leaded paint sludge, salt and possibly plating wastes were identified as sources of contamination during these initial investigations. Data generated from these previous investigations assisted CDM in developing the Remedial Investigation/Feasibility Study (RI/FS) scope of work and provided some insight into the fate and transport of site contaminants.

In the Spring of 1998, CDM completed a Remedial Investigation (RI) of the ETE Sanitation and Landfill site that included the installation and sampling of groundwater monitoring wells, geophysical studies, test pits, surface water and sediment sampling. The objective of the RI was to characterize the physical setting of the site (i.e. hydrogeology, surface water, topography) and to assess the nature and extent of environmental contamination associated with documented hazardous waste disposal. A qualitative human health risk assessment was performed to determine potential health risks associated with site contaminant. The findings of the RI have been used as the basis for developing the Feasibility Study of the ETE Sanitation and Landfill site. Results of the completed RI are detailed in the Final ETE Sanitation and Landfill Remedial Investigation Report, dated September 1998.

Physical Setting

The landfill was constructed on top of unconsolidated clay rich glacial tills containing minor beds of more permeable sands and gravel. Landfill topography generally slopes to the north. Surface water drainage as well as groundwater flow is consistent with topography with flow generally being from south to north. Surface runoff from the site flows into a small tributary of Cotton Creek which is located 0.75 miles north of the site. Groundwater flows north and may eventually discharge to downgradient surface water bodies such as Cotton Creek. The hydraulic conductivity of native soils were estimated to range from 10^{-4} to 10^{-6} cm/sec. Groundwater flow velocity within the glacial sediments underlying the landfill was estimated to range from 0.55 ft/day to 1.64 ft. day.

Based on completed test pits, approximately seven acres of the site contains landfilled waste. The maximum thickness of the waste is approximately 15 feet at the center of the landfill and tends to thin towards the perimeter of the landfill. The waste is covered with a silty clay soil between one and two feet thick, although waste is exposed within portions of the landfills northern slope. A portion of the landfilled material is believed to extend under the northern portion of the South Pond located adjacent to the landfill.

Nature and Extent of Contamination

The completed Remedial Investigation study has documented that landfill contaminants have impacted groundwater, surface water, soils and surface water sediment adjacent to, and downgradient of the landfill wastes.

RI data indicate that landfill contaminants have impacted surface water quality downgradient (north) of the site primarily by inorganic contaminants including aluminum, iron, and zinc. Additionally, surface water sediment downgradient of the site have been impacted by volatile organic compounds (VOCs), including acetone, methylene chloride, 2-butanone, ethylbenzene and xylene, and inorganic contaminants, including iron, manganese and zinc. Data indicate a leachate seeps flowing into the North Pond contain similar VOCs and inorganic contaminants identified within downgradient surface waters. Additional sampling performed by CDM in September of 1998 of Cotton Creek and it's tributaries revealed no impact by landfill contaminants. However, sodium, acetone, and lead were found to exceed background concentrations within surface water and/or surface water sediment located approximately 600 feet downstream of the landfill.

Contaminant distribution within site groundwater indicates that the majority of contamination is limited to the landfill wastes located within the west-central portion of the landfill and within shallow groundwater immediately downgradient of the site. Exceedances of NYSDEC GA groundwater standards were most frequently noted in monitoring wells screened within the landfill wastes and shallow water table aquifer. The principal contaminants of concern in the groundwater include: acetone, 2-butanone, benzene, 4-methyl-2-pentanone, 2-hexane, toluene, trichloroethene, 1,2-dichloroethene, chlorobenzene, ethylbenzene, xylenes, phenol, 2-methylphenol, 4-methylphenol and 2,4-dimethylphenol. Monitoring well MW-8S, screened in the shallow water table aquifer and waste, exhibited the highest observed volatile organic concentrations within the landfill, with a total VOC concentration of 5,394 micrograms per liter (ug/l).

Inorganic contaminants found in excess of NYSDEC GA groundwater standards included: antimony, barium, cadmium iron, lead, magnesium, manganese, sodium and thallium. As with VOCs, the greatest inorganic contamination is observed within and immediately downgradient of the landfill. However, with the exception of sodium and iron, landfill related inorganic contaminants do not appear to be significantly impacting water quality within the deep monitoring wells. Heavy metals such as lead and cadmium would not be expected to migrate offsite within the groundwater environment due to their relatively low mobility.

Groundwater transport of contaminants from the landfill is a significant offsite migration pathway given the proximity of the landfill to a number of private wells located downgradient of the site. However, sampling completed by the New York State Department of Health from 1989 to 1997 did not reveal evidence that private wells have been impacted by landfill contaminants. Additionally, contaminants within groundwater have the potential to discharge to surface water bodies downgradient of the landfill, such as Cotton Creek.

Landfill gas production appears to be minimal in the eastern portion of the landfill. However, landfill gas may not be capable of migrating upward into this area of the landfill due to an impermeable layer of water saturated soils. The west-central portion of the landfill appears to be actively producing gas. VOC analysis of four soil gas samples indicated VOCs to be present within landfill gas. The highest concentration was observed at GW-4 with a total VOC concentration of 113,490 parts per billion by volume (ppbv).

As part of the Remedial Investigation, a qualitative risk assessment was conducted for the ETE Sanitation and Landfill site to determine the potential risks and hazards that chemicals detected at the site may pose to human health under current and future conditions in the absence of remediation. Potential health risks associated with current site conditions include ingestion and inhalation of contamination in the groundwater from an onsite private well and inhalation of ambient air by a trespasser. Potential health risks for future use conditions which conservatively assumes that the landfill would be used for residential property include ingestion and inhalation of contamination in the groundwater and inhalation of ambient air.

Remedial Action Objectives

Remedial Action Objectives (RAOs) consist of medium-specific goals for protecting human health and the environment and focus on the contaminants of concern, exposure routes and receptors, and an acceptable contaminant level or range of levels for each exposure route. Based on the RI findings and the goals of the NYSDEC, the remedial action objectives established for the ETE Landfill include:

1. Isolate the landfill waste material in order to provide adequate protection to human health and the environment from direct contact or ingestion of hazardous constituents in wastes or surface soil from the landfill.

2. Remove landfill wastes from the South Pond and contaminated sediments from the North Pond. Consolidate wastes within the landfill property.

3. Reduce the production of leachate and offsite migration of contaminants by restricting the amount of surface water and groundwater flowing through the landfill.

4. Eliminate or significantly reduce the quantity of leachate discharging to groundwater and/or surface water.

5. Control emissions of landfill gases that could pose a risk to current and/or future residents.

6. Control surface water runoff and erosion.

These RAOs serve as the primary basis upon which the remedial alternatives are developed and evaluated. Using the presumptive remedy approach, a limited number of media specific remedial technologies, including any identified presumptive remedies, are identified. These are then screened for site specific feasibility, technical implementability, and practicability based on readily available information from the site RI and from similar sites.

Using the presumptive remedy approach, a number of technologies are clearly applicable to the site. These are listed below according to the remedial action objective being addressed by that technology.

The first RAO can be addressed by the construction of a modified Part 360 landfill cap. The cap would isolate landfill material and protect human health and the environment from contact with landfill contaminants. Landfill cap alternatives are included in this evaluation.

The second RAO can be addressed through waste consolidation, site regrading and by the construction of the modified Part 360 landfill cap.

Completed model simulations indicate that the landfill cap alone would not substantially reduce the generation of leachate in the future. Therefore, the third and fourth RAO would not be met with just capping the waste. However, with the addition of a hydraulic control technology, leachate generation can be substantially reduced.

The fifth RAO can be addressed by the construction of a modified Part 360 landfill cap that would include a series of passive gas vents.

The sixth RAO can be addressed by site regrading, installation of a modified Part 360 landfill cap and construction of drainage swales along the east and west perimeters of the landfill.

Evaluation of Alternatives

Four alternatives for site remediation were developed through the screening process. They are:

Alternative 1 -	No Action with Environmental Monitoring;
Alternative 2 -	Consolidate Wastes, Install Modified Part 360 Landfill Cap, Gas Vents, and Environmental Monitoring;
Alternative 3 -	Consolidate Wastes, Install Modified Part 360 Landfill Cap, Gas Vents, Drain South Pond, Relocate and Expand the North Pond and Environmental Monitoring;
Alternative 4 -	Consolidate Wastes, Install Modified Part 360 Landfill Cap, Gas Vents , Drain South Pond, Relocate and Expand the North Pond, Install a Passive Perimeter Drain, Collection and Offsite Disposal (Alternative 4a) or Onsite Discharge (Alternative 4b) of Groundwater, and Environmental Monitoring.

Alternative 1

The No Action Alternative would not include active remediation of the site but would include future environmental monitoring. Given the presence of site contamination exceeding ARARs/SCGs and the likelihood that contaminants would continue to migrate offsite, this alternative would not be protective of human health or the environment. Environmental monitoring alone would fail to address the Remedial Action Objectives; however, environmental monitoring would reduce the potential of landfill impacted groundwater being used by the public for potable uses. Further, there is no active removal or containment of contaminants in this alternative. Alternative 1 is the least costly of the four alternatives, with a present worth estimated at $345,611.

Alternative 1 is the least desirable of the three alternatives considered because of its inability to meet all stated RAOs.

Alternative 2

Alternative 2 includes environmental monitoring, the consolidation of waste and construction of a modified 6NYCRR Part 360 landfill cap. This alternative will reduce human and environmental exposure to site contaminants but does not meet all stated RAOs.

Waste consolidation and the construction of the landfill cap will reduce infiltration through the landfill mass, but leachate production is not significantly reduced given the presence of the South Pond. The cap will also control landfill gas emissions from the landfill.

Since no treatment technologies are included, Alternative 2 does not reduce the volume or toxicity of the contaminants found at the landfill and does not significantly reduce the mobility of contaminants. As a result, groundwater and surface water contamination will continue to occur through leachate discharge. Additionally, contaminated sediments within the North Pond would remain in place.

The total present worth cost of this alternative is estimated to be approximately $4,041,029.

Alternative 2 represents a reduction in risk when compared to the No Action Alternative; however, it does not significantly reduce the mobility of the contaminants within the landfill. The majority of the cost for this alternative is attributed to the installation of the landfill cap, and its cost is similar to the cost of Alternative 3. This alternative, although preferred over Alternative 1, is not recommended because Alternative 3 offers benefits of significantly reduced contaminant mobility, reducing the long term impact to groundwater and surface water, for relatively little additional cost.

Alternative 3

Alternative 3 includes waste consolidation, the installation of the modified 6NYCRR Part 360 landfill cap, passive landfill gas vents, draining the South Pond, removal of contaminated sediments from the North Pond, expansion of the North Pond and environmental monitoring.

Alternative 3 combines several identified feasible technologies to bring an enhanced level of exposure prevention and a significant reduction in contaminant mobility. Alternative 3 meets all RAOs. This alternative provides for minimization of human and environmental exposure through waste consolidation and permanent capping of the landfill, control of landfill gas emissions, and reduction of leachate generation which in turn will reduce long term groundwater and surface water impacts.

This alternative will require the permanent draining of the South Pond and will likely result in disrupting wetlands located around the North Pond. However, site regrading will include enlarging the North Pond by approximately one acre to compensate for the loss of aquatic habitat and any wetlands destroyed will be reestablished in and around the enlarged North Pond.

The total present worth cost to implement and maintain this alternative is estimated at approximately $4,350,857, approximately eight percent more than the present worth cost to complete Alternative 2.

Alternative 4

Alternative 4 includes all aspects of Alternative 3 in addition to the installation of a passive perimeter drain for the collection of a leachate/groundwater mixture, designated as Alternative 4a. A variation of Alternative 4 was added which includes the addition of a sheet pile barrier wall installed between the landfill and the passive perimeter drain, referred to as Alternative 4b. A significant advantage of Alternative 4b over 4a is that the barrier wall will prevent leachate from entering the passive perimeter drain. With the addition of the barrier wall, it is assumed only upgradient, uncontaminated, groundwater would be collected by the drain which should meet surface water discharge limits eliminating the need for treatment. This would result in a cost benefit of approximately $4.03 million over the 30 year operational period. Alternative 4b is marginally more effective at leachate reduction over Alternative 4a.

As with Alternative 3, both variations of Alternative 4 meet all stated RAOs. However, Alternative 4 provides even greater reduction of leachate discharge to groundwater, by approximately 14 to 18 percent, thereby providing increased protection to groundwater and surface water. However, Alternative 4b costs approximately $1.39 million more than Alternative 3 to implement and maintain over the 30 year operational period.

Recommendation of Alternative

Seven criteria (as discussed in The Technical and Administrative Guidance Memorandum) were used to perform a detailed analysis of the four alternatives. These were: compliance with Applicable or Relevant and Appropriate Requirements (ARARs); protection of human health and the environment; short term effectiveness; long term effectiveness and permanence; reduction of toxicity, mobility, or volume; implementability; and cost.

Alternative 1 was not selected because it does not sufficiently address protection of human health and the environment. Alternative 2 provided increased protection of human health and the environment, over Alternative 1 but does not significantly reduce leachate generation and contaminant mobility. As a result, groundwater and surface water contamination would continue under Alternative 2 virtually unabated.

Alternative 3 is recommended for implementation at the ETE Sanitation and Landfill site given it meets all RAOs, is a reliable remedy with minimal long term maintenance requirements, and is significantly more cost effective than Alternative 4a or 4b.

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Section 1
Introduction and Site Characterization

1.1 Introduction

Camp Dresser & McKee (CDM) has been retained by the New York State Department of Environmental Conservation (NYSDEC) to prepare this Feasibility Study (FS) Report for the ETE Sanitation and Landfill site under the New York State Superfund Standby Contract (Work Assignment #D002925-24). This FS Report discusses the basis and procedures used in identifying remedial alternatives which address contamination at the ETE Sanitation and Landfill site. The purpose of the FS is to select a feasible cost-effective remedial alternative that protects public health and the environment from the potential risks posed by contamination in the landfill.

Because waste in landfills usually is present in large volumes and is a heterogeneous mixture of municipal waste frequently co-disposed with industrial and/or hazardous waste, treatment usually is impracticable. In such a case, EPA generally considers capping, containment, and collection and treatment of leachate and landfill gas to be the appropriate response action or the "presumptive remedy" for municipal landfill sites (EPA, 1993).

Presumptive remedies are preferred technologies for common categories of sites, based on historical patterns of remedy selection and EPA/NYSDEC scientific and engineering evaluation of performance data on technology application. Presumptive remedies for municipal landfill sites primarily address containment of the landfill mass, source area control, and collection/treatment of landfill leachate and gas, as required.

A feasible remedy is one that is suitable to site conditions, capable of being successfully carried out with available technology, and that considers, at a minimum, implementability and cost effectiveness. Because the site under consideration is a landfill, there are numerous, comparable FS reports available with information directly applicable to the ETE Sanitation and Landfill site. This available information can help to speed the process of selecting remedial alternatives by focusing on only the most qualified technologies that apply to the media of concern. The use of presumptive remedy guidance can, in this case, provide an immediate focus to the discussion and selection of alternatives. It can help to speed the process by limiting the number of effective alternatives to those technologies that have been selected in the past at similar sites or for similar contaminants. By evaluating technologies that have been consistently selected at similar sites, a presumption can be developed that a particular remedy or set of remedies is appropriate for this specific type of site.

Using this presumptive remedy approach, a limited number of media specific remedial technologies, including any identified presumptive remedies, are identified. These are then screened for site specific feasibility, technical implementability, and practicability based on readily available information from the site RI and from similar sites. Specific technologies may not be applicable to the treatment of contamination in the concentration and form found at the site, or may be impractical due to site constraints and can be eliminated from further consideration. The remaining technologies can then be assembled into a limited number of site-wide remedial alternatives, which are subsequently subjected to a detailed, comparative evaluation.

Section 1 of this report begins with a description and background of the site and details the nature and extent of the contamination, including potential exposure pathways. The Remedial Action Objectives (RAOs) of this FS are discussed in Section 2. A summary of groundwater model simulations completed in order to conduct the preliminary evaluation of hydraulic control technologies is presented in Section 3. Section 4 provides a detailed description of the remedial technologies and process options which are included in the remedial alternatives which have undergone a detailed analysis as part of the FS. Section 5 describes each of the four selected remedial alternatives and the detailed analysis of each alternative based on NYSDEC evaluation criteria. A comparative analysis of each alternative is presented in Section 6. Section 7 presents CDM's recommendations regarding the most appropriate alternative based on the information contained in the previous sections. Section 7 also provides a discussion on the recommended construction sequence within regard to the recommended alternative.

1.2 Site Description and Background

The ETE Sanitation and Landfill site is located in a rural agricultural area on Broughton Road, the Town of Gainesville, Wyoming County, New York, approximately 1 mile north of the village of Gainesville, as shown in Figure 1-1.

The twenty acre site is surrounded by woodland buffer which separates the landfill from undeveloped agricultural land on all sides of the landfill. To the south of the landfill, Broughton Road runs east to west. To the west, Route 19 runs north to south. Two ponds are located within the study area and are found at the southern property line, South Pond, and along the northern property line, North Pond. The extent of waste accounts for approximately seven acres of the twenty acre site. The site map (Figure 1-2) shows the landfill and adjoining site features.

The ETE Sanitation and Landfill site was operated by the ETE Corporation from 1972 to 1979. Currently, the site is listed as a class 2 landfill Inactive Hazardous Waste Disposal site in New York State Registry of sites. The site has been characterized as a Class 2 landfill because of the presence of hazardous waste which presents a significant threat to public health and the environment. The ETE Site was a non permitted (operated without a NYSDEC permit to operate) private landfill which accepted municipal and industrial waste from surrounding towns in Wyoming County and local industries.

Almor Corporation of Warsaw, New York, disposed approximately 150 tons of leaded paint sludge onsite. Plating wastes from Mallory Timers in Warsaw, New York may have also been disposed onsite. Additional industrial waste included halite (table salt) and possibly other salts produced by Morton Salt. An estimated 4 to 5 truckloads of salt were disposed per week for an undetermined length of time according to site inspection reports completed by NYSDEC (URS Consultants, 1990).

Based on site history, findings of the site inspections and sample results, NYSDEC elected to perform a Preliminary Site Assessment (PSA) of the site in 1990 and a Second Phase PSA in May of 1993. The PSAs included the collection of onsite sediment, leachate and soil samples in addition to the installation and sampling of seven groundwater monitoring wells. These investigations confirmed that hazardous wastes have been disposed onsite, groundwater standards have been violated, and the contaminants have migrated into nearby surface waters.

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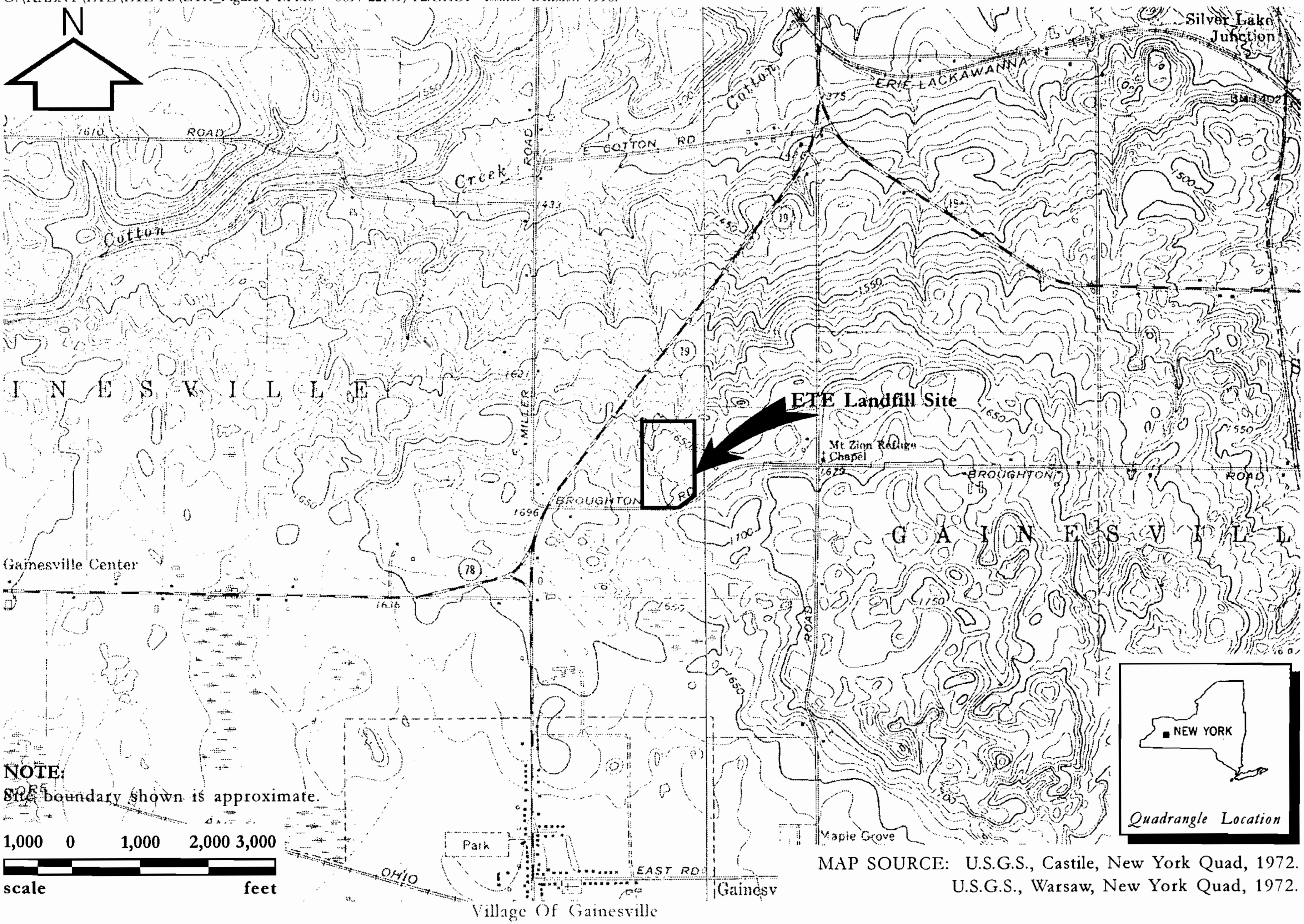

MAP SOURCE: U.S.G.S., Castile, New York Quad, 1972.
U.S.G.S., Warsaw, New York Quad, 1972.

Figure 1-1
Site Location
ETE Sanitation and Landfill Feasibility Study

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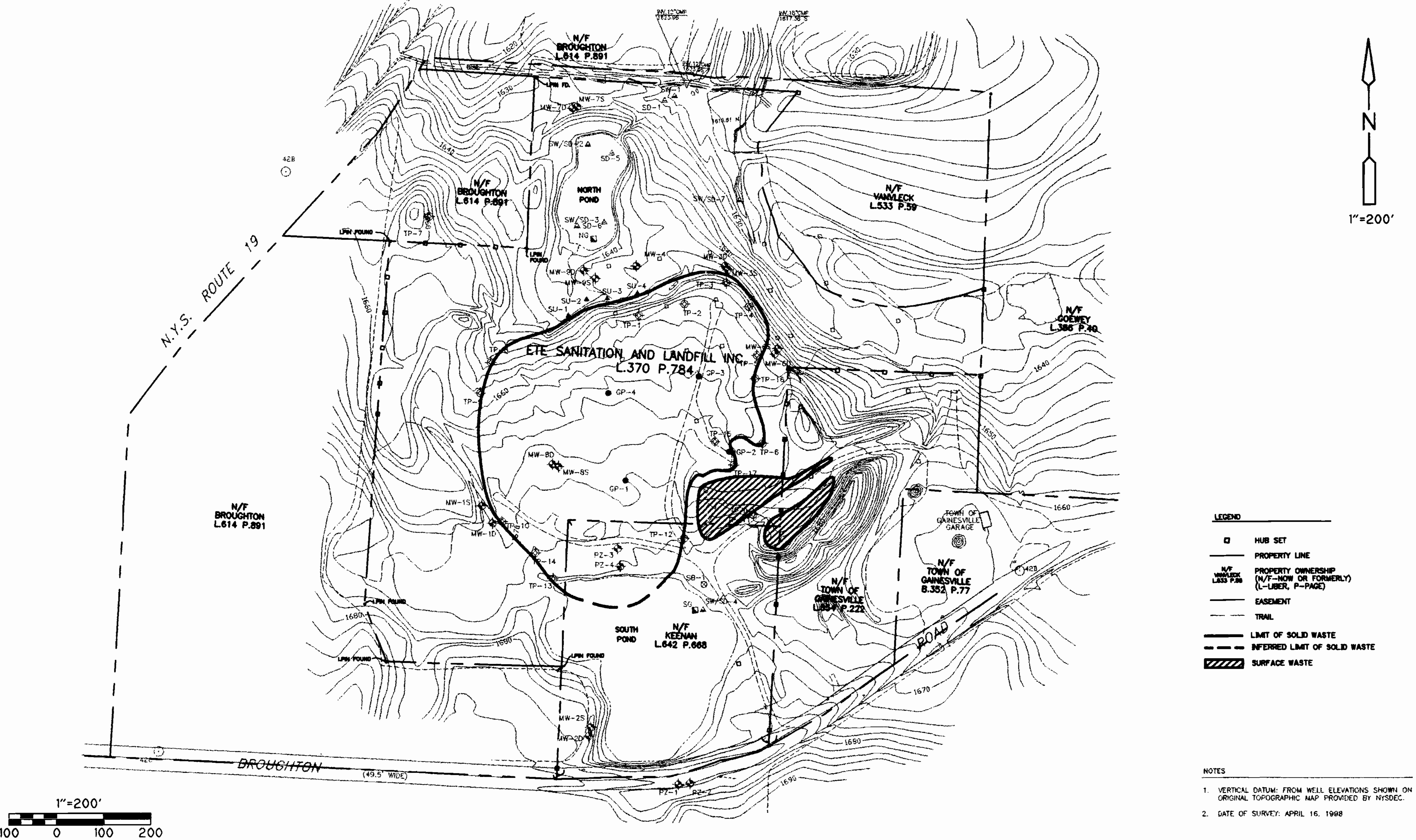

CDM Camp Dresser & McKee

Figure 1-2
Site Map Showing Adjacent Lots And Extent Of Solid Waste
ETE Sanitation And Landfill Feasibility Study

The disposal of industrial waste including leaded paint sludge, salt and possibly plating wastes were identified as sources of contamination during these initial investigations. Data generated from these previous investigations assisted CDM in developing the Remedial Investigation/Feasibility Study (RI/FS) scope of work and provided some insight into the fate and transport of site contaminants.

1.3 Summary of Remedial Investigation Results

In the Spring of 1998, CDM completed a Remedial Investigation (RI) of the ETE Sanitation and Landfill site that included the installation and sampling of groundwater monitoring wells, geophysical studies, test pits, surface water and sediment sampling. The objective of the RI was to characterize the physical setting of the site (i.e. hydrogeology, surface water, topography) and to assess the nature and extent of environmental contamination associated with documented hazardous waste disposal. A qualitative human health risk assessment was performed to determine potential health risks associated with site contaminant. The findings of the RI have been used as the basis for developing the Feasibility Study of the ETE Sanitation and Landfill site.

Results of the completed RI are detailed in the Final ETE Sanitation and Landfill Remedial Investigation Report, dated September 1998. On September 24, 1998, CDM completed a second round of surface water and sediment sampling within and downstream of the ETE Sanitation and Landfill site. Results of the laboratory analysis of collected samples were provided to NYSDEC in a memorandum dated November 6, 1998.

RI sample locations are provided on Plate 1 located in the back pocket of this report. The following is a brief summary of the RI findings and results of the second round surface water sampling:

The landfill was constructed on top of unconsolidated clay rich glacial tills containing minor beds of more permeable sands and gravel. Landfill topography generally slopes to the north. Surface water drainage as well as groundwater flow is consistent with topography with flow generally being from south to north. Existing surface water and site drainage features are shown in Figure 1-3 . Surface runoff from the site flows into a small tributary of Cotton Creek which is located 0.75 miles north of the site. Groundwater flows north and may eventually discharge to downgradient surface water such as Cotton Creek.

RI data indicates approximately seven acres of the site contains landfilled waste. The maximum thickness of the waste is approximately 15 feet at the center of the landfill and tends to thin towards the perimeter of the landfill. The waste is covered with a silty clay soil between one and two feet thick, although waste is exposed within portions of the landfills northern slope. As shown in Figure 1-2, a portion of the landfilled material is believed to extend under the northern portion of the South Pond.

RI data indicates that landfill contaminants have impacted surface water quality downgradient (north) of the site primarily by inorganic contaminants including aluminum, iron, and zinc. A summary of surface water contaminant concentrations observed during the RI is provided in Table 1-1. Additionally, surface water sediment downgradient of the site have been impacted by volatile organic compounds (VOCs), including acetone, methylene chloride, 2-butanone, ethylbenzene and xylene, and inorganic contaminants, including iron, manganese and zinc. Contaminants detected

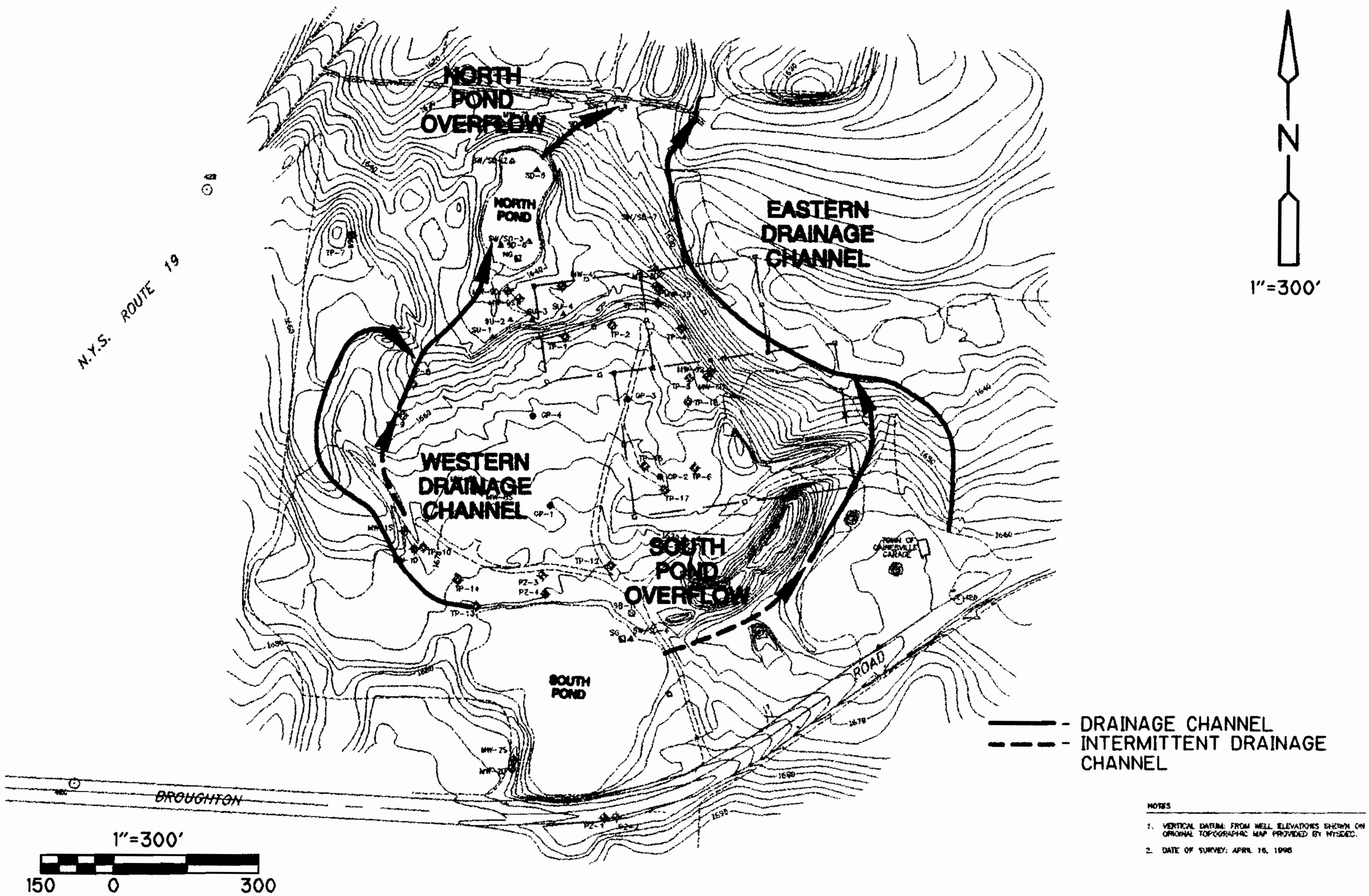

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Figure 1-3
Surface Water And Site Drainage Features
ETE Sanitation And Landfill Feasibility Study

Table 1-1
Concentration Range of Compounds in Surface Water
ETE Sanitation and Landfill
Feasibility Study

TCL Inorganics	NYSDEC Standard for for Class C Water* (ug/L)	Concentration Range Observed Minimum (ug/L)	Maximum (ug/L)	Location of Maximum Observed Concentration
Aluminum	100	15.9	511.77	SW-3
Barium	1000**	ND	213	SW-3 (II)
Calcium	NA	74.78	115,000	SW-7 (II)
Chromium	11	ND	1.69	SW-1
Iron	300	66.68	4,798.9	SW-2
Magnesium	35000**	82.24	23,500	SW-8 (II)
Manganese	300**	ND	2460	SW-7 (II)
Potassium	NA	43.47	28,700	SW-3 (II)
Sodium	20000***	199.83	2,020,000	SW-7 (II)
Vanadium	14	ND	1.96	SW-3
Zinc	30	13.46	46.4	SW-3 (II)
Copper	NA	14.5	89.2	SW-7
Lead	NA	ND	66.2	SW-8 (II)
Nickel	NA	1.6	3.4	SW-1

Notes:
Standards taken from NYSDEC, T.O.G.S 1.1.1, "Ambient Water Quality Standards and Guidance Values," 10/93
*Cotton Creek is classified by New York State as a class C water body.
Cotton Creek receives all surface water discharging from the ETE Sanitation and Landfill site.
**Standard is for class A water. A class C water standard does not exist.
***Standard is for class GA water. No surface water standard exists.
ND: Compound not detected
NA: Compound standard is varies based upon sample specific hardness concentration.
(II): Collected during Round II surface water sampling.

within surface water sediments are summarized in Table 1-2. Data indicates leachate seeps flowing into the North Pond contain similar VOCs and inorganic contaminants identified within down-gradient surface waters. Additional surface water sampling performed by CDM in September of 1998 within and downgradient of the site indicated the presence of landfill contaminants within onsite surface water including the North Pond and the eastern drainage channel. Sampling of Cotton Creek and a small unnamed tributary of Cotton Creek which drains an area including the ETE Landfill site indicated no impact by landfill contaminants. Surface water and sediment samples collected approximately 600 feet downstream from the landfill did indicate the presence of lead and sodium above background concentrations within surface water. Additionally, acetone at a concentration of 3.4 to 7.8 parts per billion (ppb) was detected within surface water sediments at this location.

Contaminant distribution within site groundwater indicates that the majority of contamination is limited to the landfill wastes located within the west-central portion of the landfill and within shallow groundwater immediately downgradient of the site. Exceedances of NYSDEC GA groundwater standards were most frequently noted in monitoring wells screened within the landfill wastes and shallow water table aquifer. Tables 1-3 and 1-4 summarize the contaminants detected within site groundwater. Clay-rich glacial tills which comprise a majority of site stratigraphy appear to limit the downward vertical migration of groundwater contamination within the site. However, several VOCs were observed in all deep, downgradient, monitoring wells indicating that some vertical contaminant migration is occurring. The principal contaminants of concern in the groundwater include: acetone, 2-butanone, benzene, 4-methyl-2-pentanone, 2-hexane, toluene, trichloroethene, 1,2-dichloroethene, chlorobenzene, ethylbenzene, xylenes, phenol, 2-methylphenol, 4-methylphenol and 2,4-dimethylphenol.

Monitoring well MW-8S, screened in the shallow water table aquifer and waste, exhibited the highest observed volatile organic concentrations within the landfill, with a total VOC concentration of 5,394 micrograms per liter (ug/l).

Inorganic contaminants found in excess of NYSDEC GA groundwater standards included: antimony, barium, cadmium iron, lead, magnesium, manganese, sodium and thallium. As with VOCs, the greatest inorganic contamination is observed within and immediately downgradient of the landfill. However, with the exception of sodium and iron, landfill related inorganic contaminants do not appear to be significantly impacting water quality within the deep monitoring wells. Heavy metals such as lead and cadmium would not be expected to migrate offsite within the groundwater environment due to their relatively low mobility. Data from downgradient wells MW-7 and MW-9 support this assumption with no heavy metal contaminants observed above GA groundwater standards.

Groundwater transport of contaminants from the landfill is a significant offsite migration pathway given the proximity of the landfill to a number of private wells located downgradient of the site. However, sampling of a number of downgradient private wells by the New York State Department of Health from 1989 to 1997 provided no evidence that private wells have been impacted by landfill contaminants. Additionally, contaminants within groundwater have the potential to discharge to surface water bodies downgradient of the landfill, such as Cotton Creek.

Table 1-2
Concentration Range of Compounds in Sediment
ETE Sanitation and Landfill
Feasibility Study

Parameter	Concentration Range Observed Minimum (ug/Kg)	Maximum (ug/Kg)	Location of Maximum Detection
TCL Volatile Organics			
Methylene Chloride	ND	14	SD-4
Acetone	ND	538	SD-6
2-Butanone	ND	104	SD-6
Ethylbenzene	ND	56	SD-5
Xylenes(total)	ND	254	SD-5
TCL Semivolatiles			
Di-n-butylphthalate	ND	140.0	SD-4

Note:
NA: Screening criteria is sample specific based upon organic carbon content. Therefore, no criteria is listed for this parameter.

Parameter	Effect Level Lowest Level* (mg/kg)	Severe Level* (mg/kg)	Concentration Range Observed Minimum (mg/kg)	Maximum (mg/kg)	Location of Maximum Detection
TCL Inorganics					
Aluminum	---	---	9504.96	27511.37	SD-2
Antimony	2.0	25.0	ND	1.87	SD-2
Arsenic	6.0	33.0	3.07	22.19	SD-7
Barium	---	---	61.04	970.07	SD-7
Beryllium	---	---	0.50	1.27	SD-2
Cadmium	0.6	9.0	ND	1.46	SD-2
Calcium	---	---	2202.95	17905.52	SD-7
Chromium	26.0	110.0	15.20	32.38	SD-2
Cobalt	---	---	6.50	12.67	SD-7
Copper	16.0	110.0	20.36	50.52	SD-4
Iron	20,000.0	40,000.0	25194.10	61220.69	SD-7
Lead	31.0	110.0	12.75	32.70	SD-4
Magnesium	---	---	2866.11	5698.34	SD-4
Manganese	460.0	1,100.0	594.95	23608.28	SD-7
Nickel	16.0	50.0	18.87	38.00	SD-2
Potassium	---	---	1142.33	2341.45	SD-2
Selenium	---	---	ND	15.48	SD-7
Sodium	---	---	463.15	8325.10	SD-2
Thallium	---	---	ND	1.81	SD-3
Vanadium	---	---	18.44	35.05	SD-2
Zinc	120.0	270.0	91.85	687.88	SD-2

Note:
--- No standard applicable

Table 1-3
Concentration Range of Organic Compounds in Groundwater
ETE Sanitation and Landfill
Feasibility Study

Parameter	Screening Standard for GA Water (ug/L)	Concentration Range Observed Minimum (ug/L)	Maximum (ug/L)	Location of Maximum Detection
TCL Volatile Organics				
Vinyl Chloride	2.0	ND	16.0	MW-3S
Chloroethane	50.0*	ND	10.0	MW-3S
Methylene Chloride	5.0	ND	56.0	MW-8S
Acetone	50.0	ND	1009.0	MW-8S
Carbon Disulfide	50.0	ND	2.2	MW-8D
1,2-Dichloroethene(total)	0.6*	ND	108.0	MW-3S
2-Butanone	50.0	ND	3379.0	MW-8S
Trichloroethene	5.0	ND	50.0	MW-3S
Benzene	1.0*	ND	15.0	MW-8S
4-Methyl-2-Pentanone	50.0	ND	316.0	MW-8S
2-Hexanone	50.0	ND	68.0	MW-8S
Toluene	5.0	ND	245.0	MW-8S
Ethylbenzene	5.0	ND	60.0	MW-8S
Xylenes(total)	5.0	ND	219.0	MW-8S
TCL Semivolatile				
Phenol	1.0	ND	100.0	MW-9S
2-Methylphenol	50.0*	ND	21.0	MW-8S
4-Methylphenol	50.0*	ND	995.0	MW-8S
2,4-Dimethylphenol	1.0	ND	19.0	MW-8S
Dimethylphthalate	50.0	ND	2.3	MW-8D
Diethylphthalate	50.0	ND	43.0	MW-8S
Di-n-butylphthalate	50.0	ND	2.3	MW-8D
bis(2-Ethylhexyl)phthalate	5.0*	ND	5.9	MW-8S

Note:
ND: Not detected.

Table 1-4
Concentration Range of Inorganic Compounds in Groundwater
ETE Sanitation and Landfill
Feasibility Study

	Screening Standard for GA Water	Concentration Range Observed		Location of Maximum Detection
		Minimum	Maximum	
	(ug/L)	(ug/L)	(ug/L)	
TCL Inorganics				
Aluminum	NA	38.2	4120	MW-7S
Antimony	3	5.64	7	MW-1S
Arsenic	25	9.8	9.8	MW-7S
Barium	1000	10.7	5217	MW-9S
Beryllium	3	1	1.5	MW-2S
Cadmium	5*	1	8.9	MW-4
Calcium	NA	298.71	429150	MW-7D
Chromium	50	1.2	19.1	MW-3S
Cobalt	NA	1.1	9.1	MW-4
Copper	200	4.9	72.92	MW-9D
Iron	300	105.51	181040	MW-8S
Lead	25	2	51.92	MW-8S
Magnesium	35000	56.14	88400	MW-3D
Manganese	300	1.41	10200	MW-4
Nickel	100*	1.31	22.51	MW-9S
Potassium	NA	291	286320	MW-9S
Selenium	10	4.5	7.6	MW-4
Sodium	20000	1126.1	31054500	MW-9S
Thallium	0.5*	7.6	11.89	MW-9S
Vanadium	NA	1.4	16.23	MW-8S
Zinc	2000*	3.3	78.4	MW-7S

Notes:
SOURCE: New York State DEC TOGS 1.1.1,"Ambient Water Quality Standards and Guidance Values," 10/93
NA: No standard applicable
*New 1998 standard, NYSDEC Revised Parts 6 NYCRR Parts 700-706, "Groundwater Standards," March 1998.

Landfill gas production appears to be minimal in the eastern portion of the landfill. However, landfill gas may not be capable of migrating upward into this area of the landfill due to an impermeable layer of water saturated soils. The west-central portion of the landfill appears to be actively producing gas. VOC analysis of four soil gas samples indicated VOCs to be present within landfill gas. The highest concentration was observed at GW-4 with a total VOC concentration of 113,490 parts per billion by volume (ppbv).

Geophysical investigations of the northeastern portion of the landfill and follow-up test pits did not identify any areas containing numerous full drums of wastes. A number of crushed and rusted drums were located and one drum was located containing paint sludge; however, waste characterization analysis of the drum contents indicated the waste to be non-hazardous.

The majority of VOCs detected within the site have been associated with paint manufacturing and paint solvents and may be attributed to the documented disposal of drummed paint sludge. The high levels of sodium and other inorganic contaminants present within leachate, groundwater and surface water may be attributable to waste salt landfilled at the site.

A qualitative risk assessment was conducted for the ETE Sanitation and Landfill site to determine the potential risks and hazards that chemicals detected at the site may pose to human health under current and future conditions in the absence of remediation. All chemicals detected in each medium were compared to risk-based concentrations to identify the chemicals of concern (COCs), i.e., those chemicals that present the highest risk potential. The list of COCs was limited to ten chemicals for each medium and COCs were identified for the groundwater, air and soil/sediment media.

Potential health risks associated for current site conditions include ingestion and inhalation of groundwater from an onsite private well and inhalation of ambient air for a trespasser. Potential health risks for future use conditions which conservatively assumes that the landfill would be used for residential property include ingestion and inhalation of groundwater and inhalation of ambient air.

It should be pointed out that this risk assessment has utilized conservative assumptions in estimating potential current and future risks to public health due to chemical contamination arising from the landfill. First, the risks discussed are only potential risks, not actual risks. It is not known if anyone is currently drinking water that has been contaminated by the landfill or if there is anyone who consistently (35 times per year) trespasses over the landfill. Likewise, the future estimates of risk are only potential risks that could occur if remediation does not occur. All risk estimates are based on long term, i.e. 30 year, exposure to chemicals from the landfill. Since contamination from the landfill has not been present for 30 years, the current potential risks are overestimated.

1.4 Standards, Criteria and Guidelines for ETE Landfill

Remedial actions undertaken at listed NYSDEC inactive hazardous waste sites must comply with NYSDEC Standards, Criteria, or Guidelines (SCGs). Table 1-5 lists all SCGs that are relevant or potentially relevant to the remediation of the ETE Sanitation and Landfill site.

Table 1-5
Potentially Applicable Standards, Criteria, and Guidelines
ETE Sanitation and Landfill
Feasibility Study

Div./ Agcy.*	Title	Std./ Guid.	Requirements
DAR	Air Guide 1 - Guidelines for the Control of Toxic Ambient Air Contaminants	G	▸ control of toxic air contaminants ▸ screening analysis for ambient air impacts ▸ toxicity classifications ▸ ambient standards - short term/annual
DAR	6 NYCRR Part 200 (200.6) - General Provisions; 1/29/93	S	▸ prohibits contravention of AAQS or causes air pollution
DAR	6 NYCRR Part 201 - Permits & Certificates; 3/31/93	S	▸ prohibits construction/operation w/o permit/certificate
DAR	6 NYCRR Part 211 (211.1) - General Prohibitions	S	▸ prohibits emissions which are injurious to human, plant, or animal life or causes a nuisance
DAR	6 NYCRR Part 212 - General Process Emission Sources	S	▸ establishes control requirements
DAR	6 NYCRR Part 257 - Air Quality Standards	S	▸ applicable air quality standards
DFW	Fish and Wildlife Impact Analysis for Inactive Hazardous Waste Sites (FWIA); 10/94	G	▸ habitat assessments ▸ contaminant impact assessments ▸ ecological effects of remedies ▸ remedial requirements ▸ monitoring ▸ checklist
DFW	ECL Article 24 & Article 71, Title 23 - Freshwater Wetlands Act	S	▸ preserve, protect, and conserve freshwater wetlands ▸ regulate use and development
DFW	Technical guidance for screening contaminated sediments; 7/94	G	▸ sediments screening levels
DFW	Freshwater Wetlands Regulations - Guidelines on Compensatory Mitigation; 10/93	G	▸ Guidance on compensatory mitigation of freshwater wetlands
DER	TAGM HWR-89-4031 Fugitive Dust Suppression and Particulate Monitoring Program at Inactive Hazardous Waste Sites; 10/27/89	G	▸ dust suppression during IRM/RA
DER	TAGM HWR-92-4030 Selection of Remedial Actions at Inactive Hazardous Waste Sites; 5/90	G	▸ remedy selection criteria/evaluations
DER	TAGM HWR-92-4042 Interim Remedial Measures; 6/1/92	G	▸ define and track IRMs
DER	TAGM HWR-92-4046 Determination of Soil Cleanup Objectives and Cleanup Levels; 1/24/94	G	▸ soil cleanup goals

Table 1-5
Potentially Applicable Standards, Criteria, and Guidelines
ETE Sanitation and Landfill
Feasibility Study

Div./ Agcy.*	Title	Std./ Guid.	Requirements
DER	TAGM HWR-92-4048 Interim Remedial Measures - Procedures; 12/9/92	G	▸ identifying and implementing IRMs
DER	TAGM HWR-94-4027 - Assistance for Contaminated Private and Public Water Supplies; 4/18/94	G	▸ when DEC can supply potable water
DER	6 NYCRR Part 375 - Inactive Hazardous Waste Disposal Site Remedial Program; 5/92	S	▸ requirements regarding remedial programs ▸ private party programs, state funded programs, state assistance to municipalities
DMR	6 NYCRR Part 555 - Plugging and Abandonment	S	▸ procedural requirements for plugging and abandonment
DMR	6 NYCRR Part 558 - Transportation	S	▸ transportation methods
DOH	Part 5 of the State Sanitary Code, Drinking Water Supplies; 3/11/92	S	▸ drinking water standards
DOH	Part 170 of title 10 of the NYCRR, Water Supply Sources	S	▸ protecting public water supplies
DOW	Analytical Services Protocols (ASP); 11/91	G	▸ analytical procedures
DOW	TOGS 1.1.2 - Groundwater Effluent Limitations; 8/94	G	▸ guidance for developing effluent limits for groundwater
DOW	TOGS 1.1.1 - Ambient Water Quality Standards & Guidance Values; 10/93	G	▸ compilation of ambient water quality stds. and guidance values
DOW	TOGS 1.2.1 -Industrial SPDES Permit Drafting Strategy for Surface Waters; 4/90	G	▸ guidance for developing effluent and monitoring limits for point source releases to surface water
DOW	TOGS 1.3.1 - Waste Assimilative Capacity Analysis & Allocation for Setting Water Quality Based Effluent Limits; 5/90	G	▸ guidance for determining maximum allowable loadings and corresponding effluent limitations for point sources to surface water
DOW	TOGS 1.3.1.C - Development of Water Quality Based Effluent Limits for Metals Amendment; 8/91	G	▸ as stated
DOW	6 NYCRR Part 702-15(a), (b), (c), (d) & (e) -	S	▸ Empowers DEC to Apply and Enforce Guidance where there is no Promulgated Standard
DOW	6 NYCRR Part 700-705 - NYSDEC Water Quality Regulations for Surface Waters and Groundwater; 9/1/91	S	▸ 700 - Definitions, Samples and Tests; 701 - Classifications Surface Waters and Groundwaters; 702 - Derivation and Use of Standards and Guidance Values; 703 - Surface Water and Groundwater Quality Standards and Groundwater Effluent Standards;
DOW	6 NYCRR Part 750-757 - Implementation of NPDES Program in NYS	S	▸ regulations regarding the SPDES program
DEP	6 NYCRR Part 364 - Waste Transporter Permits; 1/12/90	S	▸ regulates collection, transport, and delivery of regulated waste

Table 1-5
Potentially Applicable Standards, Criteria, and Guidelines
ETE Sanitation and Landfill
Feasibility Study

Div./ Agcy.*	Title	Std./ Guid.	Requirements
DSHM	TAGM 3028 "Contained In" Criteria for Environmental Media; 11/92	G	▸ Soil Action Levels
DSHM	6 NYCRR Part 360 - Solid Waste Management Facilities; 10/9/93	S	▸ solid waste management facility requirements landfill closures; C&D landfill requirements; used oil; medical waste; etc.
DSHM	6 NYCRR Part 370 - Hazardous Waste Management System: General; 1/14/95	S	▸ definitions of terms and general standards applicable to Parts 370-374 & 376
DSHM	6 NYCRR Part 371 - Identification and Listing of Hazardous Wastes; 1/14/95	S	▸ haz. waste determinations
DSHM	6 NYCRR Part 372 - Hazardous Waste Manifest System and Related Standards for Generators, Transporters and Facilities; 1/14/95	S	▸ manifest system and recordkeeping, certain management standards
DSHM	6 NYCRR Part 376 - Land Disposal Restrictions - 1/14/95	S	▸ identifies hazardous waste restricted from land disposal
DSHM	6 NYCRR Subpart 373-1 - Hazardous Waste Treatment, Storage and Disposal Facility Permitting Requirements; 1/14/95	S	▸ hazardous waste permitting requirements: includes substantive requirements
DSHM	6 NYCRR Subpart 373-2 - Final Status Standards for Owners and Operators of Hazardous Waste Treatment Storage and Disposal Facilities; 1/14/95	S	▸ hazardous waste management standards e.g., contingency plan; releases from SWMUs; closure/post-closure; container/management; tank management; surface impoundments; waste piles; landfills; incinerators; etc.
DSHM	6 NYCRR Subpart 373-3 - Interim Status Standards for Owners and Operators of Hazardous Waste Facilities - 1/14/95	S	▸ similar to 373-2
OSHA/ PESH	29 CFR Part 1910.120; Hazardous Waste Operations and Emergency Response	S	▸ health and safety
USEPA	Hydrologic Evaluation of Landfill Performance (HELP) Model Hydrologic Simulation of Solid Wast Disposal Sites	G	▸ cover system performance/hydrology
USEPA	Solidification/Stabilization and its Application to Waste Materials; 6/93	G	▸ soil treatment
USEPA	Integrated Risk Information System (IRIS)	G	▸ verified RfDs and cancer slope factors
USEPA	Risk Assessment Guidance for Superfund - Volume 1 - Human Health Evaluation Manual; 12/89	G	▸ human health risk assessments
USEPA	40 CFR Part 60 Subpart WWW: Standards of Performance for Municipal Solid Waste Landfills; 12/94	S	▸ landfill gas collection/treatment

Table 1-5
Potentially Applicable Standards, Criteria, and Guidelines
ETE Sanitation and Landfill
Feasibility Study

BMHP:	Division of Marine Resources, Bureau of Marine Habitat Protection
DAM:	Department of Agriculture and Markets
DAR:	Division of Air Resources
DEP:	Division of Environmental Permits
DER:	Division of Environmental Remediation
DFW:	Division of Fish and Wildlife
DMR:	Division of Mineral Resources
DOH:	Department of Health
DOL:	Department of Labor
DOS:	Department of State
DOW:	Division of Water
DSHM:	Division of Solid and Hazardous Materials
DSM:	Division of Spills Management
USACE:	US Army Corps of Engineers
USEPA:	US Environmental Protection Agency

The NYSDEC Technical Assistance Guidance Manual (TAGM), "Selection of Remedial Action Alternatives at Inactive Hazardous Waste Sites", requires consideration of Applicable or Relevant and Appropriate Requirements (ARARs). Because New York State does not have ARARs in its statute, and to avoid misrepresentation of New York State's requirements, ARARs are replaced with New York State Standards, Criteria and Guidance (NYS SCGs), referenced hereafter, which also include the more stringent federal requirements. Remedial actions undertaken at listed NYSDEC inactive hazardous waste sites must comply with NYSDEC Standards, Criteria or Guidelines (SCGs). A description of each "class" of SCG is as follows:

Chemical-specific

These requirements are usually health or risk-based numbers limiting the concentration or amount of a chemical that may be discharged into the environment. They are independent of the location of the discharge, but may be related to the intended use of the environmental medium.

Action-specific

These requirements will be triggered by the remedial actions selected for the site. They are based on the implementation and limitations of particular technologies or actions.

Location-specific

These restrictions are generally placed upon chemical concentrations releases, or activities solely because they are in a particular location.

Based on the RI data, VOC contamination is present within monitoring wells located immediately downgradient of the landfill. However, sampling by NYSDOH of private wells located down-gradient of the landfill did not provide evidence of landfill related contaminants within the tested wells. Based on these findings, NYSDEC ambient groundwater standards (GA Class) and NYSDOH potable water standards and criteria will be considered applicable, and appropriate response actions when evaluating remedial alternatives and future monitoring of groundwater following landfill remediation and closure.

RI data indicate impacts to onsite surface water as well as surface water immediately downgradient of the landfill. Appropriate NYSDEC surface water classifications and standards will be used as SCGs when evaluating remedial alternatives and future monitoring the surface water following landfill remediation and closure. Additionally, onsite and downgradient surface water sediments appear to have been impacted by the landfill; therefore, NYSDEC's standards for surface water sediments as defined in the document entitled: "Technical Guidance for Screening Contaminated Sediment, November 1993" will be used to evaluate sediment remediation.

NYSDEC Soil Cleanup Guidelines as defined in TAGM HWR-92-4046 will be used, as appropriate, to evaluate remedial alternatives.

Although the air pathway is not expected to be a significant potential threat to human health and the environment, New York State Annual Guideline Concentrations (AGCs) and SGCs (found in Air Guide-1) will be applied to future environmental monitoring of landfill gas. As part of this FS, CDM will not attempt to calculate the ambient concentration of landfill gases through computer modeling or other methods.

Based on information provided by NYSDEC there are no sensitive environmental areas or endangered species within the landfill vicinity. However, wetlands and surface water bodies are present within the landfill site. Therefore, NYSDEC Wetland Laws (6NYCRR Articles 24 and 25) and Use and Protection of Waters (6NYCRR Part 608) will be considered in the evaluation of remedial alternatives.

Section 2
Remedial Action Objectives

2.1 Remedial Action Objectives

Remedial Action Objectives (RAOs) consist of medium-specific goals for protecting human health and the environment and focus on the contaminants of concern, exposure routes and receptors, and an acceptable contaminant level or range of levels for each exposure route. Acceptable contaminant levels are determined by the selected SCGs listed in Table 1-5.

Based on the RI findings and the goals of the NYSDEC, the remedial action objectives established for the ETE Landfill include:

1. Isolate the landfill waste material in order to provide adequate protection to human health and the environment from direct contact or ingestion of hazardous constituents in wastes or surface soil from the landfill.

2. Remove landfill wastes from the South Pond and contaminated sediments from the North Pond. Consolidate wastes within the landfill property.

3. Reduce the production of leachate and offsite migration of contaminants by restricting the amount of surface water and groundwater flowing through the landfill.

4. Eliminate or significantly reduce the quantity of leachate discharging to groundwater and/or surface water.

5. Control emissions of landfill gases that could pose a risk to current and/or future residents.

6. Control surface water runoff and erosion.

These RAOs serve as the primary basis upon which the remedial alternatives are developed and evaluated. Using the presumptive remedy approach, a limited number of media specific remedial technologies, including any identified presumptive remedies, are identified. These are then screened for site specific feasibility, technical implementability, and practicability based on readily available information from the site RI and from similar sites.

Using the presumptive remedy approach, a number of technologies are clearly applicable to the site. These are listed below according to the remedial action objective being addressed by that technology.

The first RAO can be addressed by the construction of a modified Part 360 landfill cap. The cap would isolate landfill material and protect human health and the environment from contact with landfill contaminants. Landfill cap alternatives are included in this evaluation.

The second RAO can be addressed through waste consolidation, site regrading and by the construction of the modified Part 360 landfill cap.

Completed model simulations indicate that the landfill cap alone would not substantially reduce the generation of leachate in the future. Therefore, the third and fourth RAO would not be met with just capping the waste. However, with the addition of a hydraulic control technology, leachate generation can be substantially reduced.

The fifth RAO can be addressed by the construction of a modified Part 360 landfill cap that would include a series of passive gas vents.

The sixth RAO can be addressed by site regrading, installation of a modified Part 360 landfill cap and construction of drainage swales along the east and west perimeters of the landfill.

2.2 General Response Actions

General Response Actions are categories of activities which are applied toward remediation of contaminated sites. The remedial action objectives developed for a site dictate which general response actions should be undertaken. Within each general response action (other than No Action) are several technology types and process options.

The general response actions identified for the ETE Sanitation and Landfill site that will meet the remedial action objectives or will provide a baseline against which actions may be compared consist of the following:

No Further Action - A No Action response is always identified for the purpose of establishing a baseline with which to compare other general response actions. There are no preventative or corrective actions taken as a result of this general response action, however, monitoring of the contamination may be prescribed.

Containment - As a general response action, containment prevents risk to human health and the environment by restricting contact to or migration of the contaminants via the soil, water or air pathways. A number of technologies and different materials are available for use in establishing migration barriers. Hydraulic controls and landfill capping would be considered containment technologies.

Removal/Excavation - This response action physically removes or collects the existing contaminated media from the site. Other response actions are usually necessary in order to achieve remedial action goals and objectives for the removed and collected media. Collection and removal of solids/soils media is often associated with source control activities and eventually reduces contaminant concentrations in the surrounding surface water, groundwater, biota, and air media. Collection or removal actions in water and air media may not prevent continued migration of contaminants in those media, but typically intercept the most contaminated portions of those media. Collection actions which intercept their respective media would be considered containment general response actions.

Treatment - These actions involve removal of the contaminant from contaminated media, or alteration of the contaminant. The result is a reduction in mobility, volume, or toxicity of the contaminant. This general response is usually preferred unless site or contaminant-specific characteristic make it unrealistic.

Disposal/Discharge - This general response action involves the transfer of contaminated media, concentrated contaminants, or treated materials to a site reserved for long term storage of such materials. Disposal sites are strictly regulated in operation and the types of materials that they may accept.

The general response actions presented above form the basis for identifying technology types and process options specific for the site, which are subsequently screened for effectiveness, implementability and cost.

Section 3
Preliminary Screening of Hydraulic Control Technologies

3.1 Introduction

The ETE landfill is situated between two groundwater-fed ponds upgradient and downgradient of the landfill. Due to the relatively high groundwater table and the steep hydraulic gradients between the two ponds, the hydraulics of the site are complex. In order to gain a better understanding of the site, Camp Dresser & McKee (CDM) has constructed a 3-dimensional groundwater model utilizing DYNFLOW, a finite element numerical groundwater flow model code. As agreed in the scope of work, the model was not rigorously calibrated to contrasting hydraulic conditions, however, it was developed to match groundwater conditions as measured in the May 1998 water level round taken at the site. The uncalibrated model is intended to be used as a screening tool to test the feasibility of various closure options, however, it should be not be used for detailed design calculations. It provides relative changes in hydraulics under varying conditions. The model was specifically used to examine the relationship between the ponds, the landfill and the groundwater system and to evaluate possible hydraulic control technologies to control leachate production. The modeling analysis included the following:

- assessing the effectiveness of capping the landfill
- assessing the effectiveness of draining the South Pond to lower the groundwater table in the landfill
- assessing the effectiveness of installing a cutoff wall upgradient of the landfill
- assessing the effectiveness of a perimeter drain system upgradient of the landfill
- assessing combinations of the above for controlling groundwater flow into the landfill
- estimating flows to and from the drain system
- estimating quantities of leachate generated by groundwater flowing through the landfill under various scenarios.

3.2 Groundwater Model Description

The ETE landfill groundwater model consists of eleven levels (ten layers). The model layering was based on existing geologic information collected at the site, as detailed in the Final ETE Remedial Investigation (RI) report, dated September 1998. Figure 3-1 shows the model structure in cross-section from south to north through the landfill with the stratigraphic units and the simulated water table elevation under existing conditions. Figure 3-2 shows an enlarged portion of the model

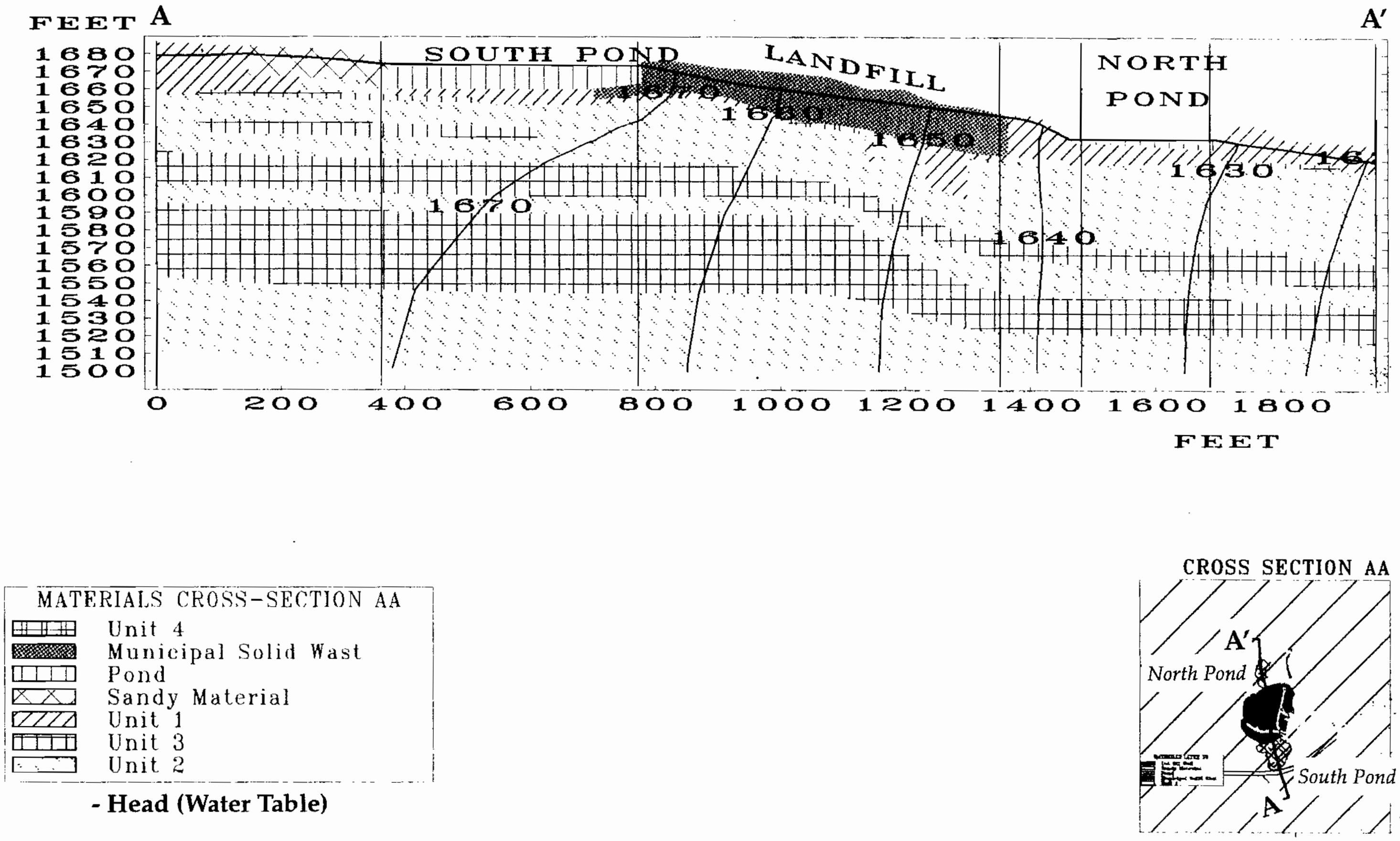

Figure 3-1
Cross Section Through Site
ETE Sanitation and Landfill Feasibility Study

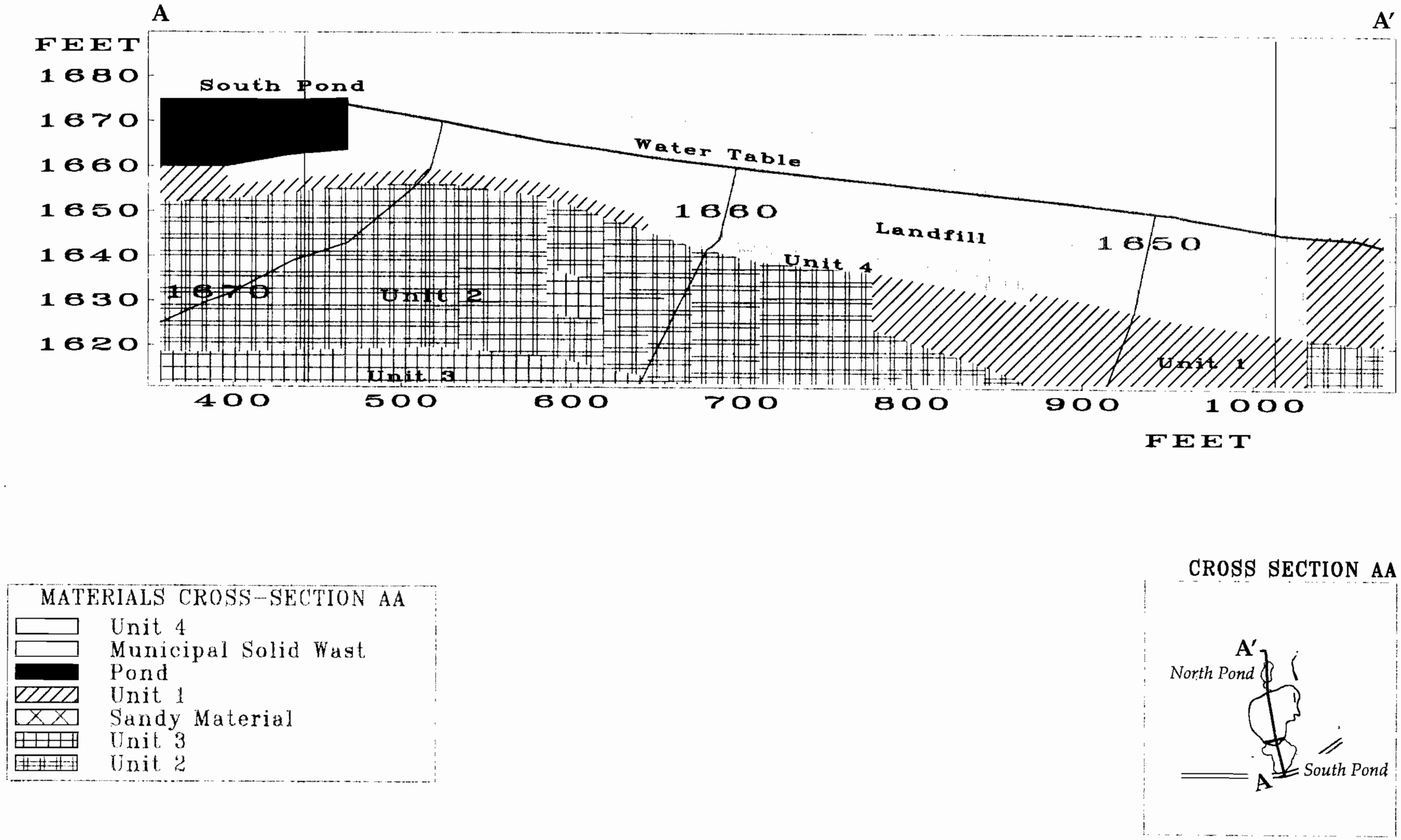

Figure 3-2
Cross Section Through Site Showing Landfill Detail
ETE Sanitation and Landfill Feasibility Study

structure showing the detail around the landfill. The model includes a variable grid spacing with a suitably fine grid at the site, and a coarser grid extending out to the selected model boundaries. The full model grid and boundary conditions are shown in Figure 3-3. The grid consists of 1001 nodes and 1948 elements. Nodal spacing in the area of interest is approximately 60 feet, as shown in Figure 3-3. The model is constructed based on the following assumptions.

Boundary Conditions

The model grid was extended to suitable hydrologic boundaries that are located sufficiently far from the site so that impacts from boundary condition assumptions have minimal impact on the results at the site. The northern boundary extends approximately 5000 feet to Cotton Creek. This boundary is a fixed head boundary at the surface, and simulates discharge to the Creek. The southern boundary also extends 5000 feet from the site to East Koy Creek. This is also a fixed head boundary. A portion of the western boundary to the south is also fixed in an area of relatively flat topography 2000 feet west of the site. The rest of the western and all of the eastern boundaries are considered no flow boundaries, with groundwater flow assumed to be parallel to the model boundary.

The bottom of the model is assumed to be a no flow boundary at bedrock, with bedrock taken to be at elevation 1500 feet from the single well log in the region that penetrates to bedrock.

The top of the model is a rising node boundary. This allows the water table to move up and down freely, depending on the hydraulic conditions. If the water table rises to the elevation of the ground surface, the head is fixed at the ground surface elevation, and the node discharges water. In this way, discharges to streams, as well as to North and South pond can be simulated.

In addition to the perimeter boundaries, a row of fixed head nodes was added to the model several hundred feet south of South Pond. These nodes improved the head gradients to the pond, and allowed the model to better simulate flows of water from the groundwater system into South Pond under varying conditions.

Hydraulic Conductivity

The model used initial estimates of hydraulic conductivities based on the estimates found in the RI report and on the soil samples taken and lithographic descriptions of the site. In general, the units have relatively low hydraulic conductivities, estimated to be about 0.3 feet per day in the RI report based on slug tests. Unit 5 was the only conductive unit at almost 300 feet per day. These values were adjusted slightly during the model development to better match the water levels taken during the May 1998 field sampling event. The final hydraulic conduc-tivities used in the model are shown in Table 3-1. The waste material was set at 2 feet per day, however, for the calculations of leachate production, a higher value of 9.5 feet per day was used based on the single slug test reported in the RI report. The ten model layers shown in Figure 3-1 are comprised of the seven stratigraphic units shown in Table 3-1.

Recharge

The recharge was set at 10 inches per year, or roughly 20 to 25 percent of average precipitation. For the uncapped landfill, recharge was assumed to match the regional recharge of 10 inches per year. For simulations of the capped landfill, infiltration into the landfill of rain water was assumed to be eliminated, and recharge was set to 0 inches per year across the surface of the landfill.

Table 3-1
Hydraulic Conductivities of Stratigraphic Units in Model
ETE Sanitation and Landfill
Feasibility Study

Stratigraphic Unit	Description	Vertical Conductivity (ft/day)	Horizontal Conductivity (ft/day)
Unit 1	Alternating layers of brown silt, little sand and gravel with medium-fine sand with silt and gravel, loose, poorly sorted.	0.06	0.6
Unit 2	Gray silt and very fine sand, little clay little pebbles, medium to no plasticity, poorly sorted.	0.06	0.6
Unit 3	Gray fine to medium sand and silt, occasionally containing pebbles and cobbles, low plasticity, poorly sorted.	0.06	0.6
Unit 4	Gray-tan/brown fine sand and silt, with orange mottling, loose, poor to well sorted	0.006	0.06
Unit 5	Greenish-gray, medium to course sands, sandstone fragments, pebbles, cobbles, boulders, loose, poorly sorted.	28	280
Waste	Primary household trash and some construction debris.	0.28	2
Sandy Material	Fine to coarse sand and intermittant gravel.	2	20

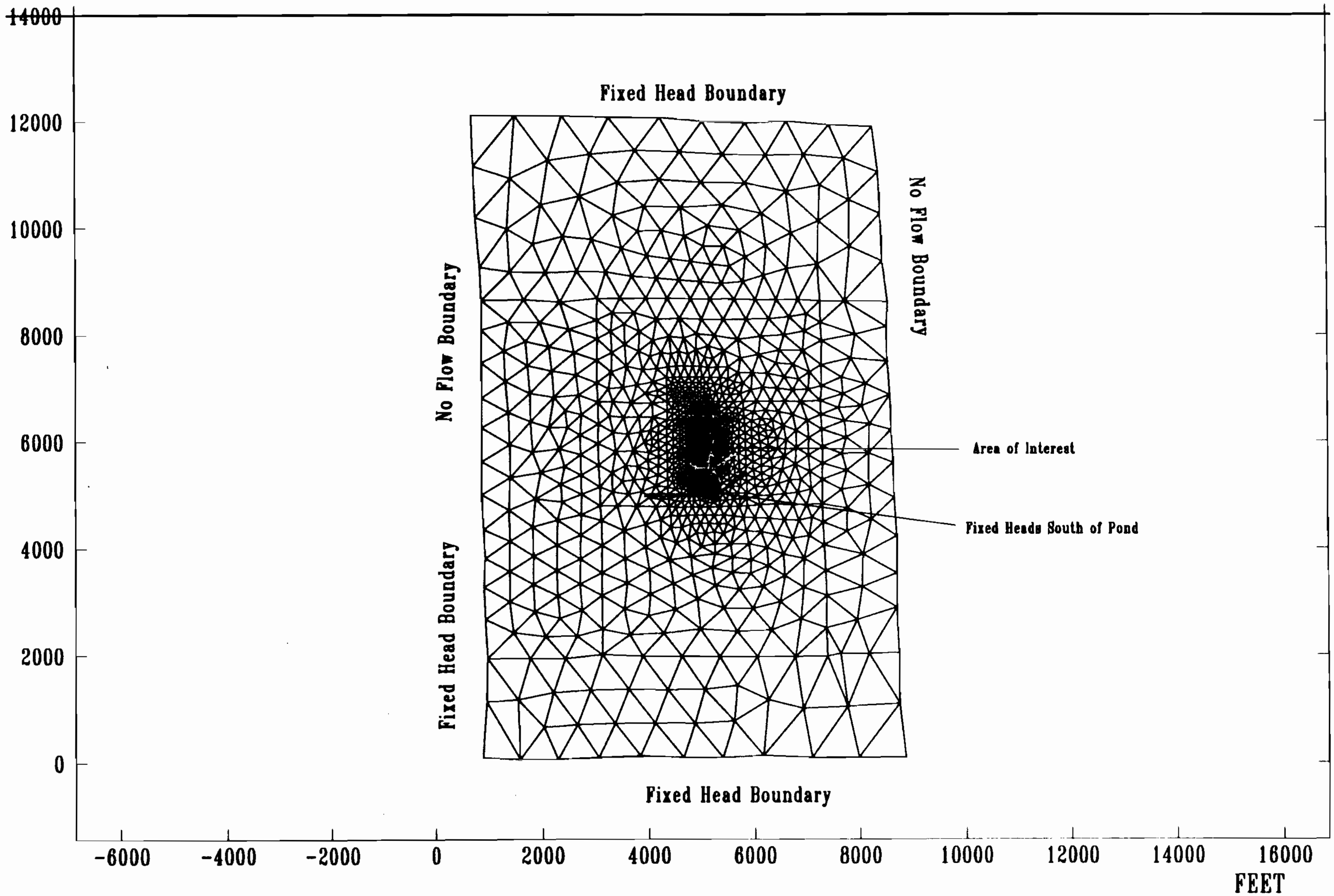

Figure 3-3
Model Grid And Boundary Conditions
ETE Sanitation and Landfill Feasibility Study

CDM Camp Dresser & McKee

Pumping

No pumping was assumed to occur within the limits of the model.

Stratigraphic Elevations of Model Levels

The model layering scheme of 10 layers was developed to match the two cross-sections through the landfill developed in the RI report. The thickness of each stratigraphic unit matches the well logs at the site. Beyond the boundaries of the site, the elevations of each model layer are extrapolated to the model boundaries.

Model Sensitivity Runs

Several sensitivity simulations were made to test the model response to changes in properties, recharge, and boundary conditions. These sensitivity simulations were made without the use of fixed heads just south of South Pond to allow the changes to fully affect the water table within the landfill . Under normal circumstances, South Pond receives discharge of groundwater and serves to maintain heads within the landfill. By adding fixed head nodes just south of the Pond, the model was able to provide rough estimates of the required fluxes needed to drain the pond, however, these fixes interfere with the sensitivity simulations results and were not used during the sensitivity testing. The following sensitivity simulations were made.

Boundary Conditions

Three simulations were made to test the effect of changing boundary conditions on the simulated water table at the site. The fixed head boundaries along the northern and southern model perimeters were raised and lowered by 10 feet from the baseline heads used in the simulations. No effect was seen on the water table near the site indicating that the boundaries are a sufficient distance from the area of interest.

Changes of up to 3 feet in the fixed head nodes south of South Pond, which are used to allow the model to estimate fluxes needed to drain the pond, had no effect on the water table in the landfill, and only affected the estimated discharge of groundwater into the South Pond. Removal of the fixed heads south of South Pond reduced the water level in South Pond by 7 feet, and had a moderate effect of 2 to 3 feet on heads in the south end of the landfill.

Recharge

One sensitivity simulation was made with recharge increased from 10 inches per year to 20 inches per year. The model is moderately sensitive to recharge, with the average water table elevation in the landfill increasing by 9 feet due to the doubling of recharge.

Hydraulic Conductivities

Most of the units gave best results with a horizontal hydraulic conductivity of 0.6 feet per day. Two sensitivity simulations were made, one with the horizontal hydraulic conductivity at 10 foot per day, the other at 0.1 feet per day. The model is extremely sensitive to changes in hydraulic conductivity, which is encouraging in the sense that the assigned values are likely to be fairly accurate. For the simulation with the horizontal K value at 10 feet per day, the average water table elevation within

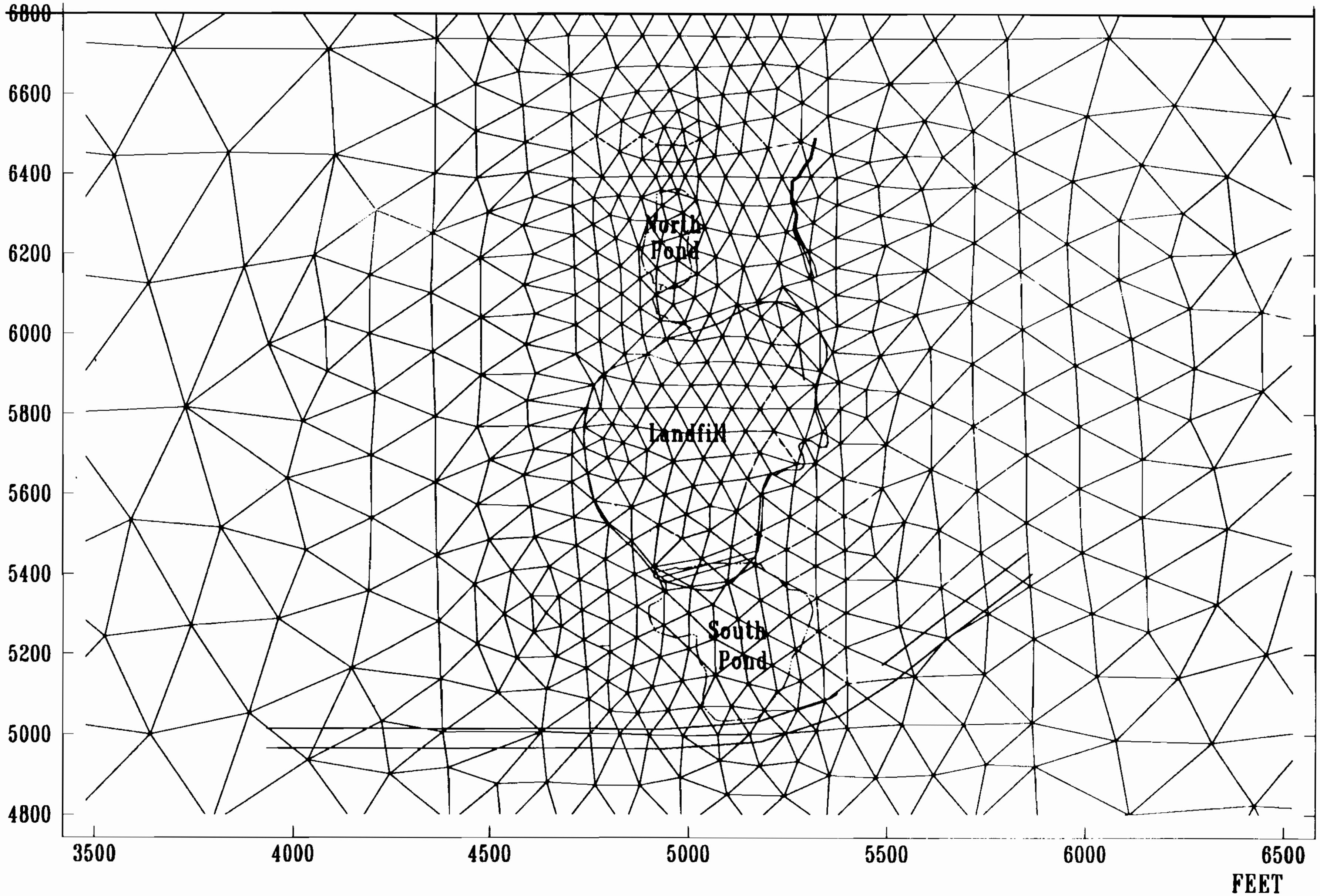

Figure 3-4
Model Grid Near ETE Landfill
ETE Sanitation and Landfill Feasibility Study

the landfill dropped by 75 feet. For the simulation with the horizontal K value at 0.1 feet, the average water table elevation within the landfill increased by 11 feet.

3.3 Model Simulations of Selected Technologies

Eight combinations of various remedial technologies were tested using the groundwater flow model under steady state conditions. Each simulation was analyzed by calculating the average water table elevation within the landfill as simulated by the model. In addition, for each remedial alternative, the average water table was compared to the baseline conditions to estimate the drawdown in the water table achieved by the applied alternative (e.g. landfill cap, drain, etc.).

The model was also able to provide relative estimates of various flows to and from the groundwater system. For those alternatives requiring a calculation of flows required to drain South Pond, the model provided an estimate of approximately 23 gallons per minute (gpm). This flow represents the steady state baseflow of groundwater that would discharge to the drainage trenches used to drain the pond under average conditions. Of course during rainfall events, runoff would significantly increase this flow, however, this was not modeled.

For those alternatives for which a drain system was included (e.g. a passive drain along the south perimeter of the landfill), the model provided estimates of leachate that would be collected by the drain system. Note that all flow estimates are dependent on the assumed hydraulic properties, and could vary by as much as one order of magnitude in either direction.

In addition to the model simulated flows to the drain and to an assumed South Pond drainage system, hand calculations of leachate released into the downgradient groundwater were made. The calculations used the model generated drawdowns and model generated hydraulic gradients for each simulation, the maximum width of the landfill (assumed to be 600 feet), and an assumed hydraulic conductivity for the landfill material of 9.5 feet per day based on the single slug test performed at the landfill in waste material. The hand calculations used the following equation:

(1) $$Q = K*I*A$$

where: "Q" is the amount of leachate generated by flowing groundwater in the landfill in cubic feet per day
"K" is the assumed hydraulic conductivity of the waste (9.5 feet per day)
"I" is the gradient of the groundwater across the landfill for each simulation (varies depending on the drawdown achieved across the landfill)
"A" is the cross-sectional area of saturated waste for each simulation (varies depending on the drawdown achieved within the landfill)

The eight simulations were designed to test baseline conditions, and to compare various combinations of:

- Capping the landfill
- Draining South Pond, either using trenches or passive drains

- Installing an impermeable barrier along the southern perimeter of the landfill to prevent the flow of clean water into the landfill

- Installing a passive drain system along the southern perimeter of the landfill to draw down the water table within the landfill.

The results of all the simulations are presented in Table 3-2 and are describe below.

3.3.1 Baseline Conditions (No Action Alternative)

The baseline run simulated present day conditions of the uncapped landfill with the water levels in both South and North Ponds at levels measured in May 1998 as reported in the RI report. Under these conditions, the average water table elevation within the landfill is simulated at 1657.4 feet mean sea level (msl). The model estimates that the leachate production within the landfill is approximately 21.6 gpm due to groundwater flowing through the waste, and 4 gpm due to infiltration of rainwater into the uncapped landfill under today's conditions. The leachate moves with ambient groundwater flow to the north. The estimated gradient beneath the landfill is 0.0487, and the saturated thickness of the waste is 15 feet. South Pond is assumed to be filled to an elevation of 1673 feet msl.

Under this simulation, there is no change to current conditions. The advantages of this alternative are that no leachate is collected for treatment, and that South Pond remains in its current state. The disadvantage is that the estimated discharge of leachate from the landfill of approximately 25.6 gpm represents a continuing source of groundwater contamination north of the landfill.

3.3.2 Landfill Cap

Under this simulation, the modified Part 360 landfill cap as detailed in Section 4.1.3 is assumed to be in place which effectively eliminates all infiltration of water into the landfill. The model estimates that the water table within the landfill would decrease to 1656.5 feet msl, a drop of 0.9 feet. The leachate production will decrease to 20.5 gpm, based on a gradient of 0.0495 and a saturated thickness of 14.1 feet. South Pond is assumed to be filled to an elevation of 1673 feet msl.

The installation of a landfill cap prevents infiltration of water into the landfill. This simulation indicates the cap alone is relatively ineffective in preventing the continuing contamination of groundwater by leachate, however, because the groundwater table in the landfill is not significantly reduced. Under this simulation, no leachate is collected, so no treatment or offsite disposal is required. The South Pond remains in its present condition.

3.3.3 Landfill Cap and Drain South Pond

This simulation assumes that the landfill is capped. It also assumes that the South Pond is drained to an elevation of 1,660 feet msl. The method of draining the pond could be through a passive system of trenches or drainage pipe that route water from the pond around the landfill to lower lying areas north of the landfill, however, for the purposes of the simulation, the method is not relevant. The model estimates that the water table within the landfill would decrease to 1651.3 feet msl, a drop of 6.1 feet. The leachate released to the groundwater would decrease to 8.8 gpm, based on a gradient of 0.0335 and a saturated thickness of 8.9 feet.

Table 3-2
Model Simulation Results
ETE Sanitation and Landfill
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Model Simulation	Retained for Detained Analysis and Alternative Number	Average Water Table Elevation in Landfill (ft above MSL)	Average Drop in Water Table in Landfill (ft)	Flow Required to Drain South Pond (gpm)	Flow to Drain System (gpm)	Leachate Production From Groundwater (gpm)	Leachate Production* From Surface Infiltration (gpm)	Total Leachate Production (gpm)
1 Baseline Conditions Present Day	Yes Alternative 1	1657.4	N/A	N/A	N/A	21.6	4.0	25.6
2 Landfill Cap	Yes Alternative 2	1656.5	0.9	N/A	N/A	20.5	0.0	20.5
3 Landfill Cap Drain South Pond	Yes Alternative 3	1651.3	6.1	23.5	N/A	8.8	0.0	8.8
4 Landfill Cap Drain South Pond Install Barrier Wall	No	1650.7	6.7	23.4	N/A	7.2	0.0	7.2
5 Landfill Cap Install Barrier Wall	No	1654.9	2.5	N/A	N/A	13.7	0.0	13.7
6 Landfill Cap Passive Perimeter Drain	No	1652.5	4.9	N/A	6.1**	5.7	0.0	5.7
7 Landfill Cap Drain South Pond Passive Perimeter Drain	Yes Alternative 4a	1650.8	6.6	23.4	2.6**	5.2	0.0	5.2
8 Landfill Cap Drain South Pond Passive Perimeter Drain Install Barrier Wall	Yes Alternative 4b	1650.5	6.9	23.4	4.6***	4.0	0.0	4.0

* 4.0 gpm from surface infiltration, as per HELP model.
** Flow would be a mixture of groundwater and leachate.
***This would be uncontaminated groundwater

This simulation requires that South Pond be drained, which represents a large change to present conditions at the site. By draining the pond, about 23 gpm of water must be routed around the landfill on a permanent basis. The simulation is very effective in reducing the release of leachate to the groundwater, with leachate production reduced to about 8.8 gpm. The simulation does not require the capture of leachate, and thus does not require treatment or offsite disposal of liquid waste.

3.3.4 Landfill Cap, Drain South Pond and Install Barrier Wall

This simulation assumes that the landfill is capped and the South Pond has been drained, similar to the previous simulation. It adds a hydraulic barrier along the south perimeter of the landfill, extending several hundred feet east and west of the landfill in a north easterly and north westerly direction respectively. The barrier could be a slurry wall, a sheet piling, or a trench installation of a liner material. The barrier is assumed to reach from the land surface, extending just below the assumed elevation of the bottom of the waste material and extending into native soil comprising unit 1, estimated to be roughly 20 feet deep. The barrier is designed to prevent the flow of clean water from the south into the landfill and was modeled with an assumed hydraulic conductivity of $1x10^{-7}$ cm/sec, similar to a standard landfill clay liner or slurry wall. The model estimates that the water table within the landfill would decrease to 1650.7 feet msl, a drop of 6.7 feet. The leachate production would decrease to 7.2 gpm, based on a gradient of 0.0295 and a saturated thickness of 8.3 feet.

This simulation requires that South Pond be drained, which represents a large change to present conditions at the site. By draining the pond, about 23 gpm of water must be routed around the landfill on a permanent basis. It includes the installation of a barrier wall, which is relatively expensive. The combination of the barrier wall and the draining of South Pond is very effective in reducing the release of leachate to the groundwater, with leachate production reduced to about 7.2 gpm. It is the second most effective alternative in reducing the level of the groundwater within the landfill. The alternative does not require the capture of leachate, and thus does not require treatment or offsite disposal of liquid waste.

3.3.5 Landfill Cap and Install Barrier Wall

In this simulation, only the landfill cap and the hydraulic barrier along the south perimeter of the landfill are tested. The model estimates that the water table within the landfill would decrease to 1654.9 feet msl, a drop of 2.5 feet. The leachate production will decrease to 13.7 gpm, based on a gradient of 0.0369 and a saturated thickness of 12.5 feet.

This simulation relies only on the barrier wall to reduce the water table elevation within the landfill. It is moderately successful in reducing the release of leachate to the groundwater, with leachate production reduced to about 13.7 gpm. It is not very effective in drawing down the water table within the landfill. Its strengths are that South Pond does not need to be drained, and that this alternative does not include the capture of leachate, and thus does not require treatment or offsite disposal of liquid waste.

3.3.6 Landfill Cap and Passive Perimeter Drain

This simulation assumes that the landfill cap is in place, and adds a passive drain system along the southern perimeter of the landfill. The drain is installed at ground surface to an estimated depth of 20 feet, and is assumed to be fully efficient in drawing the water table down by 20 feet along its length. Section 4.2.2 provides additional detail on how the drain could be constructed. It is assumed that the drain is designed to collect and dispose of the collected leachate on a steady basis. The model estimates that the water table within the landfill would decrease to 1652.5 feet msl, a drop of 4.9 feet. The leachate escaping to the ambient groundwater would decrease to 5.7 gpm, based on a gradient of 0.0191 and a saturated thickness of 10.1 feet. Under this scenario, the drain would collect an estimated 6.1 gpm of leachate mixed with fresh groundwater from the south under average steady state conditions.

This simulation relies on a passive perimeter drain to reduce the production of leachate. It is moderately successful in reducing the water table elevation within the landfill, however, it is highly successful in reducing the release of leachate to the groundwater system, with leachate released to the downgradient groundwater estimated at only 5.7 gpm. Its main disadvantage is that it requires the capture of approximately 6 gpm of leachate mixed with clean groundwater on a continuous basis. This captured leachate would require either onsite treatment or offsite disposal for many years.

3.3.7 Landfill Cap, Drain South Pond and Passive Perimeter Drain

This simulation combines the landfill cap with the passive perimeter drain, but also assumes that a drain system is in place to fully drain South Pond to an elevation of 1,660 feet msl. The objective of draining South Pond would be to limit the amount of fresh water collected in the passive perimeter drain, and to further limit the amount of leachate generated beneath the landfill. The model estimates that the water table within the landfill would decrease to 1650.8 feet msl, a drop of 6.6 feet. The leachate released to the downgradient groundwater would decrease to 5.2 gpm, based on a gradient of 0.0213 and a saturated thickness of 8.4 feet. Under this scenario, the amount of leachate ground-water mixture collected by the passive perimeter drain would be an estimated 2.6 gpm, significantly less than in the simulation described in Section 3.3.6.

This simulation represents the third most effective method of reducing the water table in the landfill and the second most effective method of reducing releases of leachate to the groundwater system. By draining South Pond, it significantly reduces the volume of liquid waste that would have to be treated (2.6 gpm), and limits the release of leachate to the groundwater to only 5.2 gpm. It has two main disadvantages: it still requires capture and treatment or offsite disposal of liquid waste on a continuing basis, and it eliminates South Pond, thereby changing the site conditions significantly.

3.3.8 Landfill Cap, Drain South Pond, Passive Perimeter Drain and Install Barrier Wall

This simulation combines the landfill cap, the passive perimeter drain and the installation of a barrier wall. In this case, the passive perimeter drain is installed south of the barrier wall to keep leachate from entering the drain. It also assumes that a drain system is in place to fully drain South Pond to an elevation of 1,660 feet msl. The objective of draining South Pond would be to limit the amount of fresh water collected in the passive perimeter drain, and to further limit the amount of leachate generated beneath the landfill. The barrier wall installed at a rough depth of 10 feet below the passive drain system would reduce migration of landfill leachate into the drain. Section 4.2.3 provided additional detail on the construction of the barrier wall. The model estimates that the water table within the landfill would decrease to 1,650.5 feet msl, a drop of 6.9 feet. The leachate released to the downgradient groundwater would decrease to 4.0 gpm, based on a gradient of 0.0167 and a saturated thickness of 8.9 feet. Under this scenario, the amount of groundwater collected by the passive perimeter drain would be an estimated 4.6 gpm. This is slightly higher than in the previous simulation, because the barrier wall increases heads upgradient of the wall, however, it can be assumed that this collected water will be relatively free of leachate contamination and will not need treatment.

This simulation represents the most effective method of reducing the water table in the landfill and the most effective method of reducing releases of leachate to the groundwater system. The volume of water collected by the drain system (4.6 gpm) should be relatively free of leachate and it reduces the release of leachate to the groundwater to only 4.0 gpm. It has two main disadvantages: it eliminates South Pond, thereby changing the site conditions significantly and the installation of the barrier wall increases costs significantly.

3.4 Conclusions and Recommendations

The model simulations provide a good overview of the relative effectiveness of each of the various technologies tested.

- Draining South Pond appears to be the most cost effective approach to reducing leachate production while avoiding the costs of leachate collection and treatment

- The perimeter drain option is an effective method of reducing impacts to groundwater downgradient of the site, however would require collection and treatment or offsite disposal of liquid waste.

- The costs of leachate collection and treatment would be significantly reduced if the perimeter drain is combined with the draining of South Pond.

- The combination of an impermeable barrier with a perimeter drain on the Pond side of the barrier prevents leachate migration into the drain systems and results in the lowest release of leachate downgradient of the site.

- The landfill cap reduces infiltration into the landfill, but is relatively ineffective in lowering the water table in the landfill, and should not be justified solely on the basis of groundwater protection.

- The impermeable barrier option is not a very effective alternative, by itself. In combination with draining South Pond and the perimeter drain, its added value is minimal in reducing leachate released to groundwater but would eliminate the need to treat water captured by the drain.

Based on the model results and discussions during a November 24, 1998 meeting between NYSDEC, CDM and NYSDOH, NYSDEC elected to retain draining the South Pond with a landfill cap; and draining the South Pond, landfill cap and passive perimeter drain as the two hydraulic control technologies to be included in the detailed analysis of remedial alternatives discussed in Section 5 of this report. Additionally, given the added benefit of not requiring treatment, CDM included the addition of an impermeable barrier wall with the passive drain as a variation to the second hydraulic containment technology.

Section 4
Description of Remedial Technologies

This section describes the various remedial technologies and process options which may be included in the remedial alternatives to be evaluated under this focused Feasibility Study. The technologies were selected based on the groundwater modeling studies discussed in Section 3.3 and based on discussions during the November 24, 1998 workshop meeting between NYSDEC, NYSDOH and CDM.

4.1 Site Regrading and Landfill Cap

The 6 NYCRR Part 360 landfill closure regulations govern the response action at the ETE Sanitation and Landfill site as Applicable or Relevant and Appropriate Requirements (ARARs). The most recent version of this regulation, effective date October 9, 1993, dictates that landfills which ceased operation before October 9, 1993, and have no approved closure plan by NYSDEC, must comply with the requirements of the previous version of the regulation. Application of this regulation specifies that the closure of the ETE site must be in accordance with the 6 NYCRR Part 360 Regulation effective December 31, 1988.

A low permeability landfill cap can be constructed over the ETE Sanitation and Landfill site to create a physical barrier that: 1) prevents exposure to solid waste via direct contact, 2) reduces leachate generation and future impacts to underlying groundwater quality, and 3) controls gas emissions from the landfill. As noted, the design requirements for cap construction are specified in 6 NYCRR Part 360 Regulations, effective date December 31, 1988.

The 6 NYCRR Part 360 Regulations, Section 360-2.15(b), specify the following components for the Final Cover (starting from the bottom):

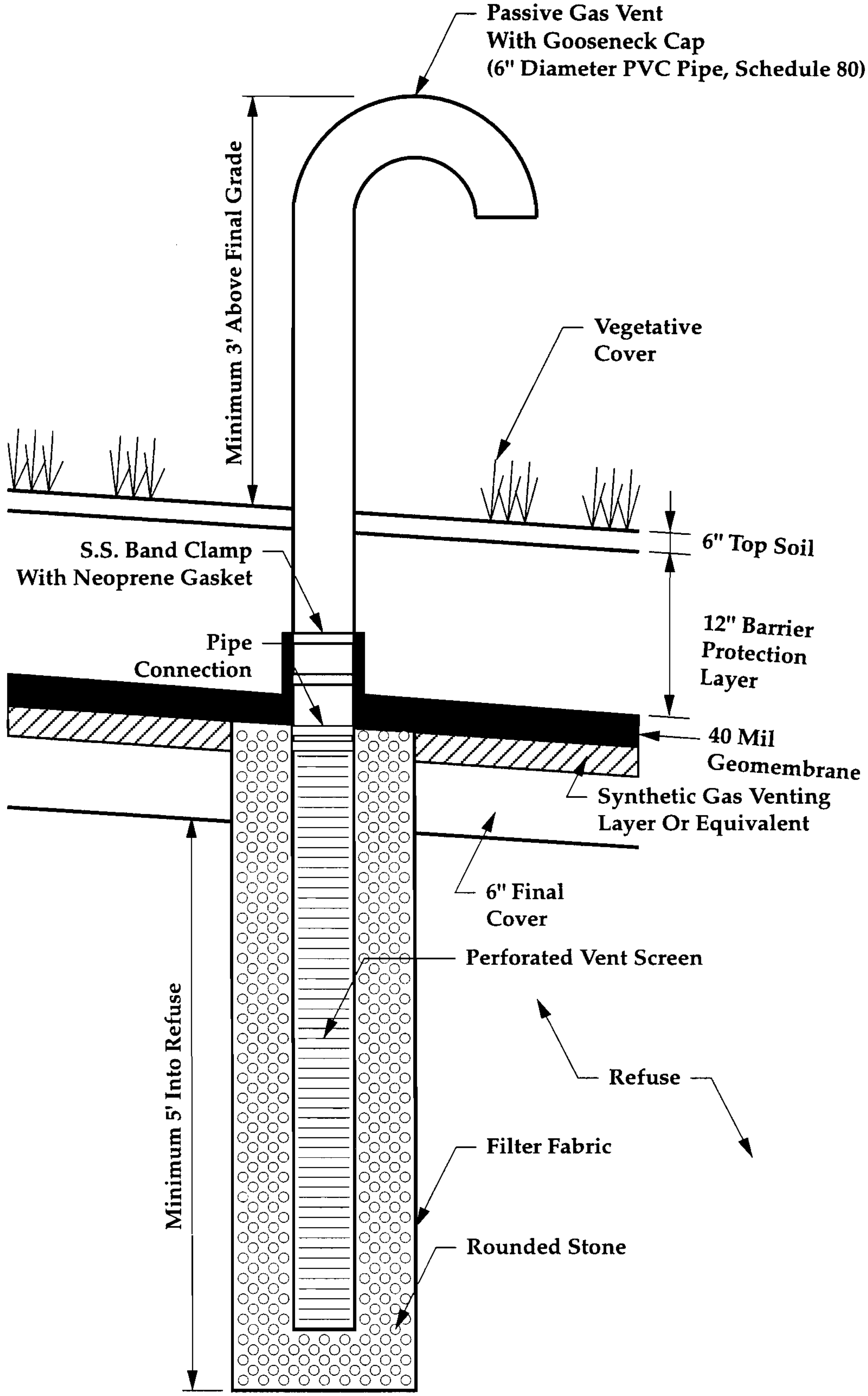
- Gas Venting Layer Section 360-2.13(p)
- Low Permeability Layer Section 360-2.13(q), Soil Layer; or
- Section 360-2.13(r), Geomembrane Layer
- Barrier Protection Layer Section 360-2.13(r)(iii)
- Topsoil Layer Section 360-2.13(s)

A typical cross-section of the required final cover is shown in Figure 4-1.

Rough grading materials required for cap construction would be obtained from onsite stockpiles, the North Pond expansion, and drainage channel construction/improvements, as described below. It is assumed that the soil currently stockpiled on the Town of Gainsville property located immediately east of the site will be available for use. Cap construction materials would be obtained from offsite source areas.

4.1.1 Waste Consolidation and Site Regrading

The topography of the existing landfill would be regraded to achieve uniform side slopes with a minimum 4% slope. The purpose of this grading plan is to minimize: 1) infiltration above the cap and 2) runoff velocities with the potential for development of preferential flow paths, which causes



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Not To Scale

Figure 4-1
Modified Part 360 Landfill Cap Cross Section With Gas Vent
ETE Sanitation And Landfill Feasibility Study

erosion. During rough grading, waste and sediment from South Pond would be excavated and placed on top of the landfill. The sediment from North Pond would also be removed and consolidated. The entire landfill would receive a minimum cover of 6 inches of screened fill materials, which will underlie the gas venting layer, as described below. Additional fill materials would likely be required to increase the slope of the southern half of the landfill to a 4 % minimum slope. Following completion of rough grading, the landfill would generally slope from south to north, and plateau near South Pond. Plate II provides the conceptual regrading of the landfill. Plate III provides cross sections of the regraded landfill. All plates are provided in the back pocket of this report.

4.1.2 Removal of Sediments and Expansion of the North Pond

As discussed below in Section 4.2.1, one of the possible hydraulic control technologies would be to permanently drain South Pond, prior to cap construction, to lower the water table and reduce long term leachate generation from the landfill. Based on review of historical aerial photographs, the size of the South Pond, prior to landfill construction, was approximately 1 acre. To compensate for the loss of the original South Pond area, North Pond would be expanded.

The existing North Pond is approximately one-half acre in surface area and is approximately two to three feet deep. Due to the presence of inorganic contamination, approximately two feet of sediment would be excavated from North Pond and consolidated on top of the landfill prior to expanding the North Pond. North Pond would be expanded by approximately 1 acre within the existing property lines, assuming that no construction offsets are required for a total surface area of approximately 1-1/2 acres. The expansion would be designed to maintain the surface water elevation (El. 1,637 feet). The bottom depth of the existing pond (3 feet deep, El. 1,634 feet) would be increased by approximately 2 feet as a result of sediment excavation. Within the expansion area, the pond would be constructed with a bottom depth of at least 3 feet. Based upon the shallow depth to groundwater in this area (El. 1,632 to 1,638 feet), lowering the surface water elevation of the new pond while maintaining a bottom depth of at least 3 feet would be costly and difficult due to flow of groundwater into excavations, stability of excavation side slopes, equipment access, equipment productivity, excavation de-watering and treatment, and potential exposure to contaminated groundwater. Additional pond depth could be achieved during construction, if determined to be feasible. Plate II provides the conceptual planned location of the reestablished North Pond.

Excess earthen materials from pond construction and expansion work would be stockpiled and used for rough grading.

4.1.3 Modified 6NYCRR Part 360 Cap

Design variances for each of the cap components may be applied for under the NYSDEC "Local Government Regulatory Relief Initiative - Guidance on Landfill Closure Regulatory Relief," dated February 26, 1993. The cap system is shown in Figure 4-1 and will consist of from top to bottom:

- vegetative cover
- 6-inch topsoil layer
- 12-inch soil barrier protection layer

- geosynthetic drainage system (geonet composite)
- 40-mil LLDPE geomembrane
- 6-inch grading layer

A description of each layer, its respective function, and design variances applicable to the ETE site are provided below. Plate IV includes the typical details of the Modified 6NYCRR Part 360 cap (herein referred to as the modified Part 360 cap).

4.1.3.1 Gas Venting Layer

The purpose of the gas venting layer is to facilitate movement of gases from the landfill interior to the venting points described in Section 4.4. It is located above the rough grade and immediately below the low permeability layer.

The 6 NYCRR Part 360 Regulations allow the use of either soil or geosynthetics that meet the minimum coefficient of permeability of 1×10^{-3} cm/sec. If soil is used, the thickness of the layer must be a minimum of 12 inches, have a maximum of five (5) percent (by weight) passing the No. 200 sieve, and be bounded on its upper and lower surfaces by a filter layer, as defined in Section 360-2.13(o).

Use of a geocomposite gas venting layer was considered for this application. It would consist of geonet and geotextile filter fabric. Geonet is porous synthetic product, typically constructed of High Density Polyethylene (HDPE), that is commonly used for subsurface drainage applications. At a minimum, six inches of rough grading material (screened fill) would be placed between the geocomposite gas venting layer and existing grade to protect the geocomposite from potential damage by sharp objects.

The main advantage of constructing the drainage layer using geonet is that it requires less space than the sand layer. The cost differential between these alternatives is generally minimal.

The actual design of the gas venting system will be dependent on the characteristics of the pregrade material and will be considered during the remedial design.

4.1.3.2 Low Permeability Layer

The purpose of the low permeability layer is to prevent leachate generation caused by infiltration of rain water and to prevent uncontrolled movement of landfill gases to the ground surface.

The 6 NYCRR Part 360 regulations allow for the use of two alternative impermeable layers for landfill covers. The first alternative allows for the use of 18 inches of low permeability soil (1×10^{-7} cm/sec permeability) and the second alternative allows for the use of 40 mil thick geomembrane.

There are two different types of soils that can be used for the low permeability alternative. These types of soils are natural clays with 1×10^{-7} cm/sec permeability and bentonite-enhanced soils that would meet the low permeability requirement of 1×10^{-7} cm/sec.

The natural clays that can be mined locally and meet the low permeability requirement, also classified as "fat" clays, are generally difficult to work with. Optimum moisture conditions are usually required to compact the material and achieve the required in-place impermeability. Optimum conditions dictate that there is no rain or freezing or hot weather during the work activity. Rain will cause the material to become very wet and impossible to work with or to compact; freezing will make the material hard, and therefore, compaction will not be possible; and hot weather will cause the moisture to evaporate, therefore jeopardizing compaction. Also, at the end of each day the active construction phase must be finished and compacted to avoid possible damage from climatic changes during the evening hours. In the event that an active phase has to remain open, the area usually is covered with plastic to protect the material. The complex installation procedure and higher cost eliminates this material from the options to be used for capping. Additionally, cost for this material can vary greatly depending on the location of the clay deposit in relation to the site, costing from $15 to $45 per cubic yard.

The bentonite-enhanced soils involve mixing of native soils with a percentage of bentonite to achieve the required impermeability. The ratio of materials can be determined in bench scale studies and the same ratios can be used during construction at an on-site mixing plant. This type of soil is significantly less affected by climatic changes and, with the exception of heavy rains or freezing weather, the installation can be accomplished without significant delays. The cost of this material including installation ranges from $35 to $45 per cubic yard depending on the source of the native soils. The lower limit ($35) will involve use of on-site loamy soils and the upper limit ($45) is for transported native soils. Assuming use of on-site soils, the cost per square yard of surface area for an 18-inch thick layer will be $17.50. Although this cost is lower than the clay cost, it is still more expensive than geomembranes, for which analysis is provided below. The existing side slopes at the ETE site are gentle, and there are geomembranes available on the market that provide the required friction angle with a sufficient safety factor. Thus, there is no added advantage in using soils which, in general, provide higher friction angles. Based upon budgetary cost estimates and experience at other landfills, the cost of the construction of an 18-inch thick low permeability layer is typically more than twice that of a geomembrane.

There are a number of geomembranes that can be used for landfill capping. Traditionally, in landfill engineering the most commonly used ones are Polyethylene (PE) and Polyvinyl Chloride (PVC). The polyethylene type membranes are available in different grades such as High Density (HDPE) and Linear Low Density (LLDPE).

The higher density polyethylenes provide a significant advantage with respect to chemical compatibility. HDPE is resistant to most chemicals and is normally used for landfill and containment liners. Due to the stiffness and comparatively lower elongation properties of the material, HDPE is usually used in areas with uniform bedding and low settling expectations. For the same reasons (rigid nature) HDPE is more difficult to work with along the side slopes and will not readily conform with the contouring of the topography.

LLDPE and PVC are the two materials most commonly used for capping landfills, where chemical compatibility is less of an issue as it is with containment liners, due to their elastic nature, ability to conform to the contouring of the topography, and ability to withstand uneven settlement.

Based on the above, a 40-mil LLDPE geomembrane liner has been considered for this application.

4.1.3.3 Barrier Protection Layer

The purpose of the barrier protection layer is to protect the geomembrane from frost action, root penetration, and physical damage. It also serves a secondary purpose by acting as a lateral drainage layer above the low permeability layer. Lateral drainage is generally essential to maintaining the slope stability of the landfill cap.

The protection layer is located above the low permeability layer. The 6 NYCRR Part 360-2.13(r)(iii) specifies that this layer must have a minimum thickness of 24 inches. In addition, the lower six inches of the layer must be "free of stones" to prevent damage to the low permeability layer during construction.

For this application, a variance to reduce the minimum barrier layer thickness from 24 inches to 12 inches was considered. This variance has been approved by the NYSDEC at New York State landfills. Based upon the gentle slopes of the landfill, a reduced protection layer would not compromise the long-term integrity of the barrier layer. Use of this variance can also be technically supported by the results of a slope stability analysis.

For slopes greater than 10 percent, a geocomposite drainage system (geotextile/geonet/geotextile bonded together) would be installed between the barrier protection layer and the low permeability layer to reduce water head buildup in the protection soil layer.

4.1.3.4 Vegetative Layer

Above the barrier protection layer, a minimum 6-inch layer of topsoil is necessary to maintain vegetative growth over the landfill. Upon completing placement of the topsoil layer, the entire landfill would be hydroseeded with a wildlife type seed mix to establish vegetation cover and avoid erosion of the cover layers. The seed mixture used for the hydroseeding consists of varieties of grass suitable for the local climatic conditions.

4.1.4 Stormwater Controls

The landfill cap would be constructed with slopes that are generally uniform from top to bottom across a given vertical cross-section. Under such conditions, storm water runoff would travel radially from the landfill cap as overland (sheet) flow. New and existing natural drainage swales would generally be used to intercept and transport storm water runoff for ultimate discharge to the North Pond or low-lying areas. Existing swales would be enhanced and extended, where required. A toe drain would also be installed around the perimeter of the cap to remove infiltrated water from above the liner for the purpose of maintaining slope stability.

As discussed in Section 4.2.1, permanent draining of the South Pond is a hydraulic control technology to be included in a remedial alternative. This would be achieved by installing a drainage pipe west of the landfill along the centerline of an existing natural swale or use of open drainage swales running along the east and west sides of the landfill. The topography of the South Pond area would be modified through partial filling and regrading so that the land may be more usable to the current property owner. However, the northern portion of the South Pond would function as a detention basin and temporarily store runoff water received from upgradient locations during intense storm events. The inlet structure for the pond drainage pipe would be designed to convey groundwater flow seeping into the drained pond (baseflow) as well as peak discharge during the 25-year storm (24 hour duration). It would be designed to prevent adverse impacts to downstream locations during peak discharge conditions.

The detention capacity of the North Pond, following expansion, would also be evaluated by performing a runoff analysis. The outfall structure from the North Pond would be designed to release overflow under controlled conditions, which would prevent adverse impacts to downstream offsite locations.

4.2 Hydraulic Controls

This section describes the various hydraulic control technologies which may be included in the remedial alternatives to reduce the water table within the landfill, thereby, reducing the amount of leachate generated after landfill closure. The following technologies were selected based on the various model simulations discussed in Section 3.3.

4.2.1 Draining the South Pond

Currently, the South Pond is approximately 3.5 acres in size with a maximum depth of approximately 12 feet. Based on review of photocopies of historical aerial photographs, the south Pond appeared to be roughly one-acre in size, prior to the site being used as a landfill. Based on available data, the depth of the South Pond prior to landfill is unknown.

The South Pond would be drained to lower the groundwater table beneath the landfill thereby reducing leachate generation. Based upon preliminary groundwater modeling results, draining South Pond and installing a landfill cap would effectively lower the groundwater table within the landfill by approximately six feet, reducing the saturated volume of waste. Model simulations indicate with draining South Pond and installing a landfill cap, leachate discharging to groundwater would be reduced to approximately 34 percent the amount currently generated with no remedial controls.

The South Pond can be drained by several methods including the use of a buried drainage pipe or with an open drainage channel. The drainage pipe method, depicted in the conceptual regrading plan designated Phase IIa, would be achieved by installing a drainage pipe west of the landfill along the centerline of an existing natural swale. The pipe would extend from the base elevation of the pond (El. approxi-mately 1,660 feet) to a downstream location of an existing drainage swale where positive slope can be achieved. The inlet structure for the pond drainage pipe would be designed to convey ground-water flow seeping into the drained pond (baseflow) as well as peak discharge during the 25-year storm (24 hour duration). It would be designed to prevent adverse impacts to downstream locations during peak discharge conditions.

The advantage of using the drainage pipe would be that the topography surrounding the landfill would require only minimal disturbance. Additionally, the pipe would require minimal maintenance and cleaning in order to function properly.

The South Pond could also be drained through the construction of open drainage channels running along the east and west sides of the landfill, as depicted in the conceptual regrading plan designated as Plate IIb. The drainage channels would be created through the enlargement and improvement of existing drainage features within, and adjacent to, the site. Existing channels would be excavated on the east and west portion of South Pond to a minimum elevation of 1,660 feet. The east drainage channel would be sloped so that water would discharge to a small unnamed tributary of Cotton Creek located northeast of the site at an approximate elevation of 1,620 feet. As shown on Plate IIb, the east drainage channel would require a drainage culvert at the South Pond to enable the construction of the landfill access road. The west drainage channel would also start at an elevation of 1,660 and would drain into the expanded North Pond at an elevation of approximately 1,640 feet.

The construction of the open drainage channels would require substantial excavation and regrading and would likely require the use of a geotextile fabric and crushed stone to stabilize the channel. A benefit of this alternative would be the generation of additional soil that could be used in the rough grading of the landfill and regrading of South Pond. The construction of east and west drainage channels may also assist in reducing leachate generation through intercepting surface water, and possibly groundwater, before reaching the landfill. The actual method of draining South Pond will be selected during the remedial design.

4.2.2 Passive Perimeter Drain

A passive perimeter drain would be installed at the southern toe of the landfill to divert groundwater from the landfill. Diversion of groundwater will lower the underlying groundwater table, thereby minimizing the saturated waste volume. Model simulations indicate that installing the passive perimeter drain in conjunction with draining the South Pond and installing the landfill cap would lower the water table within the landfill by approximately 6.6 feet and leachate released to groundwater would be reduced to approximately 28 percent the volume discharged with no remedial controls.

This technology includes constructing a trench along the southern perimeter of the landfill from ground surface to an approximate depth of 20 feet. A conceptual design of the passive drain is shown in Figure 4-2. While the actual depth and ground elevation of the passive drain would be determined during the design phase, ground-water model simulations placed the drain so that it would fully intercept the saturated thickness of the landfill which would be dependent on the final configuration of the landfill after regrading and capping. The piping system in the trench would consist of perforated pipe placed within a gravel covering at the base of the trench. Groundwater that has migrated towards the landfill would discharge into the trenched area and be conveyed through the piping system running back under gravity to sumps located at the end of each drain, thereby lowering the water table along its length. Based on the preliminary groundwater model simulations, discussed in Section 3.3, the drain system would collect an estimated 3 gallons per minute of leachate mixed with uncontaminated groundwater flowing into the drain from upgradient of the landfill. Given the groundwater model will only provide a rough estimate as to the amount of water collected by the drain, CDM conservatively estimated the amount to be 8 gallons per minute as part of the preliminary evaluation of leachate treatment technologies, discussed in Section 4.3.

Although the passive perimeter drain may be installed with any trenching equipment, "one-pass trenchers", which are custom designed and manufactured equip-ment, were considered for this study due to the reduced installation time and costs. Utilizing the one-pass trenchers eliminates or minimizes the need for dewatering and results in a fast completion time at a rate of up to 750 linear feet per day. For this study, a proposal was requested from Groundwater Control, Inc, which is the leading provider of trenched horizontal systems (Horizontal Technologies also use one-pass trenchers).

The trenching will include approximately 750 linear feet of HDPE perforated pipe with filter sock which will be installed to a depth of 20 feet, as shown in Figure 4-2. The pipe will be installed with 18 feet of pea gravel. The trenchers have a boom which holds the digging system. Also, a specially designed boot is connected to the trenching machine and acts as a sliding trench box. It is open at the top, where a hopper is mounted to direct the gravel flow. The piping is fed on rollers over the trencher, through a steel tube, mounted either behind of inside the boot, and comes out in the trench. As the excavation begins, the soil is brought to the surface where conveyers or augers on the trencher move it to the designated side of the machine. As the trencher moves forward, it cuts the soils and pulls the boot behind it within the trench. The piping is fed down the steel tube and comes out the back of the boot at the required depth. Loaders keep the boot filled with the filter media, which flows out the back of the boot and around the pipe, also at the required depth.

Since the passive perimeter drain is a hydraulic containment/control technology used to draw down the water table within the landfill, the water collected in the drain will be a mixture of landfill leachate and uncontaminated groundwater that would require treatment either on-site or off-site.

4.2.3 Passive Perimeter Drain and Barrier Wall

In addition to the passive perimeter drain, as discussed in Section 4.2.2, a sheet piling barrier wall may also be installed at the southern toe of the landfill between the landfill and perimeter drain. The sheet piling will be left in place, at a depth of 30 feet, extending approximately 15 to 20 feet into native glacial sediments creating an impermeable containment system and preventing backflow of leachate into the drain. A conceptual design of the sheet pile wall in conjunction with a passive drain is shown in Figure 4-2. The actual depth and configuration of the barrier wall would be determined during the remedial design phase of the project and would be dependent on the final consolidation and capping of the landfill. The addition of the barrier wall would further reduce the saturated thickness of landfill wastes and reduce leachate generation to approximately 16 percent current levels, according to model simulations.

The addition of the barrier wall would prevent uncontaminated groundwater that has migrated towards the landfill from mixing with leachate. Assuming the barrier wall is highly efficient in containing leachate, groundwater collected by the drain should meet surface water discharge standards and treatment would not be required prior to discharging to the stormwater drainage system. The construction of the sheet piling includes driving steel sheeting with interlocking joints into the ground, using equipment such as a crane with hammer attachment.

4.3 Leachate Controls

4.3.1 Leachate Collection and Temporary Storage

If the passive perimeter drain is to be installed, the leachate collected from the drain would require treatment and disposal. Options include on-site treatment and release to North Pond or temporary on-site storage and periodic transportation of the leachate to an off-site treatment plant. Due to limited leachate data, the quality of the collected leachate/groundwater mixture was estimated using on-site RI data for groundwater samples from the following four shallow monitoring wells: MW-8S, located within the landfill, and MW-9S, MW-4S and MW-3, all located north (downgradient) of the landfill. Table 4-1 summarizes the groundwater data used. As discussed in Section 3.3, the uncalibrated groundwater model predicted that the drain system would collect approximately 3 gallons per minute (gpm) of leachate mixed with groundwater. This estimate is highly dependent on the assumed hydraulic properties of the landfill and underlying aquifer and are expected to vary considerably. Given the uncertainties inherent with this estimate, CDM used a more conservative estimate of 8 gpm in the evaluation of leachate containment and treatment options.

The leachate/groundwater mixture will be collected in sumps located at both ends of the passive perimeter drain and pumped, using sump pumps, to a storage tank. Approximately 950 feet of piping will be installed to transport the leachate from the sumps to a storage tank. The extracted leachate/groundwater will be collected in an on-site storage tank, located in the southeast corner of the site, for either on-site or off-site treatment. The proposed location of the storage tank and distribution piping are shown in Figure 4-2. Based on a flow rate of 8 gallons per minute, approximately 80,640 gallons of leachate/groundwater will be collected per week. Therefore, in order to provide flexibility in case the treatment plant is down or the transportation of leachate is delayed, a storage tank of approximately 105,000 gallons, equivalent to nine days of groundwater storage, would be recommended.

4.3.2 Onsite Treatment

Rather than researching an individually designed leachate treatment system, a manufactured packaged system was considered to be more beneficial due to the reduced installation time and costs. For this study, a proposal was requested from Met-Pro Corporation Systems Division, which has several landfill leachate treatment systems in operation. The following process description is taken from the Met-Pro submittal.

The Met-Pro system combines a chemical/physical pretreatment step with anaerobic/aerobic Matrix Biological Film (MBF) bioreactors. The chemical treatment step includes a pH adjustment tank in which sodium hydroxide would be added to elevate the pH for optimum metals precipitation. The unit is followed by a flocculator into which polymer is added to enlarge particles and promote settling. The supernatant will overflow to the splitter box ahead of the bioreactor system and the sludge will be pumped into a sludge holding tank.

Biological treatment will occur through MBF bioreactors . The modular design for these MBF bioreactors provides process flexibility that allows the handling of wide variations in flow and leachate strength. These reactors utilize a multi-cell approach to biological treatment providing an efficient method of degradation of a greater number of organics. Following the biological treatment,

Table 4-1
Estimated Leachate Quality*
ETE Sanitation and Landfill
Feasibility Study

Parameter	Screening Standard for GA Water (ug/L)	MW-3S (ug/L)		MW-4S (ug/L)		MW-8S (ug/L)		MW-9S (ug/L)		Estimated Leachate Quality (ug/L) (ug/L)
		CONC.	Q	CONC.	Q	CONC.	Q	CONC.	Q	
TCL VOCS										
Vinyl Chloride	2	**16**		ND		ND		ND		**4**
Chloroethane	50	10		ND		4	J	ND		3.5
Methylene Chloride	5	ND		ND		**56**	J	**5.2**	J	**15.3**
Acetone	50	ND		ND		**1,009**	E	**64**		**268.25**
Carbon Disulfide	50	ND		ND		ND		ND		ND
1,2-Dichloroethene	0.6	**108**		ND		**8.8**	J	ND		**29.2**
2-Butanone	50	ND		ND		**2,231**	ED	**129**		**590**
Trichloroethene	5	**50**		ND		ND	J	ND		**12.5**
Benzene	1	ND		ND		**15**	J	ND		**3.8**
4-methyl-2-pentanone	50	ND		ND		**316**	D	ND		**79**
2-Hexanone	50	ND		ND		**68**		ND		17
Tetrachloroethene	5	ND		ND		ND		ND		ND
Toluene	5	ND		ND		**245**	D	ND		**61**
Chlorobenzene	5	ND		ND		ND		ND		ND
Ethylbenzene	5	ND		ND		**60**		ND		**15**
Styrene	5	ND		ND				ND		ND
Xylenes (total)	5	4.5	JN	2.3	JN	**219**	J	2.3	JN	**57**
TCL Semivolatile										
Phenol	1					**79**		**100**	EJ	**89.5**
2-Methylphenol	50					21		ND		10.5
4-Methylphenol	50					**995**	D	49	J	**522**
2,4-Dimethylphenol	1					**19**	J	ND		**9.5**
Naphthalene	10					ND		ND		ND
Dimethylphthalate	50					ND		ND		ND
Diethylphthalate	50					43		ND		21.5
Di-n-butylphthalate	50					ND		ND		ND
bis(2-Ethylhexyl)phthalate	5					**5.9**	J	1.9	J	3.9
TCL Pesticides/PCBs										
Heptachlor	0.04					0.005	JP	ND		0.0025
TCL Inorganics										
Aluminum	NA	73.4	B	38.2	B	2,355.1		ND		616.7
Antimony	3	ND		ND		**5.64**	B	ND		1.41
Arsenic	25	ND		ND		ND		ND		ND
Barium	1,000	69	B	679		**1,198.8**		**5,217**		**1,790.95**
Beryllium	3	ND		ND		ND		ND		ND
Cadmium	5	ND		**8.9**		**8.86**		1.6	B	4.8
Calcium	NA	110,000		230,000		155,590		298.71		123,970
Chromium	50	19.1		ND		3.35	B	ND		5.6125
Cobalt	NA	ND		9.1	B	3.34	B	8.73	B	5.2925
Copper	200	12.2	B	30.5		ND		20.82	B	15.88
Iron	300	161		**525**		**181,040**		**6,673.5**		**47,099.875**
Lead	25	ND		ND		51.92		ND		12.98
Magnesium	35,000	19,800		**74,000**		**43,710**		**58,497**		**49,001.8**
Manganese	300	**903**		**10200**		**7514.8**		**2721.2**		**5334.75**
Mercury	0.7	ND		ND		ND		ND		ND
Nickel	100	4	B	16.8	B	11.5	B	22.51	B	13.7025
Potassium	NA	21,100		140,000		248,290		286,320		173,927.5
Selenium	10	ND		7.6		ND		ND		1.9
Silver	50	ND		ND		ND		ND		ND
Sodium	20,000	**303,000**		**4,220,000**		**16,635,500**		**31,054,500**		**13,053,250**
Thallium	0.5	ND		ND		ND		**11.89**		**2.9725**
Vanadium	NA	ND		ND		16.23	B	4.59	B	5.205
Zinc	2,000	4	B	3.3	B	22.88		ND		7.545
Cyanide	200					ND		ND		ND

* Based on Groundwater Samples from MW-3S, MW-4S, MW-8S, and MW-9S (Final Investigation Report, September 1998)
BOLD: Exceeds NYSDEC criteria for class GA groundwater
ND: Non-Detect Q: Laboratory qualifier CONC: concentration
N: The value reported was less than 5 times (10 times for the common EOA contaminants) the value in the field of trip blank.
J: Indicates an estimated value. D: Identifies all compounds identified in an analysis at a secondary dilution factor.
P: Indicates a > 25% difference for detected concentrations between the two GC columns. The lower of the two values is reported.
E: Estimated value. Analyte concentration exceeds the calibrated range of the GC/MS instrument.

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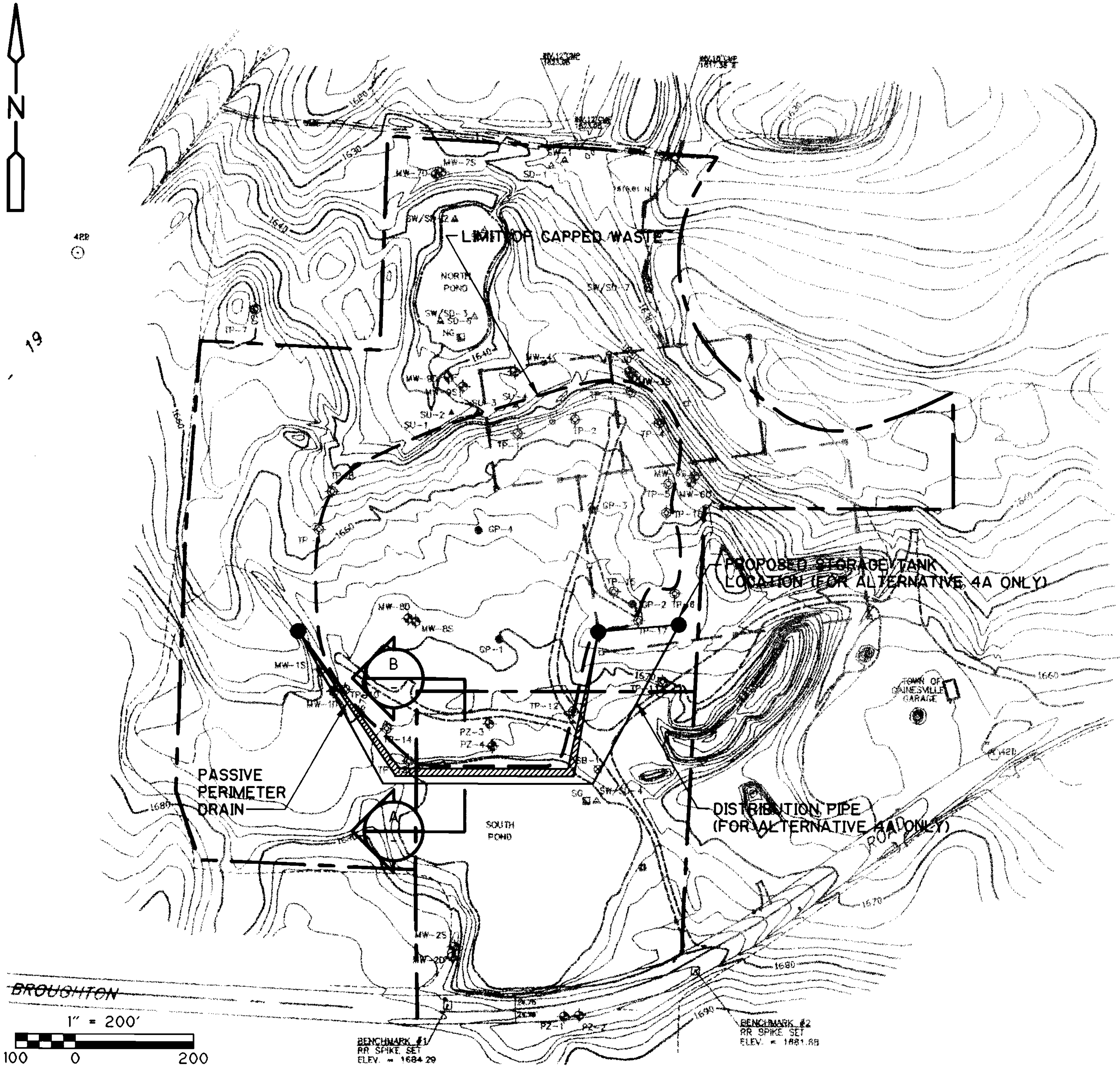
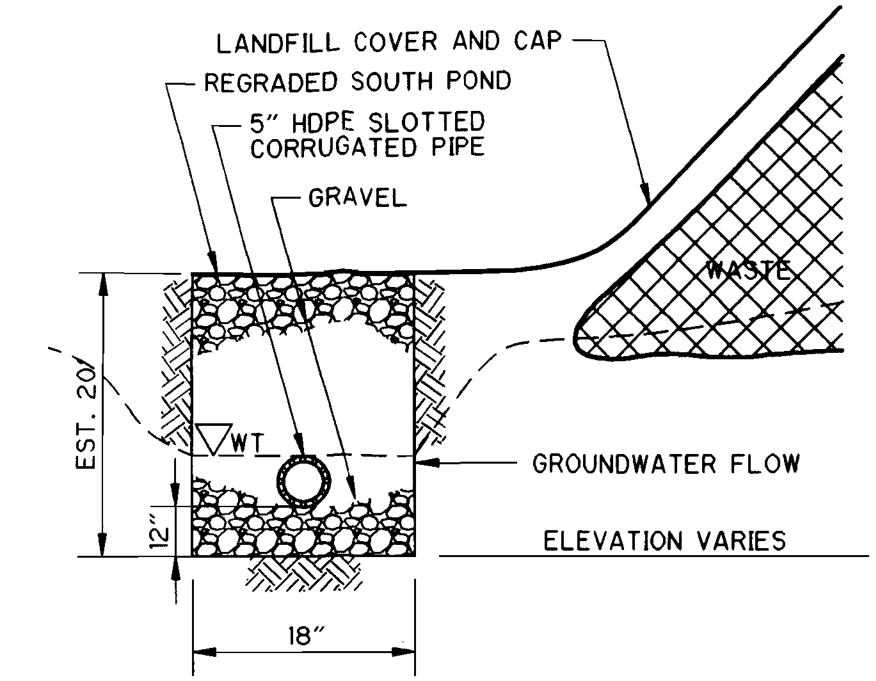
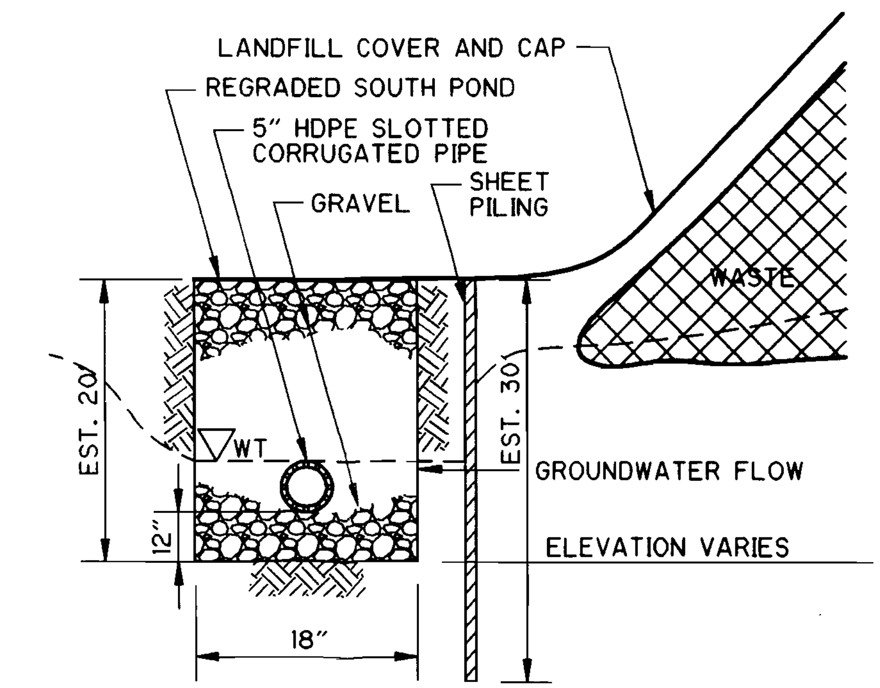




SECTION A-B
NTS
ALTERNATIVE 4A



SECTION A-B
NTS
ALTERNATIVE 4B

NOTES

1. VERTICAL DATUM: FROM WELL ELEVATIONS SHOWN ON ORIGINAL TOPOGRAPHIC MAP PROVIDED BY NYSDEC.
2. DATE OF SURVEY: APRIL 16, 1998

Figure 4-2
Conceptual Design Of Passive Perimeter Drain And Leachate Collection System
ETE Sanitation And Landfill Feasibility Study

CDM Camp Dresser & McKee

the leachate flow would enter a clarification system which would settle the biological solids generated in the biological reactors.

A sludge handling/dewatering system would be sized according to the anticipated solids loadings, with significant contributions from TSS, BOC, and metal hydroxides. The system consists of a sludge holding tank and filter press feed pump assembly. In addition, a sludge thickening tank could be provided to further thicken sludge prior to storing it in the holding tank. Also, if the TDS concentration of the leachate exceeds state or federal regulations for discharge to surface water, a reverse osmosis (RO) treatment system will also be recommended. This system consists of an integrated pumping and membrane system using high rejection, long-lasting thin-film composite membranes.

The treatment system would be housed in an onsite building for ease of operation and maintenance, as well as odor control. The total treatment and disposal system would include an in-ground piping system for effluent discharge to the North Pond.

Feasibility, risk, and cost-effectiveness issues of on-site treatment are: ease of operation, sludge disposal, hauling and disposal of the RO reject stream (if required), treatment costs, permitting requirements for construction and operation of the plant and for discharge into the North Pond. In order to assess these issues, the following considerations must be addressed:

- Met-Pro offers in-depth technical training of staff who would run the treatment plant. This training would alleviate some of the difficulties in operating the plant.

- Sludge disposal is an issue because, depending on sludge classification as hazardous or non-hazardous, disposal may be difficult and/or costly.

- Hauling and disposal of the reverse osmosis waste stream is a critical concern because the reject stream is typically high in salt content. The concentrated brine is often classified as a hazardous waste and significantly restricts the disposal options for the waste stream. The high costs of disposal of such a hazardous waste combined with potentially high hauling costs (if no local disposal site is available) may make the on-site treatment option unfeasible.

- The feasibility of obtaining the required permits is another significant issue. The following permits would be required at a minimum: permit to construct treatment plant, permit to operate plant, discharge permit, permit for hazardous materials storage/handling.

- Though the system would be automated, it would still require personnel dedicated to operate and maintain the system throughout its operational life.

4.3.3 Offsite Treatment

Off-site treatment would include trucking the stored leachate from the storage tank to a nearby wastewater treatment plant, at a frequency of approximately once a week. Assuming that one tanker has a capacity of approximately 5,100 gallons, approximately 16 tankers will be used to transport the leachate/groundwater mixture. Based on CDM's research, the nearest, most cost effective treatment facility that would accept hauled waste is the City of Niagara Falls POTW, located approximately 80 miles from the landfill, which has a capacity of 48 million gallons per day (mgd). Currently, the treatment system has a flow of approximately 30 to 32 mgd and is actively seeking additional nonhazardous wastewater streams to take advantage of the unused treatment capacity (approximately 16 to 18 mgd) resulting from reductions by resident industries. Due to the large capacity of the treatment plant and number of waste receipt locations at the plant site, scheduling flexibility is good and the transportation of waste material from other sites will not affect the delivery or unloading of the leachate. At the City of Niagara Falls POTW, leachate would be treated using activated carbon adsorption to action levels defined by the Federal and State MCLs for public drinking water supplies or natural background, or Federal and State Surface Water Quality Standards, as appropriate. Table 4-1 compares the estimated leachate/groundwater quality to the NYSDEC criteria for class GA groundwater. Sampling from the storage tank would be conducted as required by the City of Niagara Falls POTW, once or twice a year. These samples would be analyzed for TSS, soluble organic carbon, chloroform, dichloroethenes, toluene, benzene, trichloroethanes, trichloroethene, tetrachloroethene, vinyl chloride, monochlorotoluenes, and total phenols and submitted to the POTW.

Although the disposal of leachate/groundwater at the wastewater treatment plant is an effective and reliable option, it is also dependent on the transportation of the material to the facility. There are several issues that are related to the off-site treatment. These include cost, weather, and accident potential. Although cost may be described quantitatively, weather impacts, and accident potential can only be described qualitatively.

Trucking of the leachate/groundwater increases the potential for an accident to occur, especially since the treatment plant is located approximately 80 miles away. Also, inclement weather increases the risk of an accident. Freezing road conditions, snow storms, ice storms, and fog can all contribute to increased accident risk, as well as difficulty in transporting the leachate. One way to mitigate the effects of inclement weather or shortage of trucks is to have sufficient on-site leachate storage (see Section 4.3.1).

4.3.4 Preliminary Evaluation of Leachate Treatment Technologies

The onsite treatment plant and transportation and off-site disposal would be equally effective in treating the leachate/groundwater. As discussed above, a packaged treatment system would provide flexible onsite treatment, which could accommodate variations in the quantity and quality of water to be treated. The transportation and off-site disposal option is the most widely used method of leachate control due to the convenience and low monitoring required. Although the off-site treatment is more reliable than the onsite treatment, the off-site treatment will be dependent on the transportation of the material to the facility. Given both are equally effective at treating the leachate/groundwater mixture, the determining factors in selecting the most appropriate system are cost and implementability.

The costs for the onsite treatment alternative include the capital and annual costs for operation and maintenance.

- Capital Cost $995,200
- Operations and Maintenance Cost $288,500
- Future Capital Cost $0
- Present Worth (1999) $4,931,600

The costs for the off-site treatment alternative include the annual costs for transportation and disposal.

- Capital Cost $0
- Operations and Maintenance Cost $311,600
- Future Capital Cost $0
- Present Worth (1999) $4,344,500

These costs are further detailed in Appendix A.

Based on the present worth basis of the cost evaluation, the off-site treatment is lower in cost than the onsite treatment. Another significant benefit of the off-site treatment alternative is that it is readily implementable in that the POTW is currently seeking additional nonhazardous wastewater streams. On the other hand, the operation of an onsite treatment plant would require skilled personnel and full-time monitoring, as well as disposal as a hazardous waste of the treatment plant by-products, which include the highly concentrated brine solution and sludge.

Based on the above conclusions, the off-site treatment, which includes transportation and off-site disposal to a POTW, will be retained as the leachate/groundwater treatment technology.

4.4 Landfill Gas Control

The primary purpose of the landfill gas control system is to prevent uncontrolled movement of landfill gases, which may accumulate at explosive concentrations within onsite and offsite structures, or pose health hazards associated with inhalation of hazardous compounds. Landfill gases generally consist of methane and carbon dioxide, which are produced as byproducts during anaerobic biodegradation of waste. Lower levels of hydrogen sulfide and Non-Methane Organic Compounds (NMOCs) are also present.

Control of landfill gas movement is achieved by constructing a gas venting system. The gas venting system may be either a passive system or an active system. Active systems may also include a treatment system to thermally destroy hazardous gases prior to atmospheric discharge. Given the degree of gas production at the ETE site, a passive gas venting system was considered for this application.

4.4.1 Passive Gas Venting

The construction requirements for a passive gas venting system are specified in 6 NYCRR Part 360-2.13(p)(2). The system would consist of multiple vents installed through the landfill cap.

Passive vents operate based upon the natural pressure gradient between the landfill void space and the atmosphere. As gas is generated inside the landfill, the pressure underneath the protective cap increases to levels exceeding atmospheric pressure. The vents, which are typically constructed as wells and/or horizontal trenches, act as conduits that facilitate the natural release of landfill gases to the atmosphere.

The wells, installed at a minimum frequency of one well per acre, would be drilled at least five feet into the refuse using a rig equipped with a bucket auger. The diameter of vent boreholes generally ranges from 24 to 36 inches. Upon completing the borehole, the vent is installed by placing a section of 6 to 8-inch diameter perforated pipe into the hole followed by crushed stone. The vent is extended three feet above the ground surface using sections of solid pipe. A low-permeability boot is installed at the interface between the landfill cap and the vent to maintain the integrity of the protective liner. Ventilator caps or inverted 180-degree elbows are attached to the end of vents at the ground surface to prevent the entrance of rain.

Trenches are constructed using excavation equipment. Similar to well construction, the hole is filled with a horizontal section of perforated pipe followed by crushed stone. The vent is then extended vertically to the ground surface, and equipped with a low-permeable boot and a ventilator cap or inverted elbow.

For the ETE site, a standard system of wells would be installed in accordance with the regulations. Plate II provides the location of each landfill gas vent. Plate IV provides the typical design of each vent.

4.5 Institutional Controls

Institutional controls for the ETE Landfill will consist of post closure environmental monitoring and periodic inspections of the site.

Groundwater monitoring will require the installation of two additional well clusters or outpost monitoring wells downgradient (north) of the site in order to detect any potential future offsite migration of groundwater contaminants. Along with the outpost wells, two onsite well clusters, MW-7 and MW-3, and upgradient well MW-2S would be monitored. In addition, six private wells located downgradient of the site wold be included in the post closure monitoring. Based on the findings of the RI, analysis of collected groundwater samples would be analyzed for volatile organic compounds and leachate indicator parameters, i.e. chloride, TDS, nitrate/ammonia, alkalinity, etc. One surface water and surface water sediment sample would be collected from a location where surface water flows off of the ETE site, based on the planned regrading of the site, this will be the outlet of the enlarged North Pond. Analysis of these samples would be for volatile organic compounds and metals.

Landfill gas vents would be monitored using field instruments. Total volatile organic compounds would be measured with a photo ionization detector (PID). Additionally, specific VOCs of concern such as vinyl chloride would be monitored using Draeger tubes. Landfill gases such as methane, CO2 and H2S would be monitored using a landfill gas meter.

In order to comply with 6NYCRR Part 360 requirements, seven perimeter methane monitoring wells would be installed and monitored. Gas concentrations (methane, H_2S, LEL) would be measured on a routine basis to monitor the landfill gas movement potential subsurface migration of landfill gas and prevent potential offsite impacts.

Post closure monitoring would be conducted for a period of thirty years. The above sampling and monitoring would be performed quarterly (four times per year) for the first two years and then annually for the remaining 28 years. In addition, routine inspection of the landfill cap and drainage system would be performed monthly for the initial 2 years and then quarterly for the remaining 28 years to verify their integrity. Monitoring reports would be generated for each sampling event. Based on the results of completed post closure sample events, the number of sample points or target parameters can be modified for future sample events.

Section 5
Detailed Analysis of Alternatives

5.1 Introduction

A total of four alternatives for site closure were developed for the ETE Sanitation Landfill site based on discussions with NYSDEC and through the screening process presented in Sections 3 and 4. They are:

Alternative 1 - No Action with Environmental Monitoring

This alternative would entail leaving the ETE site as it currently exists. Environmental monitoring in accordance with Section 4.5.1 would be implemented and maintained for 30 years. The environmental monitoring would be conducted quarterly for the first two years after closure and annually for the remaining 28 years.

Alternative 2 - Modified Part 360 Landfill Cap, Landfill Gas Vents and Groundwater Monitoring

The evaluation of Alternative 2 includes the modified Part 360 Landfill Cap, passive landfill gas vents and environmental monitoring. The site would require regrading and waste consolidation as discussed in Section 4.1.1. The modified Part 360 Landfill Cap design is detailed in Section 4.1.3. Construction of the passive landfill gas vents is discussed in Section 4.4.1. Environmental monitoring would be consistent with the No Action alternative and is detailed in Section 4.5.1.

Alternative 3 -Install Modified Part 360 Landfill Cap, Gas Vents , Drain South Pond, and Environmental Monitoring

Alternative 3 includes the site regrading, waste consolidation and cap, gas vents and environmental monitoring as presented in Alternative 2. Plate IIa and IIb depict conceptual variations on Alternative 3. Alternative 3 also includes the draining of the South Pond in order to reduce the water table within the landfill as detailed in Section 4.2.1. The actual method of draining South Pond, either using a buried drainage pipe or open drainage channels will be determined during the remedial design. The North Pond would also be temporarily drained in order to remove contaminated sediments. The contaminated North Pond sediments would be placed on the landfill prior to capping, as discussed in Section 4.1.2. Additionally, stormwater controls would be implemented, as discussed in Section 4.1.4, to reduce the potential of uncontrolled flooding and erosion. To offset the loss of habitat associated with draining the South Pond, the North Pond would be expanded as detailed in Section 4.1.2.

Alternative 4 - Install Modified Part 360 Landfill Cap, Gas Vents , Drain South Pond, Install Passive Perimeter Drain, Collection and Disposal (Alternative 4a) or Onsite Discharge (Alternative 4b) of Groundwater, and Environmental Monitoring

Alternative 4 includes the already discussed site regrading, waste consolidation and cap, gas vents and environmental monitoring presented in Alternatives 2 and 3. Alternative 4 also includes the draining of the South Pond, enlarging the North Pond, and the Storm water controls presented in Alternative 3. In addition, Alternative 4 includes the installation of a passive perimeter drain around the southern perimeter of the landfill as detailed in Section 4.2.2.

Alternative 4 is sub-divided as Alternative 4a and 4b to evaluate two options associated groundwater collection and discharge, respectively. Alternative 4a considers: 1) installation of a passive drain, 2) collection of groundwater in an above-ground storage tank, 3) offsite transport of groundwater using a tanker truck, and 4) disposal of groundwater at a public water treatment plant, as discussed in Section 4.3.3. Treatment for this sub-alternative is considered based upon the assumption that the drain will capture clean groundwater inflow, as well as some leachate backflow from the landfill. Alternative 4b considers: 1) installation of a passive drain and downgradient sheet pile barrier wall, and 2) onsite discharge of groundwater to drainage swales. Treatment is not considered, because the barrier wall would prevent backflow of leachate into the drain.

For the evaluations presented below, Alternatives 4a and 4b are considered to be equivalent unless otherwise specified.

The purpose of this section is to analyze the above listed alternatives in sufficient detail to objectively evaluate their benefits and drawbacks. In Section 6 - Comparative Analysis, the alternatives will be compared against each other.

5.2 Criteria

The Technical and Administrative Guidance Memorandum (TAGM) identifies seven evaluation criteria to address technical and policy considerations that have proven to be important for selecting remedial alternatives. These criteria are listed and briefly described below. These seven criteria are used to perform a detailed analysis of the listed alternatives. Cost summary tables for each alternative are provided in Appendix A.

5.2.1 Compliance With Applicable or Relevant and Appropriate Requirements, and Standards Criteria and Guidelines (ARARS/SCGs)

Alternatives are evaluated to determine whether they comply with all applicable or relevant and appropriate requirements, or if a waiver is required, how it is justified. The alternatives are evaluated against the SCGs which are listed in Table 1-5.

5.2.2 Protection of Human Health and the Environment

Alternatives are evaluated to determine whether they can adequately protect human health and the environment, especially after the remediation has been completed. The analysis indicates how much risk at the site is eliminated, reduced, or controlled, and considers exposure levels established during the development of the remediation goals.

5.2.3 Short-Term Effectiveness

The short-term impacts of each alternative are evaluated, concentrating on: (1) the risks that may result during construction; (2) the time until remedial response objectives are achieved; (3) the potential impacts on workers during remedial action, the effectiveness and reliability of protective measures available to workers; and (4) the potential environmental impacts of the remedial action and the effectiveness of mitigative measures during construction.

5.2.4 Long-Term Effectiveness and Permanence

Alternatives are also assessed for the long-term effectiveness and permanence they provide, along with the degree of certainty that the alternative will be successful. This evaluation concerns the time period during the operation of the remedial action and after the operation of the remedial action. Other long-term effectiveness and permanence factors include the magnitude of residual risk from untreated waste or treatment residuals remaining at the conclusion of the remedial activities. Also, the adequacy and reliability of controls such as containment systems and institutional controls that are necessary to manage treatment residuals and/or untreated waste will be evaluated. This criterion should include assessment of the potential need to replace components of the alternative and associated risks.

5.2.5 Reduction of Toxicity, Mobility, or Volume

The degree to which alternatives employ recycling or treatment that reduces toxicity, mobility, or volume shall be assessed, including how treatment is used to address the principal threats posed by the site. Factors that shall be considered include: (1) the amount of hazardous contaminants that will be destroyed, treated, or recycled; (2) the degree to which treatment reduces the inherent hazards posed by principal threats at the site; (3) the degree to which the treatment is irreversible; and (4) the type and quantity of residuals that will remain following treatment.

5.2.6 Implementability

The ease or difficulty of implementing the alternatives shall be assessed by considering the technical and administrative feasibility of a technology and the availability of services and materials. The technical feasibility includes: (1) difficulties and unknowns associated with the construction and operation of a technology; (2) the reliability of the technology; (3) the ease of undertaking additional remedial actions; and (4) the ability to monitor the effectiveness of the remedy. The administration factors include coordination with other offices and agencies. The assessment of availability of services and materials includes: (1) the availability of adequate off-site treatment, storage capacity, and disposal capacity and services; (2) the availability of necessary equipment, specialists and skilled operators, and provisions to ensure any necessary additional resources; and (3) the availability of services and materials with competitive bidding.

5.2.7 Cost

The types of costs that are evaluated include capital costs, including both direct and indirect costs; annual operation and maintenance costs; future capital costs, and cost of future land use as described below:

- <u>Capital Costs</u> - Capital costs consist of direct (construction) and indirect (non-construction and overhead) costs.
  - Equipment Costs - Equipment necessary for the remedial action; (these materials remain until the site remedy is complete).
  - Land and Site-Development Costs - Purchase of land and site preparation of existing property.
  - Building and Services Costs - Buildings, utilities, and purchased services.
  - Disposal Costs - Transporting and disposing of waste material.
  - Engineering Expenses - Administration, design, construction supervision, drafting, and treatability testing.
  - Legal Fees and License or Permit Costs
  - Start Up and Shakedown Costs
  - Contingency Allowances - To cover unforeseen circumstances.
- <u>Operation and Maintenance Costs</u> - Annual post-construction costs necessary to ensure the continued effectiveness of a remedial action. The following annual cost components should be considered:
  - Operating Labor Costs - Wages, salaries, training, overhead, and fringe benefits associated with post-construction operation
  - Maintenance Material and Labor Costs
  - Auxiliary Materials and Energy - Chemicals, electricity, water, and sewer, etc.
  - Disposal of Residues - To treat or dispose of residuals such as sludges from treatment processes or spent activated carbon.
  - Purchased Services - Sampling costs, laboratory fees, and professional fees which can be predicted.
  - Administrative Costs
  - Insurance, Taxes, and Licensing Costs

- Replacement Costs

- Costs of Periodic Site Reviews - Reviews to be conducted every five years if a remedial action leaves any hazardous substances, pollutants, or contaminants at the site.

■ Future Capital Costs - Costs for future remedial actions should be evaluated when there is the potential for a major component of the remedial alternative to break down or need replacement.

■ Cost of Future Land Use - Potential future land use of the site is normally considered with regards to future zoning or residential development which may be restricted if hazardous waste is left at the site or if groundwater use is impacted. However, for this study it was not considered because each alternative will have similar impacts on surrounding land use. Once the site is remediated so that it no longer presents a significant threat to human health or the environment, the future use and property value of surrounding properties will be enhanced.

A present worth analysis is performed to bring all future costs to the current year (1999) for easy comparison. The total present worth cost of the alternative includes the direct and indirect capital costs and the present worth of the annual and periodic costs over the design life of the alternative at an annual rate of five percent. A cost sensitivity analysis may evaluate any uncertainties concerning specific assumptions made for individual costs, if necessary. At this stage of the Feasibility Study, costs are expected to be within -30 to +50 percent.

5.3 Detailed Analysis

This section provides a discussion of the detailed analysis of each of the five selected remedial alternatives listed above based on the seven evaluation criteria. Table 5-1 summarizes the most significant positive and negative issues associated with each alternative.

5.3.1 Alternative 1 - No Action with Environmental Monitoring

This alternative would entail leaving the ETE site as it currently exists. Environmental monitoring in accordance with Section 4.5.1 would be implemented and maintained for 30 years. The environmental monitoring would be conducted quarterly for the first two years after closure and annually for the remaining 28 years.

5.3.1.1 Compliance with ARARs/SCGs

In Alternative 1 no remediation is considered, only environmental monitoring is to be implemented. There currently exists exceeedances of SCGs for surface water, groundwater and surface water sediment within and immediately downgradient of the landfill. Therefore, chemical specific SCGs would not be met.

Because this alternative does not involve construction, removal and/or transportation of contaminated media or residuals produced at the site, action specific ARARs/SCGs related to these activities would not be applicable. This alternative would not comply with the action-specific ARARs/SCGs to close the landfill in accordance with 6NYCRR Part 360 or with action-specific

TABLE 5-1

DETAILED ANALYSIS OF REMEDIATION ALTERNATIVES
ETE Sanitation and Landfill Site
Wyoming County, New York

EVALUATION CRITERIA	ALTERNATIVE 1	ALTERNATIVE 2	ALTERNATIVE 3	ALTERNATIVE 4a	ALTERNATIVE 4b
Summary of Components	- No Action - Environmental monitoring	- Modified Part 360 cap - Passive Gas Vents - Environmental monitoring	- Modified Part 360 cap - Passive Vents - Drain South Pond - Enlarge North Pond - Remove North Pond Sediments, place on landfill - Environmental monitoring	- Modified Part 360 cap - Passive Vents - Drain South Pond - Enlarge North Pond - Remove North Pond Sediments, place on landfill -Upgradient Passive Perimeter Drain - Leachate/Groundwater mixture Storage - Offsite Disposal of Leachate/Groundwater mixture - Environmental monitoring	- Modified Part 360 cap - Passive Vents - Drain South Pond - Enlarge North Pond - Remove North Pond Sediments, place on landfill - Upgradient Passive Perimeter Drain with Barrier Wall -Discharge upgradient groundwater to drainage swale - Environmental monitoring

TABLE 5-1

DETAILED ANALYSIS OF REMEDIATION ALTERNATIVES
ETE Sanitation and Landfill Site
Wyoming County, New York

EVALUATION CRITERIA	ALTERNATIVE 1	ALTERNATIVE 2	ALTERNATIVE 3	ALTERNATIVE 4a	ALTERNATIVE 4b
Compliance with ARARs/SCGs	- Does not meet Chemical Specific SCGs - Does not meet action specific SCGs for landfill closure or site remediation. -Complies with relevant location specific SCGs	- Meets chemical specific SCGs for contaminated soil within and on the landfill - Does not meet chemical specific SCGs for groundwater, surface water or surface water sediments - Meets action specific SCGs for landfill closure, gas emissions and remediation of soil -Complies with location specific SCGs	- Meets chemical specific SCGs for soil and surface water sediments -Likely meeting chemical SCG's for surface water but likely exceeding selected chemical specific SCG's for groundwater. -Meets action specific SCGs for landfill closure, gas emissions and hazardous waste remediation -Complies with location specific SCGs, would require wetland restoration	- Meets chemical specific SCGs for soil and surface water sediments -Likely meeting chemical SCG's for surface water but likely exceeding selected chemical specific SCG's for groundwater. -Meets action specific SCGs for landfill closure, gas emissions and hazardous waste remediation -Complies with location specific SCGs , would require wetland restoration	- Meets chemical specific SCGs for soil and surface water sediments -Likely meeting chemical SCG's for surface water but likely exceeding selected chemical specific SCG's for groundwater. -Meets action specific SCGs for landfill closure, gas emissions and hazardous waste remediation -Complies with location specific SCGs , would require wetland restoration

TABLE 5-1

DETAILED ANALYSIS OF REMEDIATION ALTERNATIVES
ETE Sanitation and Landfill Site
Wyoming County, New York

EVALUATION CRITERIA	ALTERNATIVE 1	ALTERNATIVE 2	ALTERNATIVE 3	ALTERNATIVE 4a	ALTERNATIVE 4b
Protection of Human Health and the Environment	-Very limited reduction in risks to human health and the environment -Does not meet RAOs	-Greatly reduces the risk of exposure to contaminated soil and landfill gas -Potential exposure to contaminated groundwater, surface water and surface water sediments remains. -Partially meets RAOs	-Greatly reduces the risk of exposure to contaminated soil, landfill gas, surface water and surface water sediments -Effective in reducing the quantity of leachate discharging to, and impacting, groundwater and surface water, -Reduces potential exposure to contaminated groundwater. -Meets all stated RAOs	-Greatly reduces the risk of exposure to contaminated soil, landfill gas, surface water and surface water sediments -Effective in reducing the quantity of leachate discharging to, and impacting, groundwater and surface water, -Reduces potential exposure to contaminated groundwater. -Meets all stated RAOs	-Greatly reduces the risk of exposure to contaminated soil, landfill gas, surface water and surface water sediments -Effective in reducing the quantity of leachate discharging to, and impacting, groundwater and surface water, -Reduces potential exposure to contaminated groundwater. -Meets all stated RAOs

TABLE 5-1

DETAILED ANALYSIS OF REMEDIATION ALTERNATIVES
ETE Sanitation and Landfill Site
Wyoming County, New York

EVALUATION CRITERIA	ALTERNATIVE 1	ALTERNATIVE 2	ALTERNATIVE 3	ALTERNATIVE 4a	ALTERNATIVE 4b
Short-Term Effectiveness	-No potential risks associated with construction -This alternative would take one month to design and construct	-Potential risks are associated with airborne contaminants and contaminated water during construction of the cap, but there are no residents located within the immediate vicinity of the landfill and mitigation measures would further minimize risks. -This alternative would require approximately one year to design and one year to construct.	-Potential risks are associated with airborne contaminants and contaminated water during construction of the cap, but there are no residents located within the immediate vicinity of the landfill and mitigation measures would further minimize risks. -Would require draining North and South Ponds to downstream properties -This alternative would require approximately one year to design and year to construct.	-Potential risks are associated with airborne contaminants and contaminated water during construction of the cap, but there are no residents located within the immediate vicinity of the landfill and mitigation measures would further minimize risks. -Would require draining North and South Ponds to downstream properties -This alternative would require approximately one year to design and year to construct	-Potential risks are associated with airborne contaminants and contaminated water during construction of the cap, but there are no residents located within the immediate vicinity of the landfill and mitigation measures would further minimize risks. -Would require draining North and South Ponds to downstream properties -This alternative would require approximately one year to design and year to construct

TABLE 5-1

DETAILED ANALYSIS OF REMEDIATION ALTERNATIVES
ETE Sanitation and Landfill Site
Wyoming County, New York

EVALUATION CRITERIA	ALTERNATIVE 1	ALTERNATIVE 2	ALTERNATIVE 3	ALTERNATIVE 4a	ALTERNATIVE 4b
Long-Term Effectiveness	- High residual risk - Environmental monitoring reduces potential future risk of ingestion of landfill impacted groundwater.	-The cap is a highly reliable technology but will require periodic maintenance. - Risk from contaminated soils would remain low since life of cap will be designed for a minimum of 30 years. -Groundwater and surface water will continue to flow through waste, transporting contaminants off site. -Environmental monitoring reduces potential future risk of ingestion of landfill impacted groundwater.	-The cap is a highly reliable technology but will require periodic maintenance. -The drain used to keep the South Pond dewatered is a simple and reliable technology but would require periodic maintenance. -Risk from contaminated sediments and soils and would remain low since life of cap will be designed for a minimum 30 years. -Flow of water through the landfill will be reduced, resulting in decrease in surface water and groundwater contamination. -Environmental monitoring reduces potential future risk of ingestion of landfill impacted groundwater.	-The cap and passive drain are highly reliable technologies but will require periodic maintenance. -The drain used to keep the South Pond dewatered is a simple and reliable technology but would require periodic maintenance. -Risk from contaminated sediments and soils and would remain low since life of cap will be designed for a minimum 30 years. -Flow of water through the landfill will be reduced, resulting in decrease in surface water and groundwater contamination. -The need for capture, containment and offsite disposal of leachate/groundwater increases maintenance and reduces reliability. -Environmental monitoring reduces potential future risk of ingestion of landfill	-The cap, passive drain, and barrier wall are highly reliable technologies but will require periodic maintenance. -The drain used to keep the South Pond dewatered is a simple and reliable technology but would require periodic maintenance. -Risk from contaminated sediments and soils and would remain low since life of cap will be designed for a minimum 30 years. -Flow of water through the landfill will be reduced, resulting in decrease in surface water and groundwater contamination. -Environmental monitoring reduces potential future risk of ingestion of landfill impacted groundwater.

TABLE 5-1

DETAILED ANALYSIS OF REMEDIATION ALTERNATIVES
ETE Sanitation and Landfill Site
Wyoming County, New York

EVALUATION CRITERIA	ALTERNATIVE 1	ALTERNATIVE 2	ALTERNATIVE 3	ALTERNATIVE 4a	ALTERNATIVE 4b
Reduction of Toxicity, Mobility, and Volume	-Does not reduce the toxicity, mobility or volume of contaminants	-Does not reduce toxicity and volume of the contamination. - Contaminant mobility is reduced to some degree but groundwater and surface water will continue to flow through waste, transporting contaminants off site.	-Does not reduce toxicity and volume of the contamination. - Contaminant mobility is largely reduced through the reduction of water flowing through the landfill.	-Does not reduce toxicity and volume of the contamination. -Contaminant mobility is largely reduced through the reduction of water flowing through the landfill. -Does treat contaminants in groundwater/leachate mixture collected by passive drain.	-Does not reduce toxicity and volume of the contamination. -Contaminant mobility is largely reduced through the reduction of water flowing through the landfill.

TABLE 5-1

DETAILED ANALYSIS OF REMEDIATION ALTERNATIVES
ETE Sanitation and Landfill Site
Wyoming County, New York

EVALUATION CRITERIA	ALTERNATIVE 1	ALTERNATIVE 2	ALTERNATIVE 3	ALTERNATIVE 4a	ALTERNATIVE 4b
Implementability	-Highly implementable, contractors experienced in performing environmental monitoring are readily available. -Would Require obtaining access to property for outpost monitoring wells.	-Highly implementable, contractors experienced in cap construction and performing environmental monitoring are readily available. -Would require temporarily draining South Pond to remove wastes. -Would Require obtaining access to property for outpost monitoring wells.	-Highly implementable, contractors experienced in cap construction and performing environmental monitoring are readily available. -Draining the South Pond and enlarging the North Pond is possible through the use of simple drains and berms. -Would require control of surface water runnoff to prevent impact to adjacent properties. -The Cap and draining the South Pond are reliable technologies. -Would Require obtaining access to property for outpost monitoring wells.	-Highly implementable, contractors experienced in cap construction and performing environmental monitoring are readily available. -Passive drain can be completed using "one-pass trench" technology reducing cost and install time. -Draining the South Pond and enlarging the North Pond is possible through the use of simple drains and berms. -Would require control of surface water runnoff to prevent impact to adjacent properties. -The Cap and draining the South Pond are reliable technologies. -The use of trucks to transport leachate/groundwater increase potential for accidents. - Would Require obtaining access to property for outpost monitoring wells.	- Highly implementable, contractors experienced in cap construction, barrier wall installation and performing environmental monitoring are readily available. -Passive drain can be completed using "one-pass trench" technology reducing cost and install time. -Draining the South Pond and enlarging the North Pond is possible through the use of simple drains and berms. -Would require control of surface water runnoff to prevent impact to adjacent properties. -The Cap and draining the South Pond are reliable technologies. -Would Require obtaining access to property for outpost monitoring wells.

TABLE 5-1

DETAILED ANALYSIS OF REMEDIATION ALTERNATIVES
ETE Sanitation and Landfill Site
Wyoming County, New York

EVALUATION CRITERIA	ALTERNATIVE 1	ALTERNATIVE 2	ALTERNATIVE 3	ALTERNATIVE 4a	ALTERNATIVE 4b
Cost **(Capital)** **(Present Worth)**	 $27,983 $345,611	 $3,394,513 $4,041,029	 $3,688,679 $4,350,857	 $4,184,189 $9,772,004	 $5,076,243 $5,737,498

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ARARs/SCGs regarding the remediation of contaminants at inactive hazardous waste disposal sites, such as CERCLA.

The third category of ARARs/SCGs relates to location-specific ARARS/SCGs. These standards apply to remedial activities which might affect natural preserves with endangered species, wetlands and sensitive flood plains, or coastal zone areas. Also included are regulations governing potential air emissions resulting from the proposed remedial action in areas governed by special air regulations. Because the site is not located in a flood plain or coastal zone, and is not in a non-compliance area for air regulations, these location-specific ARARS/SCGs do not apply to the ETE Landfill site. Since there will be no active construction on the landfill, wetlands which are located within the site will not be disturbed.

5.3.1.2 Protection of Human Health and the Environment

The Remedial Action Objectives (ROA's) presented in Section 2 will not be met by Alternative 1. Under Alternative 1, access to the landfill by trespassers and wildlife will not be limited. As a result, trespassers and wildlife could potentially be exposed to contaminated surface water sediments, soil or surface water located on or around the landfill. Additionally, landfill gases will not be controlled.

Based on available private well sample results, summarized in the final RI Report, it does not appear that landfill contaminants have impacted private wells downgradient of the landfill. Furthermore, environmental monitoring will reduce the potential of landfill impacted groundwater being used by the public for potable uses in the future.

5.3.1.3 Short-Term Effectiveness

Alternative 1 does not pose short-term risks to the community. There is no heavy construction or excavation required within the landfill as part of this alternative. Also, the environmental monitoring portion of this alternative does not pose any short-term risks.

5.3.1.4 Long-Term Effectiveness and Permanence

Alternative 1 does not contain, treat or reduce the landfill contaminants and therefore it can not be considered to be effective over the long term. Contaminants will continue to be released to the environment unabated and will continue to migrate offsite via the groundwater and surface water pathways. Therefore, the potential health risks associated with the current condition of the site would not be significantly reduced over time.

The planned 30 year environmental monitoring program, detailed in section 4.5.1, reduces the potential for future human exposure through ingestion of contaminated groundwater.

Alternative 1 would require minimal maintenance of equipment. During the 30 year environmental monitoring program monitoring wells may require repair or replacement.

5.3.1.5 Reduction of Toxicity, Mobility or Volume

This alternative does not actively reduce the volume or toxicity of the contaminants found at the landfill, but only limit future potential exposure to contaminants through the ingestion/use of contaminated groundwater. The mobility of contaminants will be unaffected, and offsite migration will continue unabated.

Naturally occurring processes will serve to eventually decrease the size and concentration of the contamination; however, discharge of contaminants to surface waters and groundwater will continue to occur at current rates and contaminated sediments would remain onsite. Therefore, these actions and processes serve to reduce the concentration of the plume in the future, but the volume of contaminated groundwater and/or surface water may increase as contamination moves offsite.

5.3.1.6 Implementability

Environmental monitoring is not labor intensive or difficult to implement. Multiple vendors experienced in environmental monitoring are available to provide competitive bidding. The location of the two additional outpost well clusters to be installed as part of the environmental monitoring would have to be selected. Access to each location by a drill rig and installation of each well would have to be granted by the respective property owner.

5.3.1.7 Cost

The costs for this alternative would be limited to the environmental monitoring program and would include:

- Capital Cost — $27,983
- Operations and Maintenance Cost — $94,542 (year 1- 2); $223,086 (year 3 - 30)
- Future Capital Cost — $0
- Present Worth — $345,611

These costs are further detailed in Appendix A.

The capital cost includes the materials needed to install and develop the two groundwater monitoring well clusters, comprised of two monitoring wells each. Additionally, landfill gas monitoring wells would be installed as part of the environmental monitoring program.

The operations and maintenance costs include environmental monitoring and periodic inspection of the site for a period of 30 years. The sampling would be conducted quarterly for the first two years after closer and annually the remaining 28 years.

The total present worth costs of this alternative includes the direct and indirect capital costs and the present worth of the annual and periodic costs over the design life of the alternative at an annual rate of five percent.

5.3.2 Alternative 2 - Modified Part 360 Landfill Cap, Landfill Gas Vents and Groundwater Monitoring

The evaluation of Alternative 2 includes the modified Part 360 Landfill Cap, passive landfill gas vents and environmental monitoring. The site would require regrading and waste consolidation as discussed in Section 4.1.1. The modified Part 360 Landfill Cap design is detailed in Section 4.1.3.

Construction of the passive landfill gas vents is discussed in Section 4.4.1. Environmental monitoring would be consistent with the No Action alternative and is detailed in Section 4.5.1.

5.3.2.1 Compliance with ARARS/SCGs

Alternative 2 partially addresses the air and soil chemical-specific ARARS/SCGs with the installation of the cap, which contains the soil contamination and controls the landfill gas emissions. Alternative 2 does not eliminate the potential for future groundwater and surface water contamination. Even with the cap in place, groundwater modeling simulations indicate the majority of the waste mass will remain saturated. Given the saturated nature of the waste and the South Pond being in direct contact with landfill wastes, leachate generation will remain high. The water will continue to flow through the landfill generating landfill leachate which in turn will continue to impact downgradient groundwater and surface water. For this reason, Alternative 2 will not comply with chemical specific ARARs/SCGs for ground water or surface water. Additionally, under Alternative 2, contaminated sediments present within the North Pond will remain in place. Therefore, ARARs/SCGs will not be met for surface water sediments.

The second evaluation concerns action-specific ARARS/SCGs. These regulations include Federal and State air quality standards for air emissions, OSHA standards for construction activities, 6NYCRR Part 360 regulations for capping and landfill gas control and regulations regarding the remediation of hazardous waste related contamination.

During the construction of the landfill cap, there is a potential for air emissions to exceed relevant SCGs for short periods of time as the waste mass is regraded and consolidated, and thus, action-specific ARARS/SCGs for air may not be met. The construction health and safety plan will include air monitoring, and all engineering controls will be used to prevent significant releases of air borne contaminants. Alternative 2 will meet 6NYCRR Part 360 regulations for capping and landfill gas control. However, it will not likely meet all ARARs/SCGs regarding the remediation of hazardous waste related contamination.

The third category of ARARs/SCGs relates to location-specific ARARS/SCGs. These standards apply to remedial activities which might affect natural preserves with endangered species, wetlands and sensitive flood plains, or coastal zone areas. Also included are regulations governing potential air emissions resulting from the proposed remedial action in areas governed by special air regulations. Because the site is not located in a flood plain or coastal zone, and is not in a non-compliance area for air regulations, these location-specific ARARS/SCGs do not apply to the ETE Landfill site. Because Alternative 2 will likely result in the temporary disturbance of freshwater wetlands present within the ETE landfill site, wetland regulations will apply.

5.3.2.3 Protection of Human Health and The Environment

Alternative 2 partially protects human health and the environment and meets the Remedial Action Objectives (ROAs) of isolating and consolidating landfill wastes and controlling landfill gases. Consolidation of the waste mass and associated soils under a single cap prevents contact by the public with the landfill contents both through air and surface soils.

The cap will not significantly reduce future groundwater and surface water contamination and the generation of leachate, since the groundwater and surface water from South Pond will continue to flow through the waste mass. Additionally, contaminated sediments would remain in North Pond. The landfill cap's gas venting system and passive vents will collect gases and discharge them in a manner which will protect the public health and the environment.

Environmental monitoring will serve to identify future risks to human health and the environment, such as ingestion of leachate impacted groundwater.

5.3.2.4 Short-Term Effectiveness

Dust may be generated when regrading the site of consolidating waste during cap construction, thereby subjecting workers to airborne contaminants. Suppression measures, such as water or chemical dust suppressants will decrease the generation of dust, but these measures are not expected to completely remove the airborne contaminants. Air quality monitoring will measure the levels of airborne contaminants, and workers may be required to upgrade their personal protective equipment if action levels are exceeded. Impact to residents would not be expected given there are no homes located adjacent to the ETE Landfill site.

During consolidation of the waste material, waste that is presently below the water table may be moved and saturated waste within the South Pond that is reachable using conventional excavation equipment from the pond edge would be excavated and placed on top of the landfill. A short term exposure of contaminated water may result, and measures will have to be taken to control any runoff into adjacent surface water and properties.

It is expected that the remedial measures for this alternative could be implemented within two years. This includes approximately one year to design and one year to construct the cap.

5.3.2.5 Long-Term Effectiveness and Permanence

Isolation of the waste and contaminated soil will be addressed by the consolidation of the waste mass and the construction of a modified Part 360 cap. The cap is a highly reliable technology and will be designed to withstand erosion and settling of fill material. The cap will significantly reduce the risk of exposure to contaminated soils for at least a 30 year period. The cap and passive gas vents will prevent subsurface migration of landfill gases.

This alternative does not reduce the volume or concentration of the landfill contaminants. The cap will be highly effective in preventing leachate generation through infiltration of precipitation through the top and sidewalls of the closed landfill. However, model simulations indicate this will only reduce leachate production by approximately five percent of the volume generated with no remedial controls. The cap will not significantly reduce the flow of upgradient groundwater and surface water from South Pond through the landfill. As a result, groundwater and surface water will continue to be contaminated and contaminates will continue to migrate offsite. Additionally, contaminated surface water sediments within the North Pond will remain onsite.

Operation and maintenance requirements for Alternative 2 would include, but not limited to:

- Routine inspection of cap, landfill gas and stormwater control systems
- Erosion control including replacement of top soil and hydroseeding
- Grass cutting
- Cap and landfill gas vent repair
- Repair and possible replacement of groundwater and gas monitoring wells

Environmental monitoring over a 30 year period, detailed in Section 4.5.1, will be designed to detect offsite contaminant migration before it has the potential of impacting offsite receptors such as private drinking water supplies.

5.3.2.6 Reduction of Toxicity, Mobility or Volume

Since no treatment technologies are included in Alternative 2, waste consolidation and construction of the cap does not significantly reduce the volume or toxicity of the contaminants found at the landfill. It will only partially reduce the mobility of the contaminants to downgradient groundwater and surface water. Groundwater and surface water will continue to flow through the landfill waste, transporting contaminants offsite.

Natural processes, such as attenuation, dispersion and biodegradation will dilute the concentration of organic contaminants present within the landfill and downgradient groundwater and surface water over time. Heavy metals such as cadmium and lead will tend to remain relatively immobile within sediment, aquifer material and site soils and would not be expected to migrate offsite; however, heavy metals are generally not effected by biodegradation.

5.3.2.7 Implementability

The regrading and consolidation of the waste will entail the use of heavy equipment. The cap construction will also be a large scale project. However, the consolidation and capping require only readily available equipment, materials and workers. Agency coordination will be required, but will not be expected to be significant. Multiple vendors are available to bid on the project and materials are readily available.

Removing all wastes from the South Pond and placing the cap on the southern portion of the landfill would be impossible without temporarily without draining the pond. Additionally, removing the saturated wastes will result in the generation of runoff that my be potentially contaminated. Precautions will have to be implemented to control potential runoff of contaminated water.

Multiple vendors experienced in environmental monitoring are available to provide competitive bidding. The location of the two additional outpost well clusters to be installed as part of the environmental monitoring would have to be selected. Access to each location by a drill rig and installation of each well would have to be granted by the respective property owner.

Based on current property boundaries, a private landowner owns South Pond as well as a portion of the southern end of the landfill. Alternative 2 will require substantial disturbance of this private land during cap construction as well as permanent access to complete maintenance of the cap and associated structures.

5.3.2.8 Cost

The cost presented here include construction of the cap and passive landfill gas vents and the environmental monitoring program for a 30 year period. Operation and annual monitoring of the cap and passive vents is also for a 30 year period.

- Capital Cost — $3,394,513
- Operations and Maintenance Cost — $134,465 (year 1- 2); $512,051(year 3- 30)
- Future Capital Cost — $0
- Present Worth — $4,041,029

These costs are further detailed in Appendix A. Note that the above costs assumed a total area to be capped under this alternative to be 8.5 acres. It is likely that the final design will result in waste consolidation and the overall reduction in the area requiring capping. Therefore, costs related to cap construction under Alternative 2 are considered conservatively high.

5.3.3 Alternative 3 -Install Modified Part 360 Landfill Cap, Gas Vents , Drain South Pond, and Environmental Monitoring

Alternative 3 includes the site regrading, waste consolidation and cap, gas vents and environmental monitoring as presented in Alternative 2. Alternative 3 also includes the draining of the South Pond in order to reduce the water table within the landfill as detailed in Section 4.2.1. The actual method of draining South Pond, either using a buried drainage pipe or open drainage channels will be determined during the remedial design. The North Pond would also be temporarily drained in order to remove contaminated sediments. The contaminated North Pond sediments would be placed on the landfill prior to capping, as discussed in Section 4.1.2. Additionally, stormwater controls would be implemented, as discussed in Section 4.1.4, to reduce the potential of uncontrolled flooding and erosion. To offset the loss of habitat associated with draining the South Pond, the North Pond would be expanded as detailed in Section 4.1.2.

5.3.3.1 Compliance with ARARS/SCGs

Alternative 3 meets the chemical-specific ARARS/SCGs for onsite contaminated soil with the placement of the landfill cap. Additionally, removal of contaminated sediments from the North Pond and placement on the landfill prior to capping will meet chemical-specific ARARs/SCGs for surface water sediments.

Model simulations indicate draining the South Pond will lower the water table within the landfill, by an average of approximately six feet, reducing the amount of leachate generated to approximately one-third the amount generated with no remedial controls. This should result in reducing the current amount of groundwater contamination and significantly reduce the introduction of contaminants to surface water downgradient of the ETE landfill site. Therefore, ARARs/SCGs for surface water should be met as well as most groundwater chemical-specific ARARs/SCGs.

However, selected ARARs/SCGs for the most prevalent groundwater contaminants, such as 2-butanone, may continue to be exceeded at locations immediately downgradient of the ETE landfill site. It is expected that capping and the placement of passive gas vents will result meeting ARARs/SCGs for air emissions.

In summary, it is expected that Alternative 3 will comply with the chemical-specific ARARs/SCGs for surface water, surface water sediments, soil and air emissions, and partially comply for groundwater.

The second evaluation concerns action-specific ARARS/SCGs. These regulations include Federal and State air quality standards for air emissions, OSHA standards for construction activities, 6NYCRR Part 360 regulations for capping and landfill gas controls and regulations regarding the remediation of hazardous waste related contamination.

During the construction of the landfill cap, there is a potential for air emissions to exceed relevant SCGs for short periods of time as the waste mass is regraded and consolidated, and thus, action-specific ARARS/SCGs for air may not be met. The construction health and safety plan will include air monitoring, and all engineering controls will be used to prevent significant releases of air borne contaminants. Alternative 3 will meet 6NYCRR Part 360 regulations for capping and should meet regulations regarding the remediation of hazardous waste related contamination.

The third category of ARARs/SCGs relates to location-specific ARARS/SCGs. These standards apply to remedial activities which might affect natural preserves with endangered species, wetlands and sensitive flood plains, or coastal zone areas. Also included are regulations governing potential air emissions resulting from the proposed remedial action in areas governed by special air regulations. Because the site is not located in a flood plain or coastal zone, and is not in a non-compliance area for air regulations, these location-specific ARARS/SCGs do not apply. Because Alternative 3 includes draining both the South and North Ponds, substantial disturbance of approximately one acre of freshwater wetlands present within the ETE landfill site will occur. However, as part of the regrading plan, the North Pond will be relocated onsite and will be enlarged to compensate the loss of habitat from the permanent draining of the South Pond. The goal will be to meet all location-specific wetland regulations through the reestablishment of any destroyed wetlands during the reconstruction of the North Pond.

5.3.3.2 Protection of Human Health and the Environment

Alternative 3 significantly reduces the potential exposure of contaminants to humans and the surrounding environment and meets all Remedial Action Objectives stated in Section 2.1. As previously discussed, draining of the South Pond will reduce the total volume of generated leachate discharged to groundwater by approximately one-third the amount currently generated with no remedial measures in place. This will proportionally reduce the mass of contaminants entering and contaminating the shallow glacial aquifer. This will in turn reduce the potential for future impact to downgradient private wells screened within the shallow glacial aquifer. Additionally, discharge of contaminants to downgradient surface water bodies will also be reduced over time.

The potential for exposure of humans and the surrounding environment to contaminated wastes, soils, contaminated surface water sediments will be eliminated with the consolidation of waste and the installation of the cap.

The landfill cap's gas venting system and passive vents will collect gases and discharge them in a manner which will protect the public health and the environment.

Environmental monitoring will serve to identify future risks to human health and the environment, such as ingestion of leachate impacted groundwater.

5.3.3.3 Short-Term Effectiveness

As indicated for Alternative 2, during waste consolidation and construction of the landfill cap, dust may be generated and may migrate around the site causing potential risks to the workers via the inhalation pathway. Suppression measures will be used to decrease the generation of dust, and air quality monitoring will be used to determine if additional personal protective equipment is necessary.

This alternative would require the draining of the North and South Ponds with drained water running off to downstream properties. Measures will have to be undertaken to control excessive runoff into adjacent surface water and properties and avoid erosion of downstream properties.

During consolidation of the waste material, waste that is presently below the water table may be moved and saturated waste within the South Pond would be excavated. Additionally, contaminated saturated sediments would be excavated from the North Pond. A short term exposure of contaminated water may result, and measures will have to be undertaken to control any runoff into adjacent surface water and properties.

It is expected that the remedial measures for this alternative could be implemented within two years. This includes approximately one year to design and one year to complete all construction.

5.3.3.4 Long-Term Effectiveness and Permanence

This alternative does not reduce the mass of contaminants present within the landfill but it will significantly reduce the mass of contaminants migrating offsite via the groundwater pathway. This in turn will reduce the potential of landfill contaminants impacting downgradient drinking water supplies and reduce the mass of landfill contaminants discharging to surface water bodies downgradient of the ETE landfill site.

Based on groundwater model simulations, permanently draining South Pond in conjunction with the landfill cap will lower the water table within the landfill an average of approximately six feet and reduce leachate production to approximately 34 percent of the volume currently produced by the landfill with no remedial controls.

Isolation of the waste and contaminated soil and surface water sediments will be addressed by the consolidation of the waste mass and the construction of a modified Part 360 cap. The cap and passive gas vents will prevent subsurface migration of landfill gases. Stormwater controls will be designed to prevent excessive erosion of the landfill cap or surrounding soils.

The cap is a highly reliable technology and will be designed to withstand erosion and settling of fill material. The cap will significantly reduce the risk of exposure to contaminated soils for at least a 30 year period.

Operation and maintenance requirements for Alternative 3 would include, but not limited to:

- Routine inspection of cap, landfill gas and stormwater control systems
- Erosion control, including replacement of top soil and hydroseeding
- Grass cutting
- Cap and landfill gas vent repair
- Repair and possible replacement of groundwater and gas monitoring wells

The South Pond will be permanently drained through the use of a drainage pipe or open drainage channels. This pipe as well as the stormwater drainage channels will require minimal maintenance and cleaning to assure proper function. The water level of the relocated and expanded North Pond will be maintained by a permanent sluice way, requiring little or no maintenance. It is anticipated that, upon completion of Alternative 3, water discharging from North Pond would meet all appropriate standards.

Environmental monitoring over a 30 year period, detailed in Section 4.5.1, will be designed to detect offsite contaminant migration before it has the potential of impacting offsite receptors such as private drinking water supplies.

5.3.3.5 Reduction of Toxicity, Mobility or Volume

Alternative 3 is strictly a containment technology and will not reduce the volume or toxicity of contaminants within the ETE landfill. However, Alternative 3 does significantly reduce the mobility of the landfill contaminants through the reduction of landfill leachate.

Natural processes, such as attenuation, dispersion and biodegradation will dilute the concentration of organic contaminants present within the landfill and downgradient groundwater and surface water over time. Heavy metals such as cadmium and lead will tend to remain relatively immobile within sediment, aquifer material and site soils and would not be expected to migrate offsite; however, heavy metals are generally not effected by biodegradation. Based on current boundaries, a private landowner owns the South Pond and a portion of the southern end of the landfill. Substantial disturbance of this private property will occur under Alternative 3 including the loss of South Pond. Additionally, long-term access, including placing an access road through the property, will be required in order to maintain the landfill.

5.3.3.6 Implementability

As with Alternative 2, the regrading and consolidation of the waste will entail the use of heavy equipment. The cap construction and permanently draining the South Pond will also be a large scale project and will require only readily available equipment, materials and workers. Agency coordination will be required, but will not be expected to be significant. Multiple vendors are available to bid on the project and materials are readily available.

Draining of the North and South Pond would be easily done through digging of temporary drainage ditches. Draining of the South Pond will enable heavy equipment to remove all wastes from the pond and consolidate it within the landfill prior to capping. Though the South and North Ponds would be drained prior to regrading and cap construction, continued surface water flow would have to be routed to temporary drainage ditches. Precautions would have to be undertaken to minimize the potential for site contaminants migrating offsite via site runoff during construction activities.

Multiple vendors experienced in environmental monitoring are available to provide competitive bidding. The location of the two additional outpost well clusters to be installed as part of the environmental monitoring would have to be selected. Access to each location by a drill rig and installation of each well would have to be granted by the respective property owner.

Based on current property boundaries, a private landowner owns the South Pond and a portion of the southern end of the landfill. Substantial disturbance of this private property would occur under Alternative 3, including the loss of South Pond. Additionally, placing an access road through the property will be required to maintain the landfill.

5.3.3.7 Cost

This alternative includes the costs previously discussed in Alternative 2. Also included are the capital/O&M costs related to the permanent draining of South Pond and stormwater controls.

- Capital Cost — $ 3,688,679
- Operations and Maintenance Cost — $ 136,184 (year 1-2); $525,994 (year 2-30)
- Future Capital Cost — $ 0
- Present Worth — $ 4,350,857

These cost are explained further in Appendix A. Note that the above costs assumed a total area to be capped under this alternative to be 9 acres. It is likely that the final design will result in waste consolidation and the overall reduction in the area requiring capping. Therefore, costs related to cap construction under Alternative 3 are considered conservatively high.

5.3.4 Alternative 4 - Install Modified Part 360 Landfill Cap, Gas Vents , Drain South Pond, Install Passive Perimeter Drain, Collection and Disposal (Alternative 4a) or Onsite Discharge (Alternative 4b) of Groundwater, and Environmental Monitoring

Alternative 4 includes the already discussed site regrading, waste consolidation and cap, gas vents and environmental monitoring presented in Alternatives 2 and 3. Alternative 4 also includes the draining of the South Pond, enlarging the North Pond, and the Storm water controls presented in Alternative 3. In addition, Alternative 4 includes the installation of a passive perimeter drain around the southern perimeter of the landfill as detailed in Section 4.2.2.

Alternative 4 is sub-divided as Alternative 4a and 4b to evaluate two options associated groundwater collection and discharge, respectively. Alternative 4a considers: 1) installation of a passive drain, 2) collection of groundwater in an above-ground storage tank, 3) offsite transport of groundwater using a tanker truck, and 4) disposal of groundwater at a public water treatment plant, as discussed in Section 4.3.3. Treatment for this sub-alternative is considered based upon the assumption that the drain will capture clean groundwater inflow, as well as some leachate backflow from the landfill. Alternative 4b considers: 1) installation of a passive drain and downgradient sheet pile barrier wall, and 2) onsite discharge of groundwater to drainage swales. Treatment is not considered, because the barrier wall would prevent backflow of leachate into the drain.

For the evaluations presented below, Alternatives 4a and 4b are considered to be equivalent unless otherwise specified.

5.3.4.1 Compliance with ARARS/SCGs

Alternative 4 meets the chemical-specific ARARS/SCGs for onsite contaminated soil with the placement of the landfill cap. Additionally, removal of contaminated sediments from the North Pond and placement on the landfill prior to capping will meet chemical-specific ARARs/SCGs for surface water sediments.

Model simulations indicate Alternative 4a and 4b reduces the amount of leachate released to groundwater to approximately 20 to 16 percent the amount currently released with no remedial controls. This, in turn, would result in reducing the current amount of groundwater contamination and significantly reduce the introduction of contaminants to surface water downgradient of the ETE landfill site. Therefore, ARARs/SCGs for surface water should be met as well as most groundwater chemical-specific ARARs/SCGs. However, selected ARARs/SCGs for the most prevalent ground-water contaminants, such as 2-butanone, may continue to be exceeded at locations immediately downgradient of the ETE landfill site. It is expected that capping and the placement of passive gas vents will result meeting ARARs/SCGs for air emissions.

In summary, it is expected that Alternative 4 will comply with the chemical-specific ARARs/SCGs for surface water, surface water sediments, soil and air emissions, and partially comply for groundwater.

The second evaluation concerns action-specific ARARS/SCGs. These regulations include Federal and State air quality standards for air emissions, OSHA standards for construction activities, 6NYCRR Part 360 regulations for capping and landfill gas controls and regulations regarding the remediation of hazardous waste related contamination.

During the construction of the landfill cap, there is a potential for air emissions to exceed relevant SCGs for short periods of time as the waste mass is regraded and consolidated, and thus, action-specific ARARS/SCGs for air may not be met. The construction health and safety plan will include air monitoring, and all engineering controls will be used to prevent significant releases of air borne contaminants. Alternative 4 will meet 6NYCRR Part 360 regulations for capping and should meet regulations regarding the remediation of hazardous waste related contamination.

The third category of ARARs/SCGs relates to location-specific ARARS/SCGs. These standards apply to remedial activities which might affect natural preserves with endangered species, wetlands and sensitive flood plains, or coastal zone areas. Also included are regulations governing potential air emissions resulting from the proposed remedial action in areas governed by special air regulations.

Because the site is not located in a flood plain or coastal zone, and is not in a non-compliance area for air regulations, these location-specific ARARS/SCGs do not apply. As with Alternative 3, Alternative 4 includes draining both the South and North Ponds, substantial disturbance of freshwater wetlands present within the ETE landfill site will occur. However, as part of the regrading plan, the North Pond will be reestablished onsite and will be enlarged to compensate the loss of habitat from the permanent draining of the South Pond. The goal will be to meet all location-specific wetland regulations during the reconstruction of the North Pond.

5.3.4.2 Protection of Human Health and the Environment

Alternative 4 significantly reduces the potential exposure of contaminants to humans and the surrounding environment and meets all Remedial Action Objectives stated in Section 2.1. Groundwater model simulations indicate Alternative 4a would lower the water table within the landfill an average of approximately 6.6 feet and reduce leachate production to approximately 20 percent the volume currently produced by the landfill with no remedial controls. Alternative 4b appears to be marginally more effective with an average drop in water table elevations of approximately 6.9 feet and leachate production would be reduced to approximately 16 percent current levels. The reduction in leachate will proportionally reduce the mass of contaminants entering and contaminating the shallow glacial aquifer. This will in turn reduce the potential for future impact to downgradient private wells screened within the shallow glacial aquifer. Additionally, discharge of contaminants to downgradient surface water bodies will also be reduced over time.

For Alternative 4b, onsite discharge of groundwater from the passive drain would be protective of the environment. Because the barrier wall would prevent backflow of leachate into the drain, it is assumed that the upgradient groundwater quality would comply with surface water discharge standards.

The potential for exposure of humans and the surrounding environment to contaminated wastes, soils, contaminated surface water sediments will be eliminated with the consolidation of waste and the installation of the cap.

The landfill cap's gas venting system and passive vents will collect gases and discharge them in a manner which will protect the public health and the environment.

Environmental monitoring will serve to identify future risks to human health and the environment, such as ingestion of leachate impacted groundwater.

5.3.4.3 Short-Term Effectiveness

During waste consolidation and construction of the landfill cap, dust may be generated and may migrate around the site causing potential risks to the workers via the inhalation pathway. Suppression measures will be used to decrease the generation of dust, and air quality monitoring will be used to determine if additional personal protective equipment is necessary.

This alternative would require the draining of the North and South Ponds with drained water running off to downstream properties. Measures will have to be undertaken to control excessive runoff into adjacent surface water and properties and avoid erosion of downstream properties.

During consolidation of the waste material, waste that is presently below the water table may be moved and saturated waste within the South Pond would be excavated. Saturated sediments would also be removed from the North Pond. Additionally, construction of the passive perimeter drain will require excavating below the water table in saturated soils that maybe contaminated. A short term exposure of contaminated water may result, and measures will have to be undertaken to control any runoff into adjacent surface water and properties.

It is expected that the remedial measures for this alternative could be implemented within two years. This includes approximately one year to design and one year to construct the cap.

5.3.4.4 Long-Term Effectiveness and Permanence

This alternative does not reduce the mass of contaminants present within the landfill. However, after placement of the landfill cap and draining of the South Pond has been completed, a portion of leachate generated by the landfill will be captured under Alternative 4a by the passive perimeter drain and temporarily contained onsite prior to transport to a nearby waste water treatment plant for treatment and disposal.

The overall reduction in leachate discharging to the groundwater will be reduced to approximately 16 to 20 percent the current volume, significantly reducing the mass of contaminants migrating offsite via the groundwater pathway. This in turn will reduce the potential of landfill contaminants impacting downgradient drinking water supplies and reduce the mass of landfill contaminants discharging to surface water bodies downgradient of the ETE landfill site.

Isolation of the waste and contaminated soil and surface water sediments will be addressed by the consolidation of the waste mass and the construction of a modified Part 360 cap. The cap and passive gas vents will prevent subsurface migration of landfill gases. Stormwater controls will be designed to prevent excessive erosion of the landfill cap or surrounding soils.

The cap is a highly reliable technology and will be designed to withstand erosion and settling of fill material. Some maintenance of the cap will likely be required and the cap should be examined on a periodic basis for integrity. However these tasks will not be labor intensive. The cap will significantly reduce the risk of exposure to contaminated soils for at least a 30 year period.

Operation and maintenance requirements for Alternative 4 would including, but not limited to:

- Routine inspection of cap, landfill gas and stormwater control systems
- Erosion control including replacement of topsoil and hydroseeding
- Grass cutting
- Cap and landfill gas vent repair

- Repair and possible replacement of groundwater and gas monitoring wells

The passive perimeter drain and associated piping will require minimal maintenance over the 30 year operational life of the system. Pumps used to pump the leachate groundwater mixture from the passive perimeter drain would require periodic inspection and maintenance, and would likely require replacement over the 30 year period. For Alternative 4a, the 105,000-gallon onsite storage tank would require periodic maintenance, such as cleaning and painting, over the operational period. Use of the system is also dependent upon the offsite transport and disposal of collected groundwater on a daily basis. For Alternative 4b, there would be no need for a storage tank and groundwater would be pumped from collection sumps to nearby drainage swales for onsite discharge; it would not require daily attention to operate.

The South Pond will be permanently drained through the use of a drainage pipe or open drainage. The system selected to drain the pond, as well as the stormwater drainage swales, will require minimal maintenance and cleaning to assure proper function. The water level of the relocated and expanded North Pond will be maintained by a permanent sluice way, requiring little or no maintenance.

Environmental monitoring over a 30 year period, detailed in Section 4.5.1, will be designed to detect offsite contaminant migration before it has the potential of impacting offsite receptors such as private drinking water supplies.

5.3.4.5 Reduction of Toxicity, Mobility or Volume

Alternative 4 is strictly a containment technology and will not reduce the volume or toxicity of contaminants within the ETE landfill. However, Alternative 4a does treat landfill contaminants by offsite transport and disposal of the leachate groundwater mixture collected by the passive perimeter drain. Alternative 4 will significantly reduce the mobility of the landfill contaminants through the reduction of landfill leachate.

Natural processes, such as attenuation, dispersion and biodegradation will dilute the concentration of organic contaminants present within the landfill and downgradient groundwater and surface water over time. Heavy metals such as cadmium and lead will tend to remain relatively immobile within sediment, aquifer material and site soils and would not be expected to migrate offsite; however, heavy metals are generally not effected by biodegradation.

5.3.4.6 Implementability

The regrading and consolidation of the waste will entail the use of heavy equipment. The cap construction and permanently draining the South Pond will also be a large scale project and will require only readily available equipment, materials and workers. Agency coordination will be required, but will not be expected to be significant. Multiple vendors are available to bid on the project and materials are readily available.

Draining of the North and South Pond would be done through digging of temporary drainage ditches. Draining of the South Pond will enable heavy equipment to remove all wastes from the pond and consolidate it within the landfill prior to capping. Though the South and North Ponds would be drained prior to regrading and cap construction, continued surface water flow would have to be routed to temporary drainage ditches. Precautions would have to be undertaken to minimize the potential for site contaminants migrating offsite via site runoff during construction activities.

Construction of the passive perimeter drain can be completed using common excavation equipment. However, CDM evaluated the use of "one-pass' trenching equipment given the minimized installation time and costs. Additionally, this technology eliminates the need for dewatering. The installation of collection sumps, sump pumps, piping and onsite storage tanks would only require readily available equipment, material and workers. For Alternative 4a, offsite treatment of the groundwater\leachate mixture would require the use of tanker trucks to transport the water to a nearby wastewater treatment plant. Groundwater would be discharged onsite to nearby drainage swales for Alternative 4b.

For Alternative 4b, the barrier wall would be constructed by driving steel sheet piles into the ground using conventional construction equipment.

Based on the estimated amount of groundwater\leachate mixture to be captured by the passive perimeter drain, obtained from the groundwater model simulations, approximately 16, 5,100-gallon, tanker trucks would be required per week (Alternative 4a). It should be noted that these estimates are based on an uncalibrated groundwater model using estimated hydraulic properties of the aquifer and landfill waste; as a result, the actual volume of leachate captured by the drain may in fact be considerably greater than the given estimate, requiring a greater number of tanker trucks per week. The use of tanker trucks for transport creates the potential for accidents and possible leachate spills on public roads. Additionally, weather conditions such as snow and ice, common to this region of New York, would likely temporarily interrupt shipments.

Multiple vendors experienced in environmental monitoring are available to provide competitive bidding. The location of the two additional outpost well clusters to be installed as part of the environmental monitoring would have to be selected. Access to each location by a drill rig and installation of each well would have to be granted by the respective property owner.

As with Alternative 3, Alternative 4 will require permanent modification to private property which includes a portion of the southern end of the landfill as well as South Pond.

5.3.4.7 Cost

This alternative includes the costs previously discussed in Alternative 3. Also included are the capital/O&M costs for the passive perimeter drain, collections sumps, distribution piping, barrier wall (Alternative 4b), storage tank (Alternative 4a), and groundwater transportation and disposal costs (Alternative 4a).

<u>Alternative 4a</u>

■ Capital Cost	$ 4,184,189
■ Operations and Maintenance Cost	$ 676,792 (year 1-2); $4,911,023 (year 3-30); $
■ Future Capital Cost	$ 0
■ Present Worth	$ 9,772,004

Alternative 4b

- Capital Cost $ 5,076,243
- Operations and Maintenance Cost $ 82,975 (year 1-2); $578,280 (year 3-30); $
- Future Capital Cost $ 0
- Present Worth $ 5,737,498

These cost are explained further in Appendix A. Note that the above costs assumed a total area to be capped under this alternative to be 9 acres. It is likely that the final design will result in waste consolidation and the overall reduction in the area requiring capping. Therefore, costs related to cap construction under Alternative 4 are considered conservatively high.

Section 6
Comparative Analysis

The previous section described each of the four alternatives and evaluated them individually against the seven criteria specified in the NYSDEC Technical and Administrative Guidance Memorandum (TAGM). This section compares the four alternatives to each other according to the seven TAGM criteria. This comparison will identify the strengths and weaknesses of each alternative relative to each other.

6.1 Compliance with ARARS/SCGs

The No Action alternative does not address the chemical specific standards because this alternative does not reduce or remediate the constituents of concern in any media. Alternative 2 addresses the chemical specific SCGs for contaminated soil and landfill gas emissions with the placement of the modified part 360 landfill cap but does not address SCGs for surface water, sediments or groundwater. Alternative 3 will satisfy SCGs for soil, sediments, landfill gas emissions and likely meet SCGs for surface water. Though Alternative 3 significantly reduces the quantity of leachate discharging to groundwater, selected chemical specific SCGs for the most prevalent groundwater contaminants may continue to be exceeded at locations immediately downgradient of the landfill. Alternative 4 essentially meets the same SCGs as Alternative 3 but would further reduce the amount of leachate released to groundwater.

The action specific standards include OSHA health and safety protocols, CERCLA/SARA regulations for hazardous wastes, and NYSDEC 6NYCRR Part 360 regulations regarding landfill closure and landfill gas control. These standards will be addressed during the design of each remedial action when site specific conditions must be considered. It is believed that all of the alternatives can meet applicable health and safety SCGs. Alternative 1 would not meet SCGs for hazardous waste remediation or for landfill closure. Alternative 2 would likely meet most landfill closure requirements but not hazardous waste remediation requirements. Both Alternative 3 and 4 will meet landfill closure requirements and would likely meet all requirements for hazardous waste remediation.

The location specific standards apply to surface water bodies, wetlands, coastal zones, endangered species and floodplains. Most of these standards are not applicable to the site since no endangered species habitats or floodplains have been located near the landfill, and the site is not near the coast. The site does contain areas that are classified as freshwater wetlands. Therefore, wetland regulations would apply to the site. Under Alternatives 3 and 4, onsite wetlands will be disturbed during site regrading and draining of the North and South Ponds. In order to meet wetland regulations, wetland restoration would have to be a component of Alternatives 2 through 4.

6.2 Protection of Human Health and the Environment

The No Further Action alternative is ineffective in reducing the exposure to contaminants in all affected media. It would not meet the Remedial Action Objectives stated in Section 2.0.

Alternative 2 results in minimal exposure to contaminants via direct contact with contaminated soils and will control landfill gas emissions, partially meeting stated Remedial Action Objectives. However, Alternative 2 does not significantly reduce the generation of leachate. As a result, groundwater and to a lesser degree surface water would continue to be impacted. Additionally, contaminated sediments would remain in the North Pond.

Alternatives 3 is equally effective as Alternative 2 at controlling potential exposure to soil and controlling landfill gas. It significantly reduces the amount of leachate generated by the landfill, substantially reducing the impact to groundwater and surface water. Additionally, contaminated sediments would be removed from the North Pond and placed with the landfill prior to capping. Alternative 3 meets all stated Remedial Action Objectives.

Alternative 4 effectively controls the potential exposure to contaminated soil, landfill gas, surface water sediments. As with Alternative 3, Alternative 4 substantially reduces the amount of leachate generation, but to a greater degree. Therefore, Alternative 4 should be more effective in reducing impact to groundwater and surface water. Alternative 4 meets all stated Remedial Action Objectives.

6.3 Short Term Effectiveness

The No Action alternative presents no short term risks to the community and the environment given there is no onsite construction associated with this alternative. The other three alternatives present potential short term risks to the community during the construction activity associated with moving the waste from the South Pond and general regrading activities. However there are no residential homes located adjacent to the ETE Landfill site.

The generation of contaminated water may result from draining saturated wastes excavated from below the water table and the South Pond. A short term exposure to workers by contaminated water may result and measures would have to be undertaken to control any runoff into adjacent properties. Alternatives 3 and 4 would require draining the North and South Ponds with drained water running into downstream surface water and properties. Measures would have to be undertaken to control this runoff and avoid erosion of downstream properties.

6.4 Long Term Effectiveness and Permanence

Alternative 1 does not provide any long term containment or treatment of site contaminants and would result in a high residual risk. Alternative 2 consisting of the modified Part 360 cap would provide a reliable long term remedy for contaminated soil and landfill gas but leachate production would only be marginally reduced and groundwater contamination would continue virtually unabated.

Both Alternative 3 and 4 are effective and reliable remedies that would address contaminated soil, surface water, sediment, groundwater and landfill gas. However, based on completed model simulations, Alternative 4 is considered more effective than Alternative 3 in reducing the amount of leachate released to groundwater, thereby further reducing groundwater and possible surface water contamination. A drawback of Alternative 4a will be the requirement of collecting , storing and offsite transport of leachate which increases the amount of required long term maintenance and reduces the reliability of the remedy. It is assumed Alternate 4b would not require offsite transport and disposal of groundwater, because the barrier wall would prevent leachate from entering the passive drain and water collected by the drain would meet surface water discharge standards.

As part of all four alternatives, environmental monitoring would be conducted over a 30 year period reducing the potential future risk of ingestion of leachate impacted groundwater by residents located downgradient of the landfill.

6.5 Reduction of Toxicity, Mobility or Volume

The No Action alternative does not reduce the toxicity, mobility or volume of any contaminated media. By consolidating the waste and capping the landfill, Alternative 2 will not reduce the toxicity or volume of contamination and will only marginally reduce the mobility of contamination because leachate generation will be virtually unabated.

Alternatives 3 and 4 will not reduce the toxicity or volume of contaminants within the landfill, but they will substantially reduce the generation of leachate in the future, which in turn will significantly reduce the mobility of contaminants to groundwater and surface water.

Naturally occurring processes such attenuation, dispersion and biodegradation will serve to eventually decrease the size and concentration of the contamination within the landfill under all four alternatives. However, under Alternatives 1 and 2, discharge of contaminants to surface waters and groundwater will continue to occur at current rates.

6.6 Implementability

Consolidating the waste, regrading the landfill, constructing the landfill cap, and permanently draining the South Pond are all technically feasible remedial actions for the landfill. Additionally, construction of the passive perimeter drain and barrier wall under Alternative 4 are also considered technically feasible.

Though the use of tanker trucks to transport leachate for off site treatment under Alternative 4a is feasible, it would require approximately eleven tanker trucks per week based on the uncalibrated groundwater model. The use of tanker trucks for transport of leachate creates the potential for accidents and possible spills on public roads. Additionally, weather conditions such as snow and ice would likely temporarily interrupt shipments. It is assumed installation of a barrier wall downgradient of the passive drain (Alternative 4b) would support onsite discharge of groundwater, since backflow of leachate into the drain would not occur.

6.7 Cost

The total present worth cost of each alternative includes the direct and indirect capital costs and the present worth of the annual and periodic costs over the design life of the alternative at an annual rate of five percent. A cost sensitivity analysis may evaluate any uncertainties concerning specific assumptions made for individual costs, if necessary. At this stage of the Feasibility Study, costs are expected to be within -30 to +50 percent. The present worth of the four alternatives are summarized below:

Alternative 1	$ 345,611
Alternative 2	$4,041,029
Alternative 3	$4,350,857
Alternative 4a	$9,772,004
Alternative 4b	$5,737,498

The cost difference between subalternatives 4a and 4b represents the cost benefit of installing a barrier wall downgradient of the perimeter drain versus collecting the leachate groundwater mixture and disposing it off site.

Section 7
Recommendation of Alternative

In Section 5 each of the four alternatives were described and evaluated individually against the seven criteria specified in the NYSDEC Technical and Administrative Guidance Memorandum (TAGM). In section 6, the four alternatives were compared with each other using the seven TAGM criteria. This final section uses the information and conclusions from the previous sections in order to recommend the most appropriate alternative for remedial action at the ETE Sanitation and Landfill site.

7.1 Alternative 1

The no action alternative, is included to provide a baseline for comparison to other remedial actions. The no action alternative would not include active remediation of the site but would include future environmental monitoring. Given the presence of site contamination exceeding ARARs/SCGs and the likelihood that contaminants would continue to migrate offsite, environmental monitoring alone would fail to address the Remedial Action Objectives (RAOs) stated in Section 2.0. Though environmental monitoring would reduce the potential of landfill impacted groundwater being used by the public for potable uses, it would fail to be adequately protective of human health and the environment. Further, there is no active removal or containment of contaminants in this alternative. Alternative 1 is the least costly of the four alternatives, with a present worth estimated at $345,611.

Alternative 1 is the least desirable of the three alternatives considered because of its inability to meet the majority of RAOs.

7.2 Alternative 2

Alternative 2 includes environmental monitoring, the consolidation of waste and construction of a modified 6NYCRR Part 360 landfill cap. This alternative will reduce human and environmental exposure to site contaminants but does not meet all stated RAOs.

Waste consolidation and the construction of the landfill cap will significantly reduce infiltration through the landfill mass, but leachate production is not significantly reduced given the presence of the South Pond. The cap will also control landfill gas emissions from the landfill.

Since no treatment technologies are included, Alternative 2 does not reduce the volume or toxicity of the contaminants found at the landfill and does not significantly reduce the mobility of contaminants. As a result, groundwater and surface water contamination will continue to occur through leachate discharge. Additionally, contaminated sediments within the North Pond would remain inplace.

The total present worth cost of this alternative is estimated to be approximately $4,041,029.

Alternative 2 represents a significant reduction in risk when compared to the No Action Alternative; however, it does not significantly reduce the mobility of the contaminants within the landfill. The majority of the cost for this alternative is attributed to the installation of the landfill cap, and its cost is similar to the cost of Alternative 3. This alternative, although preferred over Alternative 1, is not recommended because Alternative 3 offers benefits of significantly reduced contaminant mobility, reducing the long term impact to groundwater and surface water, for relatively little additional cost.

7.3 Alternative 3

Alternative 3 includes waste consolidation, the installation of the modified 6NYCRR Part 360 landfill cap, passive landfill gas vents, draining the South Pond, removal of contaminated sediments from the North Pond and environmental monitoring.

Alternative 3 combines several identified feasible technologies to bring an enhanced level of exposure prevention and a significant reduction in contaminant mobility. Alternative 3 meets all RAOs. This alternative provides for minimization of human and environmental exposure through waste consolidation and permanent capping of the landfill, control of landfill gas emissions, and reduction of leachate generation which in turn will reduce long term groundwater and surface water contamination.

This alternative will require the permanent draining of South Pond and will likely result in disrupting wetlands located around North Pond. However, site regrading will include enlarging North Pond by approximately one acre to compensate for the loss of aquatic habitat and any wetlands destroyed will be reestablished in and around the enlarged North Pond.

The total present worth cost to implement and maintain this alternative is estimated at approximately $4,350,857, approximately eight percent more than the present worth cost to complete Alternative 2.

Alternative 3 is recommended for implementation at the ETE Sanitation and Landfill site given it meets all RAOs, is a reliable remedy with minimal long term maintenance requirements, and is significantly more cost effective than Alternative 4a or 4b.

7.4 Alternative 4

Alternative 4 includes all aspects of Alternative 3 in addition to the installation of a passive perimeter drain for the collection of a leachate/groundwater mixture, designated as Alternative 4a. A variation of Alternative 4 was added which includes the addition of a sheet pile barrier wall installed between the landfill and the passive perimeter drain, referred to as Alternative 4b. A significant advantage of Alternative 4b over 4a is that the barrier wall will prevent leachate from entering the passive perimeter drain. With the addition of the barrier wall, it is assumed upgradient, uncontaminated, groundwater would be collected which could be discharged to onsite drainage swales with no treatment. This would result in a cost benefit of approximately $3.97 million over the 30 year operational period.

Alternative 4 is more effective in reducing leachate generation than Alternative 3. Alternative 4b is marginally more effective in reducing leachate generation than Alternative 4a.

As with Alternative 3, both variations of Alternative 4 meet all stated RAOs. However, Alternative 4 provides even greater reduction of leachate discharge to groundwater, by approximately 10 percent, thereby providing increased protection to groundwater and surface water. However, Alternative 4b costs approximately $1.44 million more than Alternative 3 to implement and maintain over the 30 year operational period.

7.5 Construction Sequence

The following is a conceptual construction sequence for Alternative 3, which was developed based upon the level analysis conducted for this Feasibility Study. A detailed construction sequence would be further developed as part of the landfill closure design.

The conceptual construction sequence would be as follows:

- Drain the North Pond by lowering its discharge elevation below the base depth of the pond.

- Construct a drainage channel through the North Pond area to facilitate channel flow of surface water and groundwater inflow to the pond outlet. The bottom depth of the channel should be deeper than the bottom depth of the pond expansion. After letting North Pond drain, excavate contaminated sediment and place on top of the landfill.

- Drain South Pond by constructing a temporary drainage swale to the North Pond along the west side of the landfill. Then install the stormwater drainage pipe or open channels to achieve complete and permanent drainage of the pond. As an alternative, construct a new culvert underneath the existing landfill access road to facilitate drainage along the east side of the landfill. Enhance the hydraulics of the existing drainage swale at this location, where required.

- Perform North Pond expansion using conventional excavation equipment. Slope the bottom of excavation toward the drainage channel.

- After letting sufficient time for the wastes to dewater, consolidate wastes from the South Pond area on top of the landfill, where feasible. Perform rough grading concurrently, such that excavation materials from the North Pond are hauled and placed on top of the landfill, covering any exposed waste removed from the South Pond and consolidated on top of the landfill.

- Complete rough grading using excavation materials from the North Pond. If necessary, obtain additional rough grading materials, from perimeter drainage swale construction and enhancements. Then, reconstruct the outfall to the pond to restore the water level of North Pond.

- Complete cap construction.

- Complete site restoration work including wetlands restoration and install environmental monitoring structures.

Section 8
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Appendix A

Capital and O&M Technology Costs

Table 1
Preliminary Leachate Treatment Cost Evaluation
ETE Sanitation and Landfill
Feasibility Study

ON-SITE TREATMENT				
ITEM	UNIT COST	UNITS	QUANTITY	COST
CAPITAL COSTS				
Equipment/Construction				
Treatment System		LS		$500,000
Installation		LS		$50,000
Building (50'x40')	$50.00	SF	2000	$100,000
Distribution Piping, Valves and Appurtances	$40.00	LF	100	$4,000
Subtotal				$654,000
Engineering Costs and Contractor OH&P @ 30%				$196,200
Subtotal (Capital and Engineering)				$850,200
Contingencies @ 10%				$85,020
Permitting				$20,000
Total Capital Cost				**$955,220**
ANNUAL OPERATING COSTS				
Chemicals				$3,500
Electricity				$8,600
Labor				$33,750
Monitoring				$6,000
Maintenance and Repair				$50,000
Administrative and General				$10,000
Sludge and Brine Disposal				$176,602
Total Annual Operating Cost				**$288,452**

OFF-SITE TREATMENT				
ITEM	UNIT COST	UNITS	QUANTITY	COST
ANNUAL OPERATING COSTS				
Transportation	$360.00	tanker	825	$297,000
Disposal at Niagara Falls POTW	$0.0034	gallon	4204800	$14,296
Sampling	$150.00	each	2	$300
Total Annual Operating Cost				**$311,596**

PRESENT WORTH COST SUMMARY		
ITEM	ON-SITE TREATMENT	OFF-SITE TREATMENT
Capital Cost	$955,220	$0
Present Worth Capital Cost (1999)	$909,752	$0
O&M Annual Operating Cost	$288,452	$311,596
Present Worth O&M Cost (for 30 years)	$4,021,845	$4,344,543
Total Present Worth (in 1999)	**$4,931,597**	**$4,344,543**

Table 2
Capital Cost Estimate
ETE Sanitation and Landfill
Feasibility Study

ITEM	UNIT COST	UNITS	ALTERNATIVE 1 QUANTITY	ALTERNATIVE 1 COST	ALTERNATIVE 2 QUANTITY	ALTERNATIVE 2 COST	ALTERNATIVE 3 QUANTITY	ALTERNATIVE 3 COST	ALTERNATIVE 4a QUANTITY	ALTERNATIVE 4a COST	ALTERNATIVE 4b QUANTITY	ALTERNATIVE 4b COST
CAP CONSTRUCTION:												
Clearing/Grubbing	$20,000.00	Acre		$0	10	$200,000	10	$200,000	10	$200,000	10	$200,000
Gravel Access Roads	$15.00	LF		$0	2,500	$37,500	2,500	$37,500	2,500	$37,500	2,500	$37,500
Rough Grading with Common Fill (onsite source)	$15.00	CY		$0	10,000	$150,000	36,000	$540,000	36,000	$540,000	36,000	$540,000
Rough Grading with Common Fill (offsite source)	$18.00	CY		$0	26,000	$468,000		$0		$0		$0
Hydroseeding	$4,000.00	Acre		$0	8.5	$34,000	9	$36,000	9	$36,000	9	$36,000
Topsoil	$25.00	CY		$0	6,900	$172,500	7,200	$180,000	7,200	$180,000	7,200	$180,000
Protection Layer	$20.00	CY		$0	13,800	$276,000	13,800	$276,000	13,800	$276,000	13,800	[illegible]
Barrier Layer	$1.00	SF		$0	370,000	$370,000	392,000	$392,000	392,000	$392,000	392,000	$392,000
Gas Venting Layer (Geogrid Composite)	$1.00	SF		$0	370,000	$370,000	392,000	$392,000	392,000	$392,000	392,000	$392,000
Geogrid Composite Drainage Layer (@steep slopes)	$1.00	SF		$0	71,000	$71,000	93,000	$93,000	93,000	$93,000	93,000	$93,000
Erosion Control Netting	$0.25	SF		$0	71,000	$17,750	93,000	$23,250	93,000	$23,250	93,000	$23,250
Toe Drain	$50.00	LF		$0	2,400	$120,000	2,400	$120,000	2,400	$120,000	2,400	$120,000
Drainage Swale	$15.00	LF		$0	1,600	$24,000	1,600	$24,000	1,600	$24,000	1,600	$24,000
Passive Gas Vents	$2,000.00	EA		$0	9	$18,000	9	$18,000	9	$18,000	9	$18,000
Subtotal Cap Construction				$0		$2,328,750		$2,331,750		$2,331,750		$2,331,750
S. POND DRAINAGE / N. POND EXPANSION:												
Clearing/Grubbing	$20,000.00	Acre		$0		$0	5	$100,000	5	$100,000	5	$100,000
Gravel Access Roads	$15.00	LF		$0		$0	1,000	$15,000	1,000	$15,000	1,000	$15,000
Waste Excavation & Consolidation (allowance)	$20.00	CY		$0		$0	600	$12,000	600	$12,000	600	$12,000
Drainage Pipe	$35.00	LF		$0		$0	500	$17,500	500	$17,500	500	$17,500
Manholes	$2,000.00	EA		$0		$0	1	$2,000	1	$2,000	1	$2,000
Inlet/Outlet Structures	$5,000.00	LS		$0		$0	2	$10,000	2	$10,000	2	$10,000
Hydroseeding	$4,000.00	Acre		$0		$0	6	$24,000	6	$24,000	6	$24,000
Erosion Control Netting	$0.25	SF		$0		$0	48,000	$12,000	48,000	$12,000	48,000	$12,000
Wetlands Replacement	$20,000.00	Acre		$0		$0	1	$20,000	1	$20,000	1	$20,000
Subtotal Pond Drainage/Expansion				$0		$0		$212,500		$212,500		$212,500
GROUNDWATER DIVERSION SYSTEM CONSTRUCTION:												
Interceptor Trench	$13.00	SF		$0		$0		$0	15,000	$195,000	15,000	$195,000
Sheet Pile Barrier Wall	$35.00	SF		$0		$0		$0		$0	22,500	$787,500
Collection Sumps, Pumps, and Appurtances	$15,000.00	EA		$0		$0		$0	2	$30,000	2	$30,000
Distribution Piping, Valves, and Appurtances	$40.00	LF		$0		$0		$0	950	$38,000	100	$4,000
Storage Tank	$100,000.00	LS		$0		$0		$0	1	$100,000		$0
Subtotal Groundwater Diversion System Construction				$0		$0		$0		$363,000		$1,016,500
SITE ACCESS, CONTROL, AND RESTORATION:												
Asphalt Access Roads	$35.00	LF		$0	2,500	$87,500	2,500	$87,500	2,500	$87,500	2,500	$87,500
Subtotal Site Access, Control & Restoration				$0		$87,500		$87,500		$87,500		$87,500
ENGINEERING CONTROL:												
Surveying	$40,000.00	LS		$0		$40,000		$40,000		$40,000		$40,000
Site Erosion Control	$10,000.00	LS		$0		$10,000		$10,000		$10,000		$10,000
Methane Monitoring Wells	$1,500.00	EA	7	$10,500	7	$10,500	7	$10,500	7	$10,500	7	$10,500
Groundwater Monitoring Wells	$2,500.00	EA	4	$10,000	4	$10,000	4	$10,000	4	$10,000	4	$10,000
Subtotal Engineering Control				$20,500		$70,500		$70,500		$70,500		$70,500
SUBTOTAL COST				$20,500		$2,486,750		$2,702,250		$3,065,250		$3,718,750
Engineering (10%)		LS		$2,050		$248,675		$270,225		$306,525		$371,875
Construction Inspection (10%)		LS		$2,050		$248,675		$270,225		$306,525		$371,875
Contractor OH + H&S (15%)		LS		$3,075		$373,013		$405,338		$459,788		$557,813
Contingency (15%)				$3,075		$373,013		$405,338		$459,788		$557,813
TOTAL COST				$30,750		$3,730,125		$4,053,375		$4,597,875		$5,578,125
PRESENT WORTH (1999 Dollars., i = 5%)				$27,983		$3,394,513		$3,688,679		$4,184,189		$5,076,243

Table 2
Capital Cost Estimate
ETE Sanitation and Landfill
Feasibility Study

			ALTERNATIVE 1		ALTERNATIVE 2		ALTERNATIVE 3		ALTERNATIVE 4a		ALTERNATIVE 4b	
ITEM	UNIT COST	UNITS	QUANTITY	COST	QUANTITY	COST	QUANTITY	COST	QUANTITY	COST	QUANTITY	COST
CAP CONSTRUCTION:												
Clearing/Grubbing	$20,000.00	Acre		$0	10	$200,000	10	$200,000	10	$200,000	10	$200,000
Gravel Access Roads	$15.00	LF		$0	2,500	$37,500	2,500	$37,500	2,500	$37,500	2,500	$37,500
Rough Grading with Common Fill (onsite source)	$15.00	CY		$0	10,000	$150,000	36,000	$540,000	36,000	$540,000	36,000	$540,000
Rough Grading with Common Fill (offsite source)	$18.00	CY		$0	26,000	$468,000		$0		$0		$0
Hydroseeding	$4,000.00	Acre		$0	8.5	$34,000	9	$36,000	9	$36,000	9	$36,000
Topsoil	$25.00	CY		$0	6,900	$172,500	7,200	$180,000	7,200	$180,000	7,200	$180,000
Protection Layer	$20.00	CY		$0	13,800	$276,000	13,800	$276,000	13,800	$276,000	13,800	$276,000
Barrier Layer	$1.00	SF		$0	370,000	$370,000	392,000	$392,000	392,000	$392,000	392,000	$392,000
Gas Venting Layer (Geogrid Composite)	$1.00	SF		$0	370,000	$370,000	392,000	$392,000	392,000	$392,000	392,000	$392,000
Geogrid Composite Drainage Layer (@steep slopes)	$1.00	SF		$0	71,000	$71,000	93,000	$93,000	93,000	$93,000	93,000	$93,000
Erosion Control Netting	$0.25	SF		$0	71,000	$17,750	93,000	$23,250	93,000	$23,250	93,000	$23,250
Toe Drain	$50.00	LF		$0	2,400	$120,000	2,400	$120,000	2,400	$120,000	2,400	$120,000
Drainage Swale	$15.00	LF		$0	1,600	$24,000	1,600	$24,000	1,600	$24,000	1,600	$24,000
Passive Gas Vents	$2,000.00	EA		$0	9	$18,000	9	$18,000	9	$18,000	9	$18,000
Subtotal Cap Construction				**$0**		**$2,328,750**		**$2,331,750**		**$2,331,750**		**$2,331,750**
S. POND DRAINAGE / N. POND EXPANSION:												
Clearing/Grubbing	$20,000.00	Acre		$0		$0	5	$100,000	5	$100,000	5	$100,000
Gravel Access Roads	$15.00	LF		$0		$0	1,000	$15,000	1,000	$15,000	1,000	$15,000
Waste Excavation & Consolidation (allowance)	$20.00	CY		$0		$0	600	$12,000	600	$12,000	600	$12,000
Drainage Pipe	$35.00	LF		$0		$0	500	$17,500	500	$17,500	500	$17,500
Manholes	$2,000.00	EA		$0		$0	1	$2,000	1	$2,000	1	$2,000
Inlet/Outlet Structures	$5,000.00	LS		$0		$0	2	$10,000	2	$10,000	2	$10,000
Hydroseeding	$4,000.00	Acre		$0		$0	6	$24,000	6	$24,000	6	$24,000
Erosion Control Netting	$0.25	SF		$0		$0	48,000	$12,000	48,000	$12,000	48,000	$12,000
Wetlands Replacement	$20,000.00	Acre		$0		$0	1	$20,000	1	$20,000	1	$20,000
Subtotal Pond Drainage/Expansion				**$0**		**$0**		**$212,500**		**$212,500**		**$212,500**
GROUNDWATER DIVERSION SYSTEM CONSTRUCTION:												
Interceptor Trench	$13.00	SF		$0		$0		$0	15,000	$195,000	15,000	$195,000
Sheet Pile Barrier Wall	$35.00	SF		$0		$0		$0		$0	22,500	$787,500
Collection Sumps, Pumps, and Appurtances	$15,000.00	EA		$0		$0		$0	2	$30,000	2	$30,000
Distribution Piping, Valves, and Appurtances	$40.00	LF		$0		$0		$0	950	$38,000	100	$4,000
Storage Tank	$100,000.00	LS		$0		$0		$0	1	$100,000		$0
Subtotal Groundwater Diversion System Construction				**$0**		**$0**		**$0**		**$363,000**		**$1,016,500**
SITE ACCESS, CONTROL, AND RESTORATION:												
Asphalt Access Roads	$35.00	LF		$0	2,500	$87,500	2,500	$87,500	2,500	$87,500	2,500	$87,500
Subtotal Site Access, Control & Restoration				**$0**		**$87,500**		**$87,500**		**$87,500**		**$87,500**
ENGINEERING CONTROL:												
Surveying	$40,000.00	LS		$0		$40,000		$40,000		$40,000		$40,000
Site Erosion Control	$10,000.00	LS		$0		$10,000		$10,000		$10,000		$10,000
Methane Monitoring Wells	$1,500.00	EA	7	$10,500	7	$10,500	7	$10,500	7	$10,500	7	$10,500
Groundwater Monitoring Wells	$2,500.00	EA	4	$10,000	4	$10,000	4	$10,000	4	$10,000	4	$10,000
Subtotal Engineering Control				**$20,500**		**$70,500**		**$70,500**		**$70,500**		**$70,500**
SUBTOTAL COST				$20,500		$2,486,750		$2,702,250		$3,065,250		$3,718,750
Engineering (10%)		LS		$2,050		$248,675		$270,225		$306,525		$371,875
Construction Inspection (10%)		LS		$2,050		$248,675		$270,225		$306,525		$371,875
Contractor OH + H&S (15%)		LS		$3,075		$373,013		$405,338		$459,788		$557,813
Contingency (15%)				$3,075		$373,013		$405,338		$459,788		$557,813
TOTAL COST				$30,750		$3,730,125		$4,053,375		$4,597,875		$5,578,125
PRESENT WORTH (1999 Dollars., i = 5%)				$27,983		$3,394,513		$3,688,679		$4,184,189		$5,076,243

Table 3
O&M Cost Estimate (Year 1 - 2)
ETE Sanitation and Landfill
Feasibility Study

			ALTERNATIVE 1		ALTERNATIVE 2		ALTERNATIVE 3		ALTERNATIVE 4a		ALTERNATIVE 4b	
ITEM	UNIT COST	UNITS	QUANTITY	COST	QUANTITY	COST	QUANTITY	COST	QUANTITY	COST	QUANTITY	COST
OPERATION:												
GROUNDWATER DIVERSION SYSTEM:												
Electric	$1,500	LS		$0		$0		$0	1	$1,500	1	$750
Offsite Disposal of Leachate	$310,000	LS		$0		$0		$0	1	$310,000		$0
Subtotal Leachate Collection System Operation				**$0**		**$0**		**$0**		**$311,500**		**$750**
MAINTENANCE:												
CAP:												
Hydroseeding (5 % damage)	$4,000	Acre		$0	0.4	$1,700	0.4	$1,700	0.4	$1,700	0.4	$1,700
Topsoil (5% damage)	$25	CY		$0	345	$8,625	345	$8,625	345	$8,625	345	$8,625
Protection Layer (5% damage, top 6")	$20	CY		$0	345	$6,900	345	$6,900	345	$6,900	345	$6,900
Grass Cutting	$2,000	LS		$0		$2,000		$2,000		$2,000		$2,000
Subtotal Cap Maintenance				**$0**		**$19,225**		**$19,225**		**$19,225**		**$19,225**
SOUTH POND AREA:												
Grass Cutting	$1,000	LS		$0		$0	1	$1,000	1	$1,000	1	$1,000
Subtotal Pond Drainage/Expansion				**$0**		**$0**		**$1,000**		**$1,000**		**$1,000**
GROUNDWATER DIVERSION SYSTEM:												
Maintenance (annual average, 30 year equipment life)	$3,000	LS		$0		$0		$0	1	$3,000	1	$3,000
Subtotal Leachate Collection System Maintenance				**$0**		**$0**		**$0**		**$3,000**		**$3,000**
SITE INSPECTION & MONITORING:												
Routine Site Inspections	$500	Event	4	$2,000	12	$6,000	12	$6,000	12	$6,000	12	$6,000
Groundwater Sampling	$11,000	Event	4	$44,000	4	$44,000	4	$44,000	4	$44,000	4	$44,000
Methane Monitoring	$500	Event	4	$2,000	4	$2,000	4	$2,000	4	$2,000	4	$2,000
Surface Water Sampling	$1,000	Event	4	$4,000	4	$4,000	4	$4,000	4	$4,000	4	$4,000
Annual Reporting	$3,000	LS	1	$3,000	1	$3,000	1	$3,000	1	$3,000	1	$3,000
Subtotal Site Inspection and Maintenance				**$55,000**		**$59,000**		**$59,000**		**$59,000**		**$59,000**
TOTAL COST				**$55,000**		**$78,225**		**$79,225**		**$393,725**		**$82,975**
PRESENT WORTH (1999 Dollars, i = 5%)				**$94,542**		**$134,465**		**$136,184**		**$676,792**		**$142,630**

Table 4
O&M Cost Estimate (Year 3 - 30)
ETE Sanitation and Landfill
Feasibility Study

ITEM	UNIT COST	UNITS	ALTERNATIVE 1 QUANTITY	ALTERNATIVE 1 COST	ALTERNATIVE 2 QUANTITY	ALTERNATIVE 2 COST	ALTERNATIVE 3 QUANTITY	ALTERNATIVE 3 COST	ALTERNATIVE 4a QUANTITY	ALTERNATIVE 4a COST	ALTERNATIVE 4b QUANTITY	ALTERNATIVE 4b COST
OPERATION:												
GROUNDWATER DIVERSION SYSTEM:												
Electric		LS		$0		$0		$0	1	$1,500	1	$750
Offsite Disposal of Leachate	$310,000	LS		$0		$0		$0	1	$310,000		$0
Subtotal Leachate Collection System Operation				**$0**		**$0**		**$0**		**$311,500**		**$750**
MAINTENANCE:												
CAP:												
Hydroseeding (5 % damage)	$4,000	Acre		$0	0.4	$1,700	0.4	$1,700	0.4	$1,700	0.4	$1,700
Topsoil (5% damage)	$25	CY		$0	345	$8,625	345	$8,625	345	$8,625	345	$8,625
Protection Layer (5% damage, top 6")	$20	CY		$0	345	$6,900	345	$6,900	345	$6,900	345	$6,900
Grass Cutting	$2,000	LS		$0		$2,000		$2,000		$2,000		$2,000
Subtotal Cap Maintenance				**$0**		**$19,225**		**$19,225**		**$19,225**		**$19,225**
SOUTH POND AREA:												
Grass Cutting	$1,000	LS		$0		$0		$1,000		$1,000		$1,000
Subtotal Pond Drainage/Expansion				**$0**		**$0**		**$1,000**		**$1,000**		**$1,000**
GROUNDWATER DIVERSION SYSTEM:												
Maintenance (annual average, 30 year equipment life)	$3,000	LS		$0		$0		$0	1	$3,000	1	$3,000
Subtotal Leachate Collection System Maintenance				**$0**		**$0**		**$0**		**$3,000**		**$3,000**
SITE INSPECTION & MONITORING:												
Routine Site Inspections	$500	Event	1	$500	4	$2,000	4	$2,000	4	$2,000	4	$2,000
Groundwater Sampling (11 Wells)	$11,000	Event	1	$11,000	1	$11,000	1	$11,000	1	$11,000	1	$11,000
Methane Monitoring (7 Wells)	$500	Event	1	$500	1	$500	1	$500	1	$500	1	$500
Surface Water Sampling (1 Station)	$1,000	Event	1	$1,000	1	$1,000	1	$1,000	1	$1,000	1	$1,000
Annual Reporting	$3,000	LS		$3,000		$3,000		$3,000		$3,000		$3,000
Subtotal Site Inspection and Maintenance				**$16,000**		**$17,500**		**$17,500**		**$17,500**		**$17,500**
TOTAL COST				**$16,000**		**$36,725**		**$37,725**		**$352,225**		**$41,475**
PRESENT WORTH (1999 Dollars, i = 5%)				**$223,086**		**$512,051**		**$525,994**		**$4,911,023**		**$578,280**

Table 5
Present Worth Cost Summary
ETE Sanitation and Landfill
Feasibility Study

ITEM	PRESENT WORTH				
	Alternative 1	Alternative 2	Alternative 3	Alternative 4a	Alternative 4b
Captial Cost	$27,983	$3,394,513	$3,688,679	$4,184,189	$5,076,243
O&M Cost (year 1-2)	$94,542	$134,465	$136,184	$676,792	$142,630
O&M Cost (year 3-30)	$223,086	$512,051	$525,994	$4,911,023	$578,280
TOTAL	**$345,611**	**$4,041,029**	**$4,350,857**	**$9,772,004**	**$5,797,152**

WELL ELEVATION TABLE (in feet)

WELL ID	GROUND	TOP CASING	TOP PVC
PZ-1	1682.36	1682.52	1681.81
PZ-2	1682.32	1682.51	1682.22
PZ-3	1673.05	1675.69	1675.62
MW-1S	1669.70	1672.19	1672.11
MW-1D	1669.60	1672.33	1672.18
MW-2S	1681.90	1684.63	1684.63
MW-2D	1682.00	1684.28	1684.29
MW-3S	1646.10	1648.84	1648.90
MW-3D	1646.10	1648.75	1648.80
MW-4	1643.80	1647.04	1647.01
MW-6S	1653.33	1655.73	1655.69
MW-6D	1655.24	1657.66	1657.63
MW-7S	1632.12	1634.66	1634.60
MW-7D	1632.43	1634.60	1634.60
MW-8S	1668.66	1671.32	1671.26
MW-8D	1668.85	1670.97	1671.02
MW-9S	1642.67	1645.10	1645.07
MW-9D	1641.96	1644.36	1644.32

LEGEND

- MW — MONITORING WELL
- PZ — PIEZOMETER
- SW — SURFACE WATER SAMPLE
- SD — SEDIMENT SAMPLE
- SU — SOIL SAMPLE
- TP — TEST PIT
- GP — GAS PROBE
- SB — SOIL BORING
- NG OR SG — STAFF GAUGE (NORTH GAUGE OR SOUTH GAUGE)
- BENCHMARK
- LIMIT OF SOLID WASTE
- INFERRED LIMIT OF SOLID WASTE
- POND DEPTH MEASUREMENT LOCATION
- (0.2') SEDIMENT THICKNESS (FT.)
- DRAINAGE CHANNEL
- APPROXIMATE BOTTOM ELEVATION CONTOUR (FT) WITHIN NORTH AND SOUTH PONDS

NOTES

1. VERTICAL DATUM: FROM WELL ELEVATIONS SHOWN ON ORIGINAL TOPOGRAPHIC MAP PROVIDED BY NYSDEC.
2. DATE OF SURVEY: APRIL 16, 1998
3. PROPERTY BOUNDARIES BETWEEN ETE SANITATION AND LANDFILL INC. AND KEENAN ARE APPROXIMATE.
4. PROPERTY BOUNDARIES BETWEEN ETE SANITATION AND LANDFILL INC. AND VANLECK ARE APPROXIMATE.

1" = 100'
50 0 100

REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: B. MURTAGH
DRAWN BY: J. ZEGERS
SHEET CHK'D BY:
CROSS CHK'D BY:
APPROVED BY:
DATE: MAY 1998

CDM Camp Dresser & McKee
consulting engineering construction operations

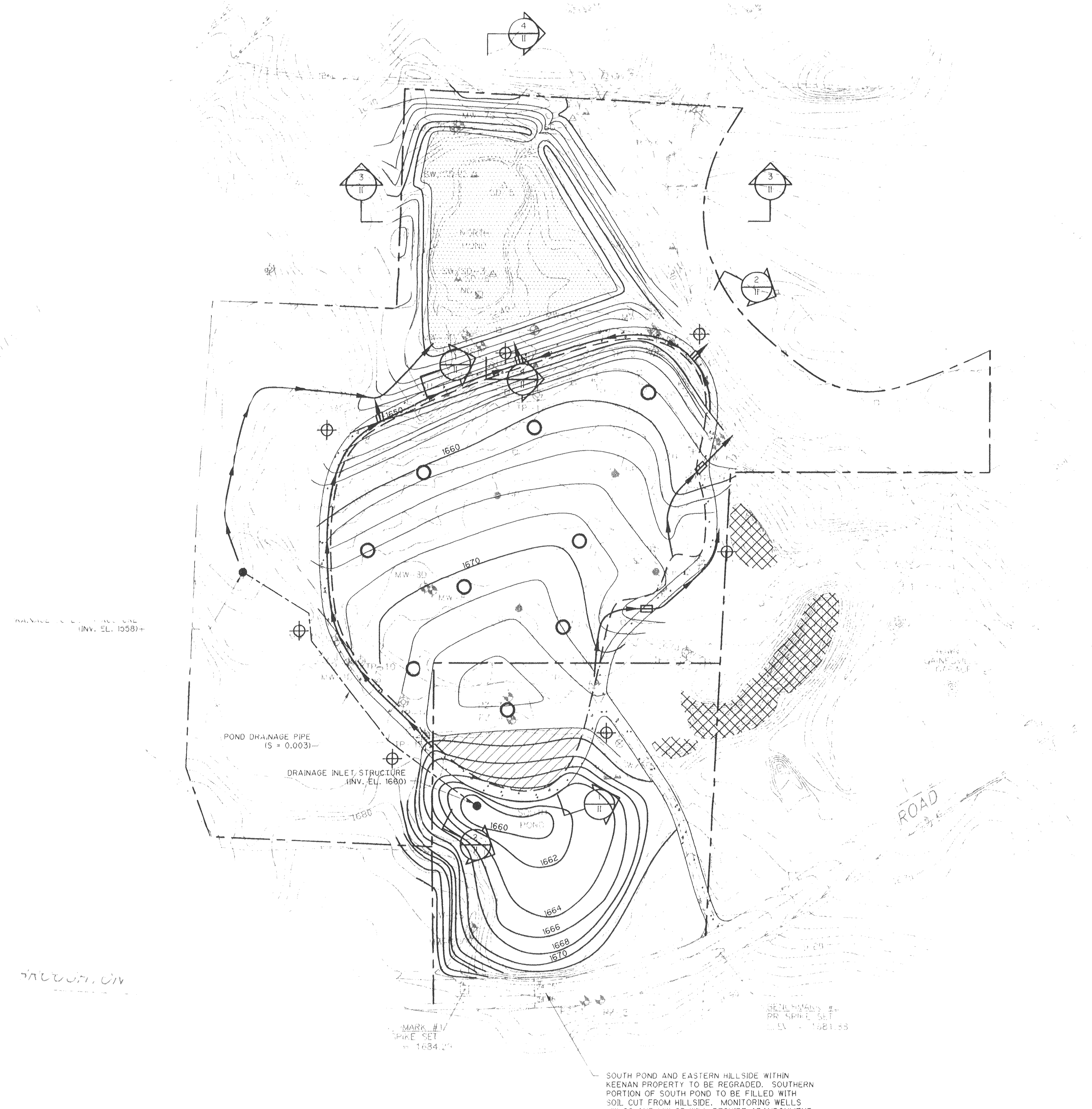
ETE SANITATION AND LANDFILL
WYOMING COUNTY, NEW YORK

REMEDIAL INVESTIGATION

SITE PLAN

PROJECT NO. 0897-22149
FILE NAME: SITEPLAN

PLATE NO.
1



NOTES:

1. SOUTH POND TO BE DRAINED TO INCREASE THE EFFECTIVENESS OF THE LANDFILL CONTAINMENT SYSTEM.
2. NORTH POND TO BE EXPANDED BY 1-ACRE, EQUIVALENT TO THE ORIGINAL AREA OF THE SOUTH POND PRIOR TO LANDFILL CONSTRUCTION.
3. EXCESS EXCAVATION AND STOCKPILE MATERIALS TO BE USED FOR LANDFILL CAP CONSTRUCTION AND SITE WORK, WHERE APPROPRIATE.
4. WASTE MATERIALS WITHIN THE LIMITS OF THE SOUTH POND TO BE EXCAVATED AND CONSOLIDATED, WHERE FEASIBLE.
5. STORMWATER DRAINAGE PIPE TO BE INSTALLED AT INTERSECTIONS OF DRAINAGE SWALES AND THE ACCESS ROAD.
6. VERTICAL DATUM: FROM WELL ELEVATIONS SHOWN ON ORIGINAL TOPOGRAPHIC MAP PROVIDED BY NYSDEC.
7. LANDFILL CAP WILL EXTEND TO THE LIMITS OF WASTE, AT A MINIMUM.
8. DATE OF SURVEY: APRIL 16, 1998.

- NORTH POND EXPANSION AREA
- PROPERTY BOUNDARY
- APPROXIMATE LIMIT OF WASTE
- 20' WIDE ACCESS ROAD
- STOCKPILED MATERIALS TO BE USED FOR ROUGH GRADING
- WASTE TO BE EXCAVATED AND REGRADED TO MINIMIZE THE SIZE OF THE LANDFILL CAP IN THIS AREA
- 2' ROUGH GRADE CONTOURS
- 10' ROUGH GRADE CONTOURS
- STORM WATER DRAINAGE PIPE
- LANDFILL GAS VENT
- DRAINAGE SWALE
- METHANE MONITORING WELL
- EXISTING GROUNDWATER MONITORING WELLS
- DRAINAGE CULVERT

REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: M. MINER
DRAWN BY: C. KALNY
SHEET CHK'D BY:
CROSS CHK'D BY:
APPROVED BY:
DATE: JANUARY 1999

CDM Camp Dresser & McKee
consulting engineering construction operations

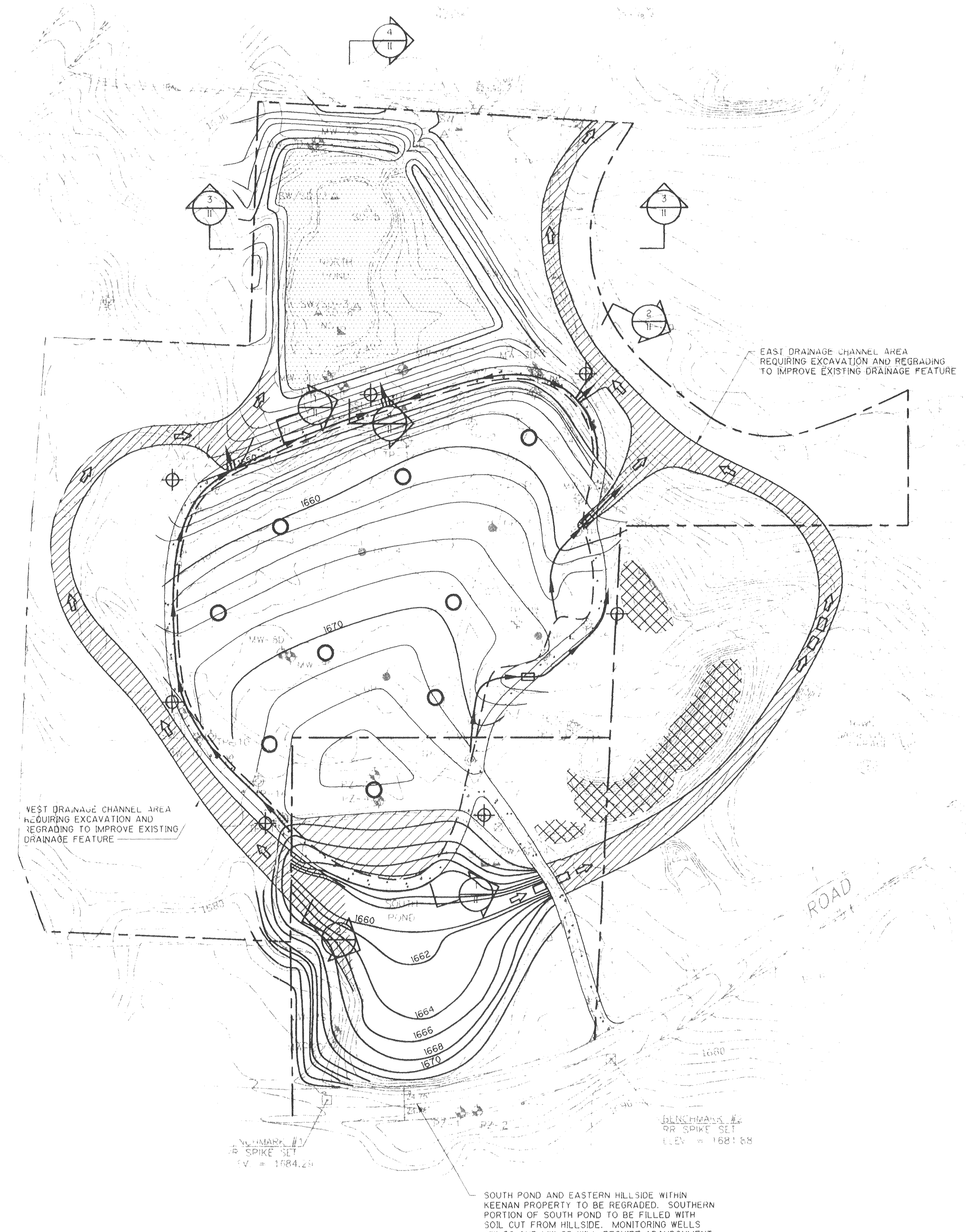
ETE SANITATION AND LANDFILL
WYOMING COUNTY, NEW YORK

FEASIBILITY STUDY

CONCEPTUAL SITE REMEDIATION PLAN WITH POND DRAINAGE PIPE

PROJECT NO. 0897-22149
FILE NAME: SitePlan-Ia

PLATE NO.
IIa



NOTES:

1. SOUTH POND TO BE DRAINED TO INCREASE THE EFFECTIVENESS OF THE LANDFILL CONTAINMENT SYSTEM.
2. NORTH POND TO BE EXPANDED BY 1-ACRE, EQUIVALENT TO THE ORIGINAL AREA OF THE SOUTH POND PRIOR TO LANDFILL CONSTRUCTION.
3. EXCESS EXCAVATION AND STOCKPILE MATERIALS TO BE USED FOR LANDFILL CAP CONSTRUCTION AND SITE WORK, WHERE APPROPRIATE.
4. WASTE MATERIALS WITHIN THE LIMITS OF THE SOUTH POND TO BE EXCAVATED AND CONSOLIDATED, WHERE FEASIBLE.
5. STORMWATER DRAINAGE PIPE TO BE INSTALLED AT INTERSECTIONS OF DRAINAGE SWALES AND THE ACCESS ROAD.
6. VERTICAL DATUM: FROM WELL ELEVATIONS SHOWN ON ORIGINAL TOPOGRAPHIC MAP PROVIDED BY NYSDEC.
7. LANDFILL CAP WILL EXTEND TO THE LIMITS OF WASTE, AT A MINIMUM.
8. DATE OF SURVEY: APRIL 16, 1998.

- PROPERTY BOUNDARY
- APPROXIMATE LIMIT OF WASTE
- 20' WIDE ACCESS ROAD
- STOCKPILED MATERIALS TO BE USED FOR ROUGH
- WASTE TO BE EXCAVATED AND REGRADED TO MINIMIZE THE SIZE LANDFILL CAP IN THIS AREA
- AREA REQUIRING EXCAVATION AND REGRADING TO CONSTRUCT DRAINAGE CHANNELS
- 2' ROUGH GRADE CONTOURS
- 10' ROUGH GRADE CONTOURS
- STORM WATER DRAINAGE PIPE
- LANDFILL GAS VENT
- DRAINAGE SWALE
- METHANE MONITORING WELL
- EXISTING GROUNDWATER MONITORING WELLS
- ROAD CULVERT

0 100

REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: M. MINER
DRAWN BY: C. KALNY
SHEET CHK'D BY:
CROSS CHK'D BY:
APPROVED BY:
DATE: JANUARY 1999

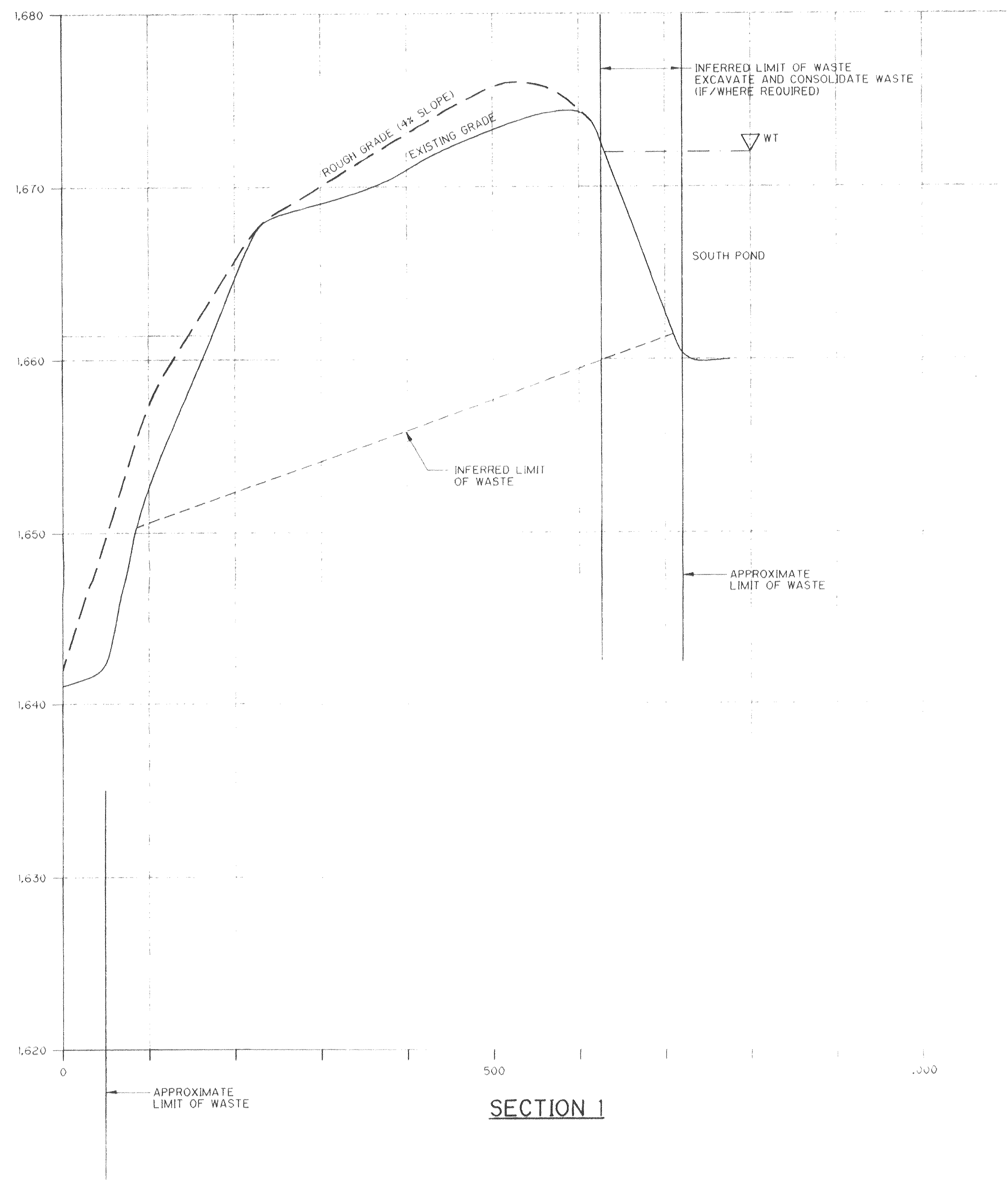
CDM Camp Dresser & McKee
consulting engineering construction operations

ETE SANITATION AND LANDFILL
WYOMING COUNTY, NEW YORK

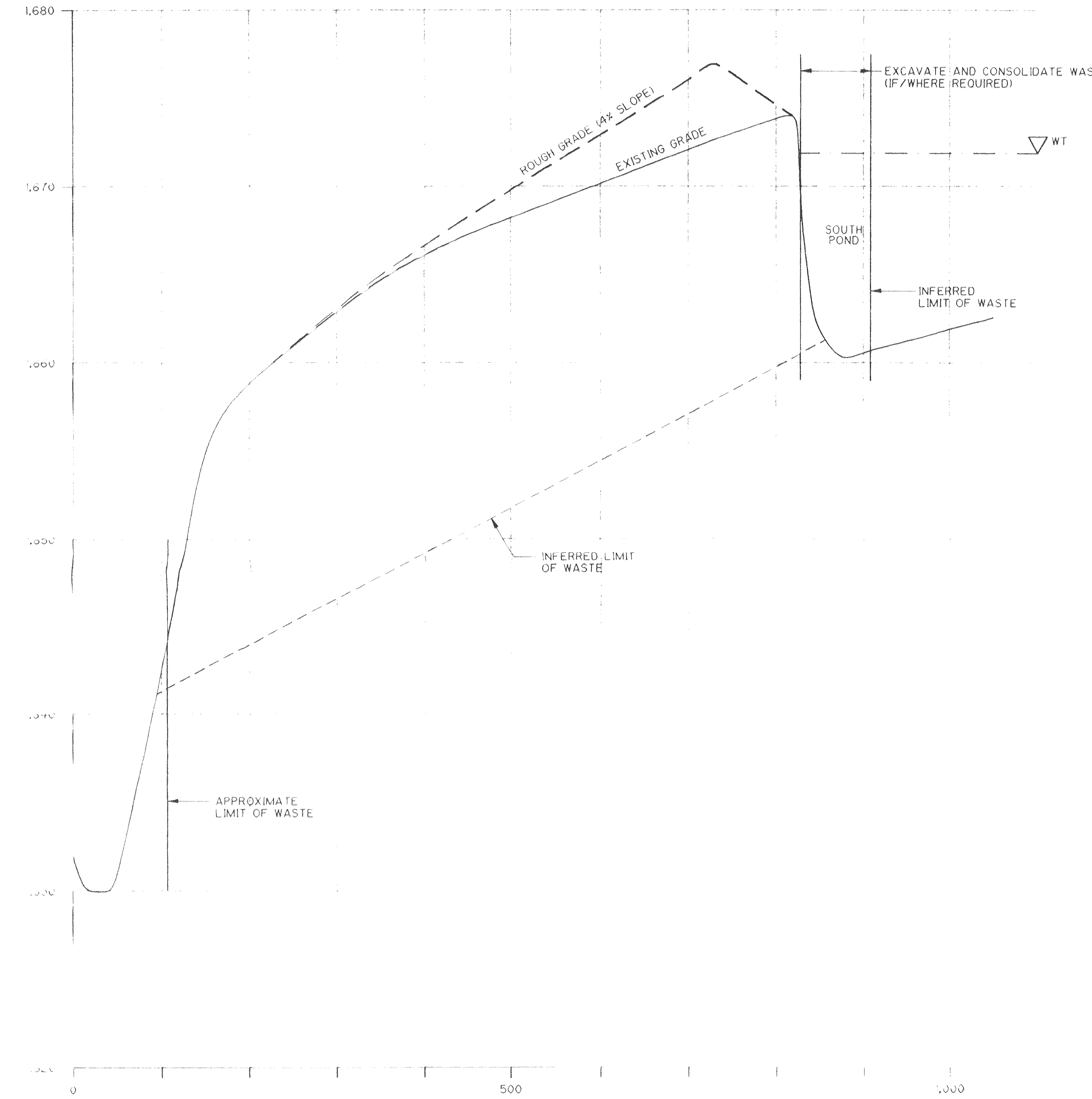
FEASIBILITY STUDY

CONCEPTUAL SITE REMEDIATION PLAN WITH OPEN EAST-WEST DRAINAGE CHANNELS

PROJECT NO. 0897-22149
FILE NAME: SitePlan-IIb
PLATE NO. IIb



SECTION 1



SECTION 2

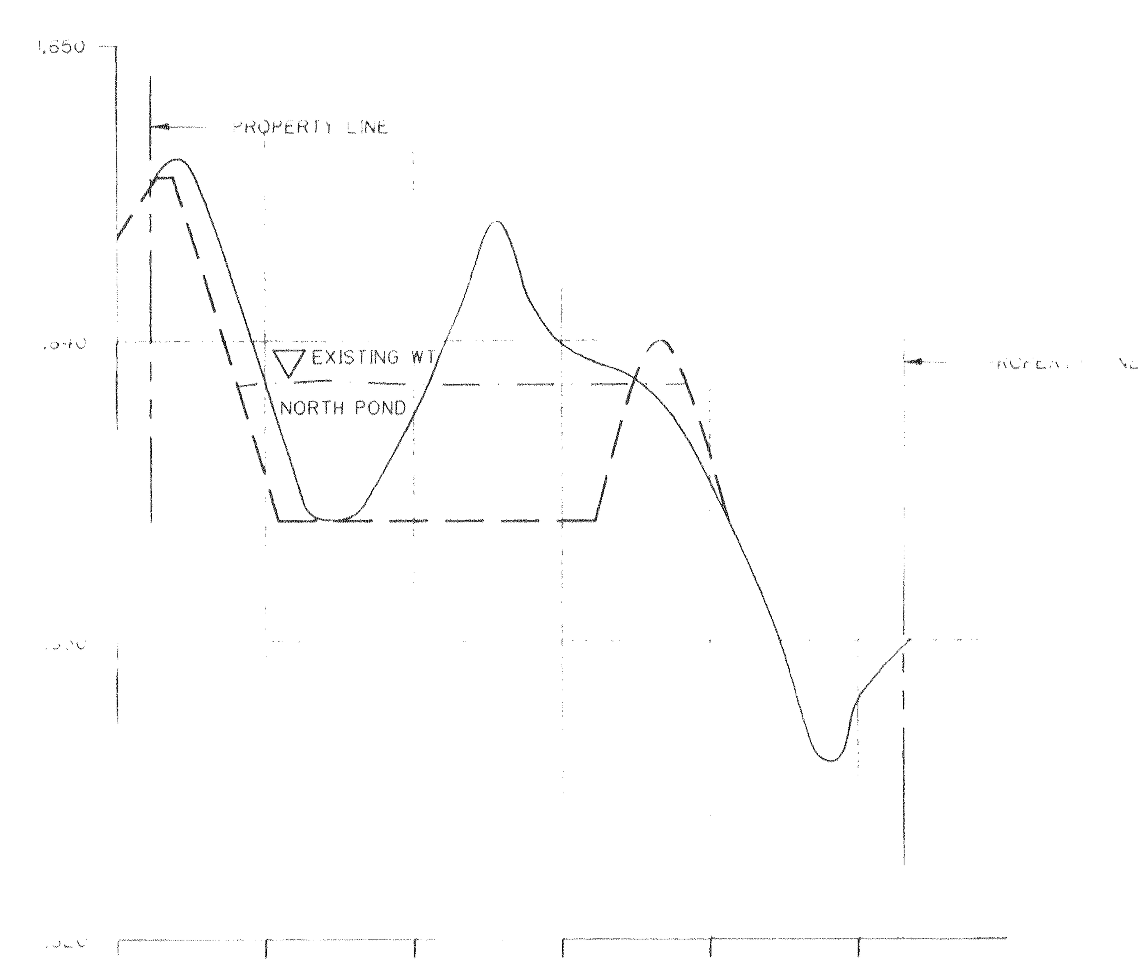
LEGEND:

———— - EXISTING GRADE

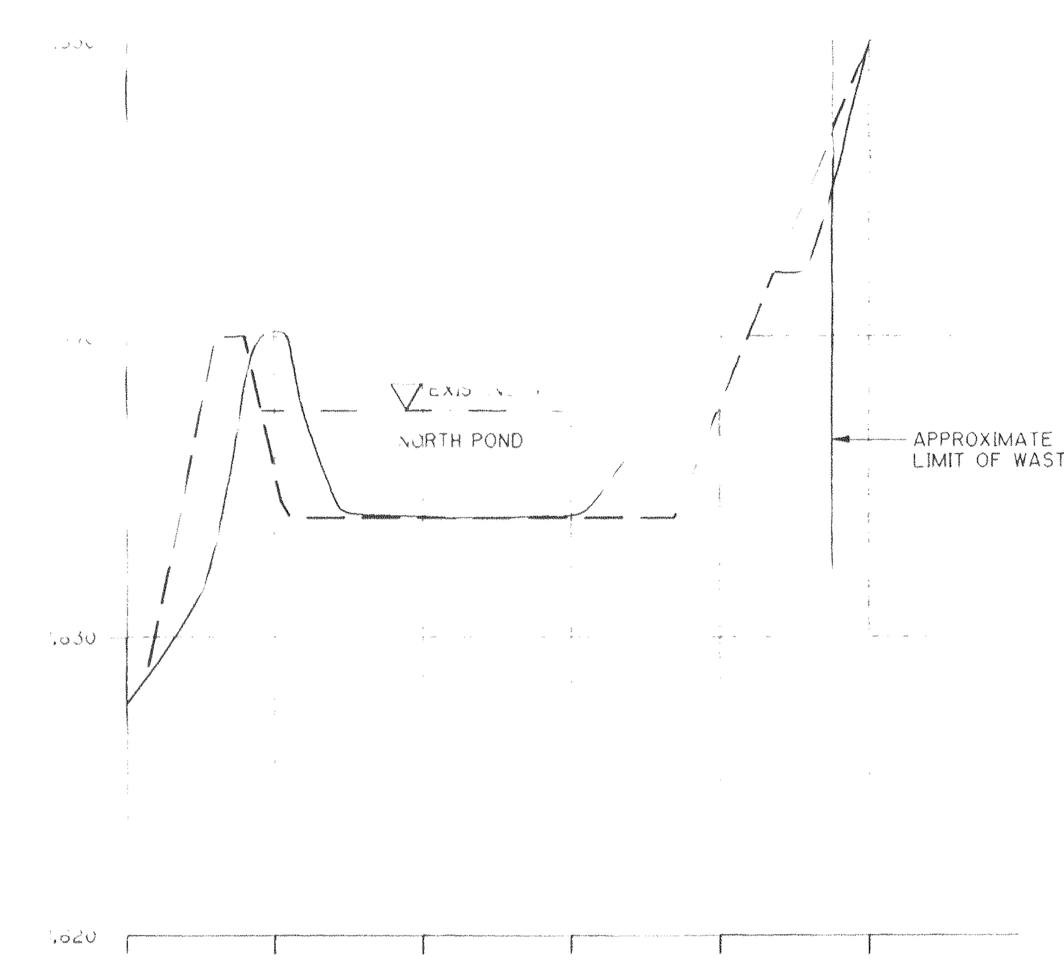
— — - ROUGH GRADE

NOTES:

1. EXISTING WATER LEVEL OF NORTH POND TO BE MAINTAINED AFTER POND EXPANSION.
2. POND DEPTH AND SIZE MAY BE INCREASED DURING CONSTRUCTION IF FEASIBLE.
3. LANDFILL CAP TO BE CONSTRUCTED DIRECTLY ABOVE THE ROUGH GRADE WITHIN THE LIMITS OF WASTE AS SHOWN. A TYPICAL DETAIL FOR THE CAP IS INCLUDED ON PLATE IV.



SECTION 3



SECTION 4

REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: M. MINER
DRAWN BY: C. KALNY
SHEET CHK'D BY:
CROSS CHK'D BY:
APPROVED BY:
DATE: JANUARY 1999

CDM Camp Dresser & McKee
consulting engineering construction operations

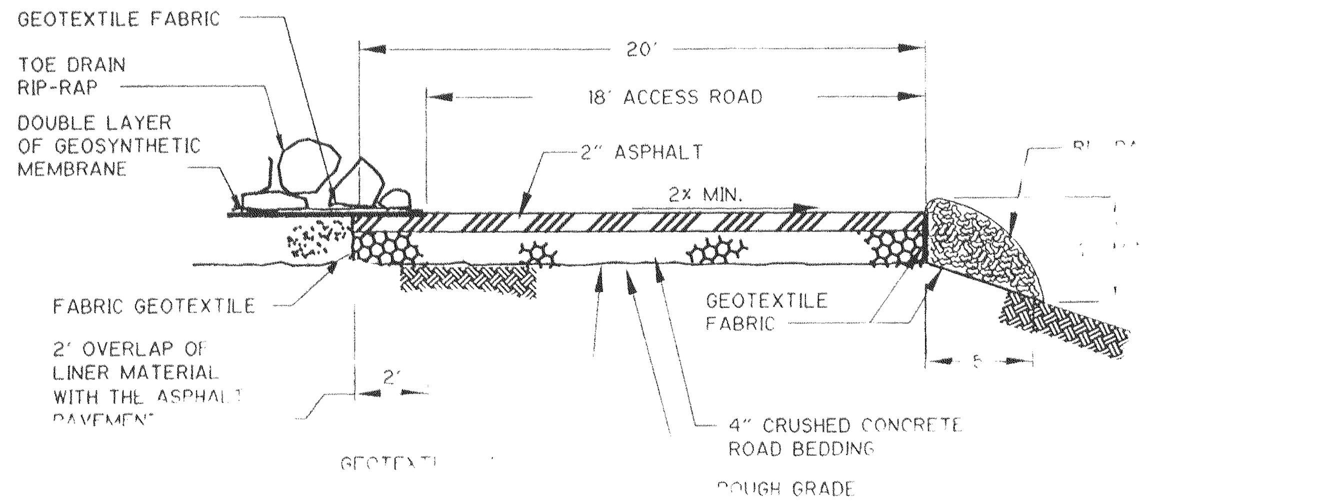
ETE SANITATION AND LANDFILL
WYOMING COUNTY, NEW YORK

FEASIBILITY STUDY

CROSS SECTIONS

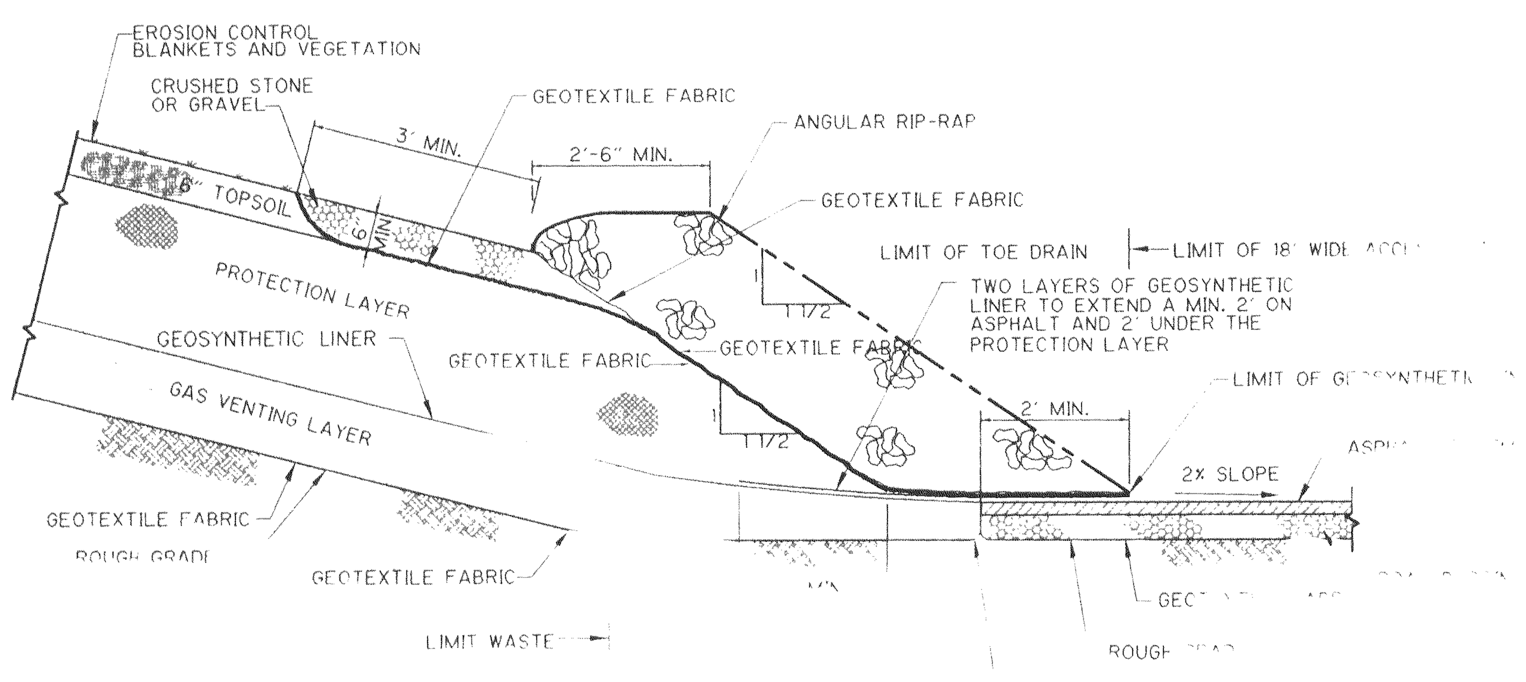
PROJECT NO. 0897-22149
FILE NAME: CrossSection-1

PLATE NO.
III

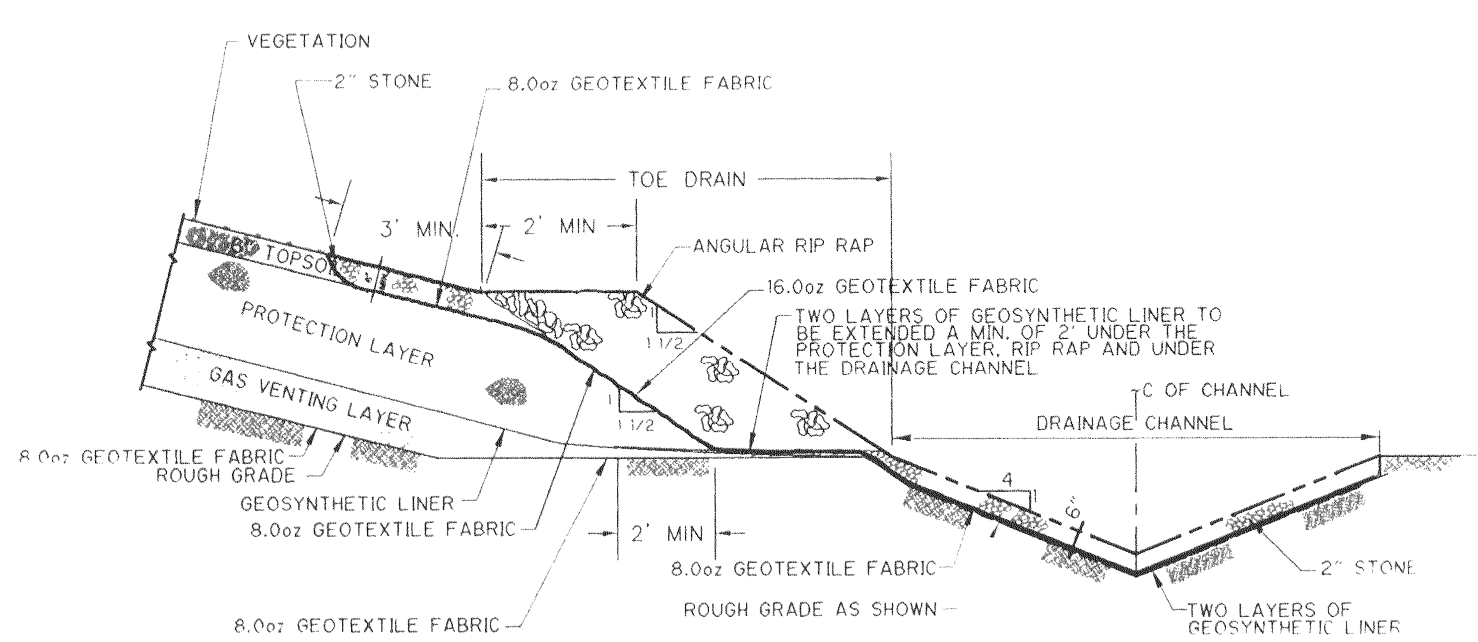


NOTE:
THE SIDES OF THE ACCESS ROAD WILL BE ADJUSTED TO ACCOMMODATE DRAINAGE CHANNELS AND TOE DRAIN ...

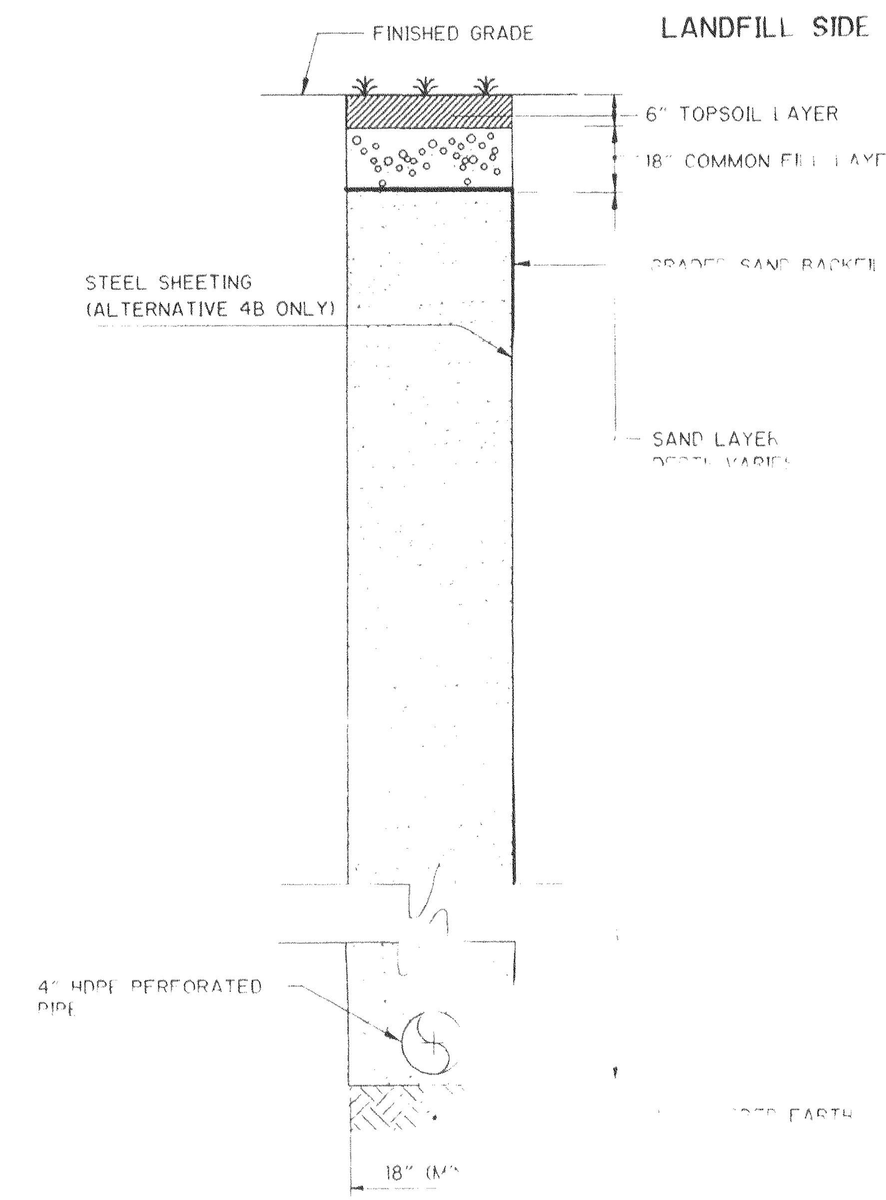
ASPHALT ROAD CROSS-SECTION
DETAIL (A)
NTS



TOE DRAIN/ACCESS ROAD
DETAIL (B)
NTS

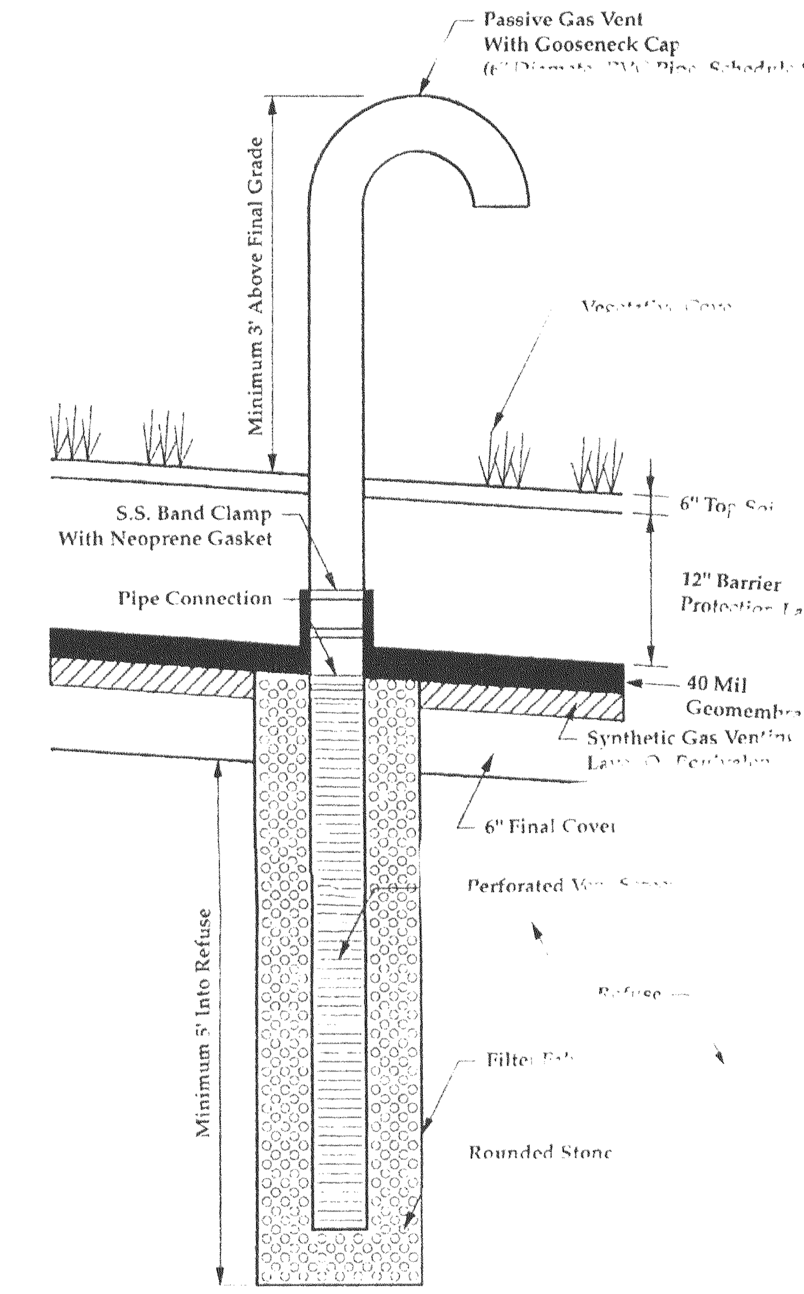


TOE DRAIN/STONE-LINED DRAINAGE CHANNEL
DETAIL (C)
NTS



SECTION

GROUNDWATER DIVERSION TRENCH
DETAIL (D)



MODIFIED PART 360 LANDFILL CAP CROSS SECTION WITH GAS VENT
DETAIL (E)

REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: MWM/JDB
DRAWN BY: C. KALNY
SHEET CHK'D BY:
CROSS CHK'D BY:
APPROVED BY:
DATE: JANUARY 1999

CDM Camp Dresser & McKee
consulting engineering construction operations

ETE SANITATION AND LANDFILL
WYOMING COUNTY, NEW YORK

FEASIBILITY STUDY

TYPICAL DETAILS

PROJECT NO. 0897-22149
FILE NAME: FSDetails
PLATE NO.
IV