FEASIBILITY STUDY REPORT

CUBA MUNICIPAL WASTE DISPOSAL SITE
VILLAGE OF CUBA, NEW YORK

(SITE REGISTRY NO. 9-02-012)

PREPARED FOR

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

BY

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1.0 INTRODUCTION

1.1 Purpose and Site Background

As part of the State of New York's Superfund Program to investigate and remediate hazardous waste sites, the New York State Department of Environmental Conservation (NYSDEC) issued a Work Assignment to Dvirka and Bartilucci Consulting Engineers (D&B) of Woodbury, New York. The Work Assignment was issued to D&B under its Superfund Standby Contract with NYSDEC to conduct a remedial investigation and feasibility study (RI/FS) for the Cuba Municipal Waste Disposal Site located in the Village of Cuba, Allegheny County, New York (see Figure 1-1). The site is presently listed as Class 2 in the NYSDEC Registry of Inactive Hazardous Waste Sites (Site No. 9-02-012). A Class 2 site is defined by the State as posing a significant threat to human health or the environment.

The purpose of this RI/FS is the following:

- Determine the impacts from hazardous waste disposal;
- Ascertain whether complete routes of exposure to site contaminants exist; and
- Develop a remedial action that will be protective of human health and the environment.

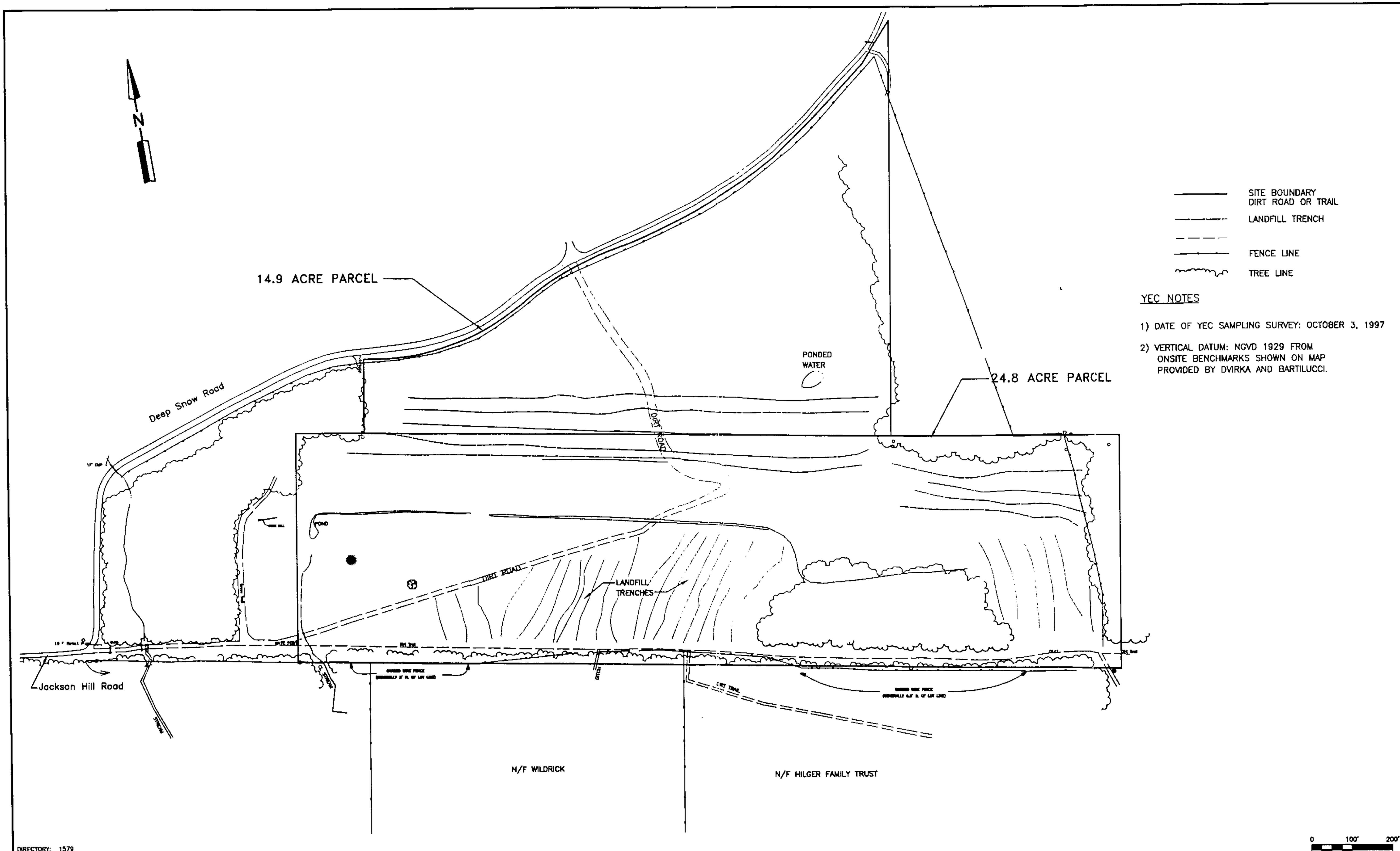
This feasibility study for the Cuba Municipal Waste Disposal Site has been prepared in accordance with the federal Comprehensive Emergency Response, Compensation and Liability Act (CERCLA) and Superfund Amendments and Reauthorization Act (SARA), and the New York State Superfund Program, including NYSDEC guidance as prescribed in the Technical and Administrative Guidance Memorandum (TAGM HWR-90-4030) for "Selection of Remedial Actions at Inactive Hazardous Waste Sites" and "Accelerated Remedial Actions at Class 2, Non-RCRA Regulated Landfills" (TAGM HWR-92-4044).

The Cuba Municipal Waste Disposal Site is bordered on the west and north by Deep Snow Road, which provides access to the Cuba Cheese property north of the site, and several privately owned properties north and east of the site. A tributary to the North Branch of Van Campen Creek defines the eastern site border. The southern border consists of an east-west landfill access road that is bordered on the south by forested land. The site is composed of two parcels of property. The larger parcel is rectangular in shape and is approximately 24.8 acres in size. The other parcel is contiguous to the rectangular parcel on the north and is approximately 14.9 acres in size (see Figure 1-2). The Village of Cuba currently owns both parcels and the landfill no longer accepts waste.

The site slopes steeply from north to south and consists mainly of tall grasses and brush. Some areas contain small trees. Access to the site is from the unpaved Deep Snow Road off Jackson Hill Road. The access road leads to a cattle gate at the southwest corner of the site. The northern boundary of the site is fenced, however, the fence is in various stages of disrepair. Access to the site can also be made through a break in the fence where Deep Snow Road forms the northern site boundary.

The Cuba Municipal Waste Disposal Site was listed as a Class 2 site because of reported disposal of hazardous waste comprising halogenated solvents, cyanide plating wastes, PCB capacitors and paint sludges.

From the early 1950s until 1981, the Cuba Municipal Waste Disposal Site accepted household, commercial and industrial waste, including industrial waste from the Acme Electric Corporation. Acme Electric identified several listed hazardous wastes generated by the facility and disposed at the landfill between 1952 and 1981. These wastes included spent halogenated solvents used in degreasing operations, plating bath sludges from the bottom of plating bath solutions from electroplating operations, spent stripping and cleaning bath solutions from electroplating operations, PCB capacitors and paint sludges. The paint sludges reportedly consisted of polyester, polyurethane, alkyd, acrylic, epoxy and vinyl based paints with a small percentage of various pigments. No records of the quantities disposed are available.



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CUBA MUNICIPAL WASTE DISPOSAL SITE
VILLAGE OF CUBA, NEW YORK

SITE MAP

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FIGURE 1-2

In addition to the material reportedly disposed of by Acme Electric, the Village of Cuba wastewater treatment plant reportedly used the site for disposal of 200 tons of dried sludge per year between 1965 and 1983. The sludge reportedly contained cadmium, chromium, iron, cyanide, aluminum and zinc.

Wastes were deposited in trenches approximately 10 to 15 feet wide by 4 to 10 feet deep and several hundred feet long. Filled trenches were covered by 6 inches to 24 inches of clay fill. Bedrock has been determined to be approximately 4 to 10 feet below ground surface, therefore, the wastes were likely deposited directly on bedrock.

The Village of Cuba has owned the property since November 15, 1967. Prior to 1967, the property was leased from Ida Cleghorn Barber, whose family owned the property since May 1947. The facility was issued a sanitary landfill permit in 1979 by NYSDEC and was inspected on a regular basis by NYSDEC until the Village completed an approved closure plan in 1987.

In October 1990, URS Consultants, Inc. prepared a Phase I/Preliminary Site Assessment (PSA) for NYSDEC to determine if the site should be reclassified from Class 2A (potential hazardous waste site) or delisted from the registry. The PSA included a file review, data search and site inspection. Based on the results of the PSA, the report indicated that there was insufficient information to reclassify the site. The report recommended that additional investigation, including installation of monitoring wells, groundwater sampling, surface water sampling, soil sampling and a geophysical survey, be conducted in order to determine if the site should be reclassified or delisted.

In January 1994, Engineering Science, Inc. prepared a Phase II/PSA report for NYSDEC to determine if the site should be reclassified or delisted. As part of the PSA, four monitoring wells were installed and three surface water, three sediment, two leachate, four surface soil, four composite subsurface soil and three groundwater samples were collected. The results of the investigation indicated the presence of volatile organic compounds (VOCs) in the groundwater above Class GA groundwater standards and, as a result, it was recommended to reclassify the site as Class 2.

1.2 Remedial Investigation Results

The following is a summary of the findings and conclusions resulting from the remedial investigation conducted for the Cuba Municipal Waste Disposal Site as a function of the media investigated. These findings and conclusions are based on comparison of the investigation results to standards, criteria and guidelines (SCGs) selected for the site. The results of the investigation are described in detail in the Remedial Investigation Report dated July 1999.

Leachate

The results of the chemical analyses of leachate samples indicate the presence of VOCs, PCBs and metals consistently above the SCGs. The major organic contaminants found were 1,1-dichloroethane, 1,2-dichloroethene, trichloroethene and PCB Aroclor-1260. The inorganic contaminants found consistently above the SCGs were iron, manganese and sodium. Low levels of other contaminants, such as 1,4-dichlorobenzene, 1,2,4-trichlorobenzene, Aroclor-1242, Aroclor-1254, lindane, endrin, 4,4'-DDT, lead and antimony were sporadically detected above the SCGs. Leachate samples were collected from locations downgradient of known landfill trenches. Observations made during site visits in wet weather and the spring months showed that the occurrence of leachate seeps increases as a result of increased recharge through the landfill due to precipitation. Comparison of the results of sampling events conducted in the fall (relatively low recharge) and spring (relatively high recharge) indicate that contaminants and concentrations are similar under both conditions.

Surface Soil

The concentrations of contaminants detected in the surface soil samples collected on-site did not indicate contaminants above the SCGs. As a result, surface soil is not a media of concern relative to this site. The thickness of the surface soil covering the buried waste material of 12 to 18 inches appears to be of sufficient thickness to prevent exposure to waste through dermal contact.

Subsurface Soil

Visual inspections of subsurface soil collected during the remedial investigation confirmed that landfilling was performed using trenches. Subsurface soil samples collected from areas where waste material was not disposed did not indicate the presence of contaminants above the SCGs. Therefore, subsurface soil not in contact with the buried waste does not pose a concern as a contaminant source.

Groundwater

Groundwater flow at the site is complex and controlled by bedrock fractures. Groundwater flow is likely along preferential pathways dominated by flow along the top of horizontal bedrock strata and flow through vertical fractures between strata. Groundwater flow appears to be in pulses that are probably related to rainfall events or snowmelt.

Groundwater samples collected during the remedial investigation indicate that groundwater contaminants are in exceedance of SCGs both on- and off-site. Groundwater contaminant characteristics vary from well to well. The variations in groundwater chemistry are likely the result of the proximity of the sample collection points to landfill trenches and the heterogeneity of waste disposed at the site. Each trench likely has its own unique suite of contaminants with varying concentrations based upon the type of waste disposed in the trench. VOCs, including 1,1-dichloroethane, 1,1,1-trichloroethane, 1,2-dichloroethene and trichloroethene, are the contaminants most frequently found in groundwater samples.

Groundwater contaminant migration likely occurs in pulses as a result of the groundwater pulse flow. Surface water infiltrates the site and passes through buried waste. The presence of leachate seeps confirms the transfer of contaminants from buried waste to the groundwater flow system. Contaminant concentrations in groundwater are relatively low despite direct contact with waste.

Neighbors to the site are outside of the Village of Cuba water district and do not receive public water. Residents along Jackson Hill Road obtain potable water from individual private water supply wells completed in bedrock or springs that discharge from bedrock or overburden. Analysis of groundwater from the well of the closest downgradient home during the remedial investigation indicates no site-related contamination above drinking water standards. Analyses of private water supply wells west (cross-gradient) of the site by the New York State Department of Health (NYSDOH) have not indicated groundwater contaminants above standards.

Surface Water Sediment

Off-site surface water sediment samples collected from two tributaries to Van Campen Creek that flow near the site did not indicate exceedances of SCGs for site related contaminants. The tributaries are located downgradient of the site and are likely groundwater discharge locations resulting from groundwater passing through or in close proximity to the site. Surface water sediment are not media of concern for the site.

Springs

Several spring samples collected approximately 200 feet downgradient of the site exhibited contaminants associated with the site, including 1,1-dichloroethene, 1,1-dichloroethane and 1,1,1-trichloroethane in concentrations exceeding SCGs. Flow from the springs is intermittent based on precipitation and snowmelt. The source of the springs is likely water infiltrating on-site and flowing off-site. Springs located and sampled further downgradient of the site (approximately 300 feet) did not exceed SCGs for landfill related contaminants.

1.3 Risk Assessment Exposure Pathways and Potential Receptors

The following is a summary of the findings and conclusions of the qualitative risk assessment prepared for the Cuba Municipal Waste Disposal Site as a function of the media investigated. The risk assessment identifies the potential human and environmental exposure pathways that are of concern at the site and surrounding area, and the need for remediation. The assessment addresses possible human exposures to contaminants resulting from ingestion, inhalation, and dermal contact and absorption.

Ingestion

Soil

The possibility of exposure to contaminated soil via ingestion is low. Exposure to contaminated soils is minimized due to relatively low concentrations of contaminants in soil, and the likelihood that only a limited number of adults would have access to the soils and would be involved in activities that would not result in soil ingestion.

Leachate

Although exposure to leachate seeps is possible, ingestion of contaminated leachate by the property owner or other individuals is, however, unlikely due to the unappealing color and physical nature of the liquid. As a result, the ingestion hazard for leachate is low.

Groundwater

Based on the nature of the groundwater flow system at the site and the lack of contaminants in nearby water supplies, ingestion of contaminated groundwater is unlikely. Although results of the remedial investigation suggest that contaminated groundwater has not migrated further south than the tributary of Van Campen Creek, there is a possibility that groundwater contaminants may continue to migrate downgradient and impact private wells in the future. As a result of this potential exposure to contaminated groundwater, this media presents a slight risk of exposure to landfill related contaminants.

Inhalation

Air monitoring conducted with a photoionization detector and flame ionization detector in areas of known or suspected contamination during the site investigation indicated no elevated levels of VOCs in the breathing zone. In addition, since the surface soil at the site did not contain elevated levels of contaminants and the site is well vegetated, there is little or no risk to inhalation of contaminated dust. As a result, the risk of inhalation exposure from contaminants identified at the site is very low due to low concentrations and low mobility in air.

Dermal Contact and Absorption

Exposure to leachate by dermal contact and absorption is low due to the warning to contact as a result of the unnatural orange color of leachate. Contact to contaminated groundwater is possible only by contacting water in the locked monitoring wells or water emerging from springs south of the site. Dermal contact and absorption provide the highest risk or exposure to contaminants at the site, however, the risk for this exposure is low to moderate.

1.4 Remedial Action Objectives

Remedial action objectives are goals developed for the protection of human health and the environment. Definition of these objectives requires an assessment of the contaminants and media of concern, migration pathways, exposure routes and potential receptors. Typically, remediation goals are established based upon standards, criteria and guidelines (SCGs) to protect human health and the environment. SCGs for the Cuba Municipal Waste Disposal Site, which were developed as part of the remedial investigation, include NYSDEC Recommended Soil Cleanup Objectives and

New York Class GA Groundwater Standards and Guidance Values. Based on these SCGs and the results of the investigation, the remedial action objectives developed for the site are the following:

1. Protect public health and the environment;
2. Prevent direct contact exposure (dermal absorption, inhalation and incidental ingestion) with waste and leachate;
3. Prevent leachate migration from the site and transport of contaminants off-site; and
4. Prevent precipitation from infiltrating through waste and adversely impacting groundwater.

In addition to consideration of SCGs to meet the remedial action objectives, applicable or relevant and appropriate requirements (ARARs) are to be considered when formulating, screening and evaluating remedial alternatives, and selecting a remedial action. ARARs may be categorized as contaminant-specific, location-specific or action-specific. Federal statutes, regulations and programs may apply to the site where state or local standards do not exist. Potentially applicable contaminant-specific, location-specific and action-specific ARARs for the Cuba Municipal Waste Disposal Site, along with guidance, advisories, criteria, memoranda and other information issued by regulatory agencies to be considered (TBC), are presented in Tables 1-1, 1-2 and 1-3. As a note, many of the NYSDEC ARARs include federal requirements which have been delegated to New York State. Generally, federal ARARs are referenced when state requirements do not exist.

1.5 Feasibility Study Description

The Technical and Administrative Guidance Memorandum (TAGM 4030) prepared by NYSDEC entitled, "Selection of Remedial Actions at Inactive Hazardous Waste Sites," and revised May 15, 1990, describes the feasibility study as a process to identify and screen potentially applicable remedial technologies, combine technologies into alternatives and evaluate applicable alternatives in detail, and select an appropriate remedial action plan.

Table 1-2

POTENTIALLY APPLICABLE LOCATION SPECIFIC ARARs/TBCs
CUBA MUNICIPAL WASTE DISPOSAL SITE

Citation/ Reference	Title	Applicable Media	Potential ARAR/TBC	Regulatory Agency
6 NYCRR 360	Solid Waste Management Facilities	Solid Waste	ARAR	NYSDEC
6 NYCRR 608	Use and Protection of Waters	Surface Water	ARAR	NYSDEC
N/A	Fish and Wildlife Impact Analysis for Inactive Hazardous Waste Sites	Hazardous Waste Sites	TBC	NYSDEC

Table 1-3

POTENTIALLY APPLICABLE ACTION SPECIFIC ARARs/TBCs CUBA MUNICIPAL WASTE DISPOSAL SITE

Citation/ Reference	Title	Applicable Media	Potential ARAR/TBC	Regulatory Agency
6 NYCRR 360	Solid Waste Management Facilities	Solid Waste	ARAR	NYSDEC
6 NYCRR 364	Waste Transporter Permits	Solid/Hazardous Waste	ARAR	NYSDEC
6 NYCRR 370	Hazardous Waste Management System - General	Hazardous Waste	ARAR	NYSDEC
6 NYCRR 372	Hazardous Waste Manifest System and Related Standards for Generators, Transporters and Facilities	Hazardous Waste	ARAR	NYSDEC
6 NYCRR 373	Hazardous Waste Management Facilities	Hazardous Waste	ARAR	NYSDEC
6 NYCRR 375	Inactive Hazardous Waste Disposal Site Remedial Program	Hazardous Waste	ARAR	NYSDEC
6 NYCRR 376	Land Disposal Restrictions	Hazardous Waste	ARAR	NYSDEC
6 NYCRR 608	Use and Protection of Waters	Surface Water	ARAR	NYSDEC
6 NYCRR 617 and 618	State Environmental Quality Review	All Media	ARAR	NYSDEC
6 NYCRR 621	Uniform Procedures	All Media	ARAR	NYSDEC
6 NYCRR 624	Permit Hearing Procedures	All Media	ARAR	NYSDEC
6 NYCRR 650	Qualifications of Operators of Wastewater Treatment Plants	NA	ARAR	NYSDEC
6 NYCRR 700-705	Classifications and Standards of Quality and Purity	Surface Water/ Groundwater	ARAR	NYSDEC
6 NYCRR 750-758	State Pollutant Discharge Elimination System	Surface Water/ Groundwater	ARAR	NYSDEC

Table 1-3 (continued)

POTENTIALLY APPLICABLE ACTION SPECIFIC ARARs/TBCs
CUBA MUNICIPAL WASTE DISPOSAL SITE

Citation/ Reference	Title	Applicable Media	Potential ARAR/TBC	Regulatory Agency
Air Guide No. 1	Guideline for the Control of Toxic Ambient Air Contaminants	Air	TBC	NYSDEC
Air Guide No. 29	Technical Guidance for Regulating and Permitting Air Emissions from Air Strippers, Soil Vapor Extraction Systems and Cold-Mix Asphalt Units	Air	TBC	NYSDEC
TAGM HWR-4030	Selection of Remedial Actions at Inactive Hazardous Waste Disposal Sites	Hazardous Waste	TBC	NYSDEC
TAGM HWR-4031	Fugitive Dust Suppression and Particulate Monitoring Programs at Inactive Hazardous Waste Sites	Air	TBC	NYSDEC
TAGM HWR-4046	Determination of Soil Cleanup Objectives and Cleanup Levels	Soil	TBC	NYSDEC
N/A	Analytical Services Protocol	All Media	TBC	NYSDEC
TOGS 1.3.1	Waste Assimilative Capacity Analysis and Allocation for Setting Water Quality Based Effluent Limits	Wastewater Discharge	TBC	NYSDEC
TOGS 1.3.1C	Development of Water Quality Based Effluent Limits for Metals Amendment	Wastewater Discharge	TBC	NYSDEC
TOGS 1.3.4	BPJ Methodologies	Wastewater Discharge	TBC	NYSDEC
TOGS 2.1.2	UIR at Groundwater Remediation Sites	Groundwater	TBC	NYSDEC
TOGS 2.1.3	Primary and Principal Aquifer Determinations	Groundwater	TBC	NYSDEC

Table 1-3 (continued)

POTENTIALLY APPLICABLE ACTION SPECIFIC ARARs/TBCs
CUBA MUNICIPAL WASTE DISPOSAL SITE

Citation/ Reference	Title	Applicable Media	Potential ARAR/TBC	Regulatory Agency
29 CFR 1910.120	Hazardous Waste Operations and Emergency Response	NA	ARAR	USDOL
40 CFR 122	EPA Administered Permit Programs: The National Pollutant Discharge Elimination System	Wastewater Discharge	ARAR	USEPA

In discussion with NYSDEC in the initial phase of the RI/FS process, in conformance with closure procedures for landfills, at a minimum, capping, which is a Presumptive Remedy for municipal solid waste landfills which are Class 2 sites, is considered as a remedy for the Cuba Municipal Waste Disposal Site. This Presumptive Remedy provides a final cover for the site consistent with the requirements of 6 NYCRR Part 360 with variances under Part 360-1.7(c), and the NYSDEC TAGM 4044 "Accelerated Remedial Actions at Class 2, Non-RCRA Regulated Landfills," revised March 9, 1992. The objective of this feasibility study will also be to meet the goal and criteria of this guidance document.

The approach of a feasibility study, as described above, initially is to develop remedial action objectives for medium-specific or operable unit-specific goals to protect human health and the environment. The goals consider the contaminants and contaminant concentrations (as determined by the remedial investigation), the exposure routes and potential receptors (as determined by the baseline risk assessment), and the acceptable contaminant or risk levels or range of levels.

In the initial phase of the feasibility study, identified remedial technologies which are not technically applicable to the site media or contamination found, or are unproven and/or not commercially available, will be eliminated from further consideration. The technologies remaining after initial screening will be assembled into remedial alternatives for evaluation. Preliminary screening of alternatives will consider effectiveness, implementability and relative costs. Effectiveness evaluation includes consideration of the following:

1. The potential effectiveness of process options in handling the estimated areas or volumes of contaminated media, and meeting the remediation goals identified by the remedial action objectives;

2. The potential impacts to human health and the environment during the construction and implementation phase; and

3. The proven effectiveness and reliability of the process with respect to the contaminants and conditions at the site.

Implementability includes both the technical and administrative feasibility of utilizing the alternative. Administrative feasibility considers institutional factors, such as the ability to obtain necessary permits for on-site or off-site actions and the ability to restrict land use based on specific remediation measures. Technical feasibility considers such aspects as the ability to comply with SCGs, the availability and capacity of treatment, storage and disposal facilities, the availability of equipment and skilled labor to implement the technology, the ability to design, construct and operate the alternative, and acceptability to the regulatory agencies and the public.

Preliminary costs are considered at this stage of the feasibility study process for the purpose of relative cost comparison among the alternatives.

The results of the screening process identifies potentially viable technologies or combinations of technologies/alternatives for the site which will be carried forward for detailed evaluation.

The guidance requires that a feasibility study provide a detailed analysis of the potentially viable remedial alternatives based on consideration of the following evaluation criteria for each alternative.

- Threshold Criteria
  - Protection of human health and the environment
  - Compliance with standards, criteria and guidelines
- Balancing Criteria
  - Short-term impacts and effectiveness
  - Long-term effectiveness and permanence
  - Reduction in toxicity, mobility or volume through treatment
  - Implementability
  - Cost

In addition to the above listed threshold and balancing criteria, the guidance also provides consideration of the following modifying criteria:

- Regulatory agency acceptance
- Community acceptance

Provided below is a description of each of the feasibility study criteria.

Applicable federal and New York State SCGs are identified to provide both action-specific guidelines for remedial work at the site and contaminant-specific cleanup standards for the alternatives under evaluation. In addition to action-specific and contaminant-specific guidelines, there are also location-specific guidelines that pertain to such issues as restrictions on actions at historic sites. These guidelines and standards are referenced in Section 1.4 of this document and are considered a minimum performance specification for each remedial action alternative under consideration.

Protection of human health and the environment is evaluated on the basis of estimated reductions in both human and environmental exposure to contaminants for each remedial alternative. The evaluation focuses on whether a specific alternative achieves adequate protection, and how site risks are eliminated, reduced or controlled through treatment, engineering or institutional controls. An integral part of this evaluation is an assessment of long-term residual risks to be expected after remediation has been completed. Evaluation of the human health and environmental protection factor is generally based, in part, on the findings of a site-specific risk assessment. The risk assessment performed for this site incorporates the qualitative estimation of the risk posed by carcinogenic and noncarcinogenic contaminants detected during the remedial investigation. The results of the risk assessment performed for the Cuba Municipal Waste Disposal Site are presented in the Remedial Investigation Report dated July 1999, and summarized in Section 1.3.

Evaluation of short-term impacts and effectiveness of each alternative examines health and environmental risks likely to exist during the implementation of a particular remedial action. Principal factors for consideration include the expediency with which a particular alternative can be completed, potential impacts on the nearby community and on-site workers, and mitigation measures for short-term risks required by a given alternative during the necessary implementation period.

Examination of long-term impacts and effectiveness for each alternative requires an estimation of the degree of permanence afforded by each alternative. To this end, the anticipated service life of each alternative must be estimated, together with the estimated quantity and characterization of residual contamination remaining on-site at the end of this service life. The magnitude of residual risks must also be considered in terms of the amount and concentrations of contaminants remaining following implementation of a remedial action, considering the persistence, toxicity and mobility of these contaminants and their propensity to bioaccumulate.

Reduction in toxicity, mobility and volume of contaminants is evaluated on the basis of the estimated quantity of contamination treated or destroyed, together with the estimated quantity of waste materials produced by the treatment process itself. Furthermore, this evaluation considers whether a particular alternative will achieve the irreversible destruction of contaminants, treatment of the contaminants or merely removal of contaminants for disposal elsewhere.

Evaluation of implementability examines the difficulty associated with the installation and/or operation of each alternative on-site and the proven or perceived reliability with which an alternative can achieve system performance goals (primarily the SCGs discussed above). The evaluation must examine the potential need for future remedial action, the level of oversight required by regulatory agencies, the availability of certain technology resources required by each alternative and community acceptance of the alternative.

Cost evaluations presented in this document estimate the capital, and operation and maintenance (O&M) costs, including monitoring, associated with each remedial alternative. From these estimates, a total present worth for each option is determined.

Regulatory agency and community acceptance evaluates the technical and administrative issues and concerns which the agencies or the community may have regarding each of the alternatives.

1.6 Approach to Feasibility Study

Technical and Administrative Guidance Memorandum (TAGM) HWR-92-4044 (Accelerated Remedial Actions at Class 2, Non-RCRA Regulated Landfills) states that the RI/FS process for Class 2 sites requires the identification and screening of remedial technologies, however, the TAGM indicates the process may be "somewhat simplified and accelerated" due to the typical large size and composition of mixed waste landfills that are composed primarily of municipal solid waste. Therefore, for the waste media at the Cuba Municipal Waste Disposal Site, placement of a Part 360 cap will be the Presumptive Remedy. The second media of concern for the site is leachate. Leachate collection treatment and disposal technologies will be identified and evaluated in this feasibility study.

2.0 IDENTIFICATION AND SCREENING OF REMEDIAL TECHNOLOGIES

2.1 Introduction

In general, response actions which satisfy remedial objectives for a site include institutional, containment, isolation, removal or treatment actions. In addition, United States Environmental Protection Agency (USEPA) guidance under the Comprehensive Emergency Response, Compensation and Liability Act (CERCLA) requires the evaluation and comparison of a "no-action" alternative to the action alternatives. Each response action for each medium of interest must satisfy the remedial action objectives for the site or the specific area of concern. Technologies and process options, which are available commercially and have been successfully demonstrated, are identified in this feasibility study along with selected emerging technologies, if applicable.

The screening of process options or technology types is performed by evaluating the ability of each technology to meet specific remedial action objectives, technical implementability, and short-term and long-term effectiveness. A discussion of selected response actions and their applicability to the Cuba Municipal Waste Disposal Site is provided below. Primary evaluation/screening of the response actions and remedial technologies will be based on technical effectiveness as it related to the specific characteristics of the site. However, where appropriate, consideration will also be given to implementability and cost.

2.2 No Action

The no-action alternative will be considered, and as described above, will serve as a baseline to compare and evaluate the effectiveness of other alternatives. Under the no-action scenario, only monitoring will be considered as a limited remedial response action. Monitoring would consist of periodic groundwater and leachate sampling to evaluate changes over time in conditions at the site and to ascertain the level of any natural attenuation which may occur or any increase in contamination which may necessitate remedial action. Natural attenuation (under the no-action alternative), as opposed to active remediation, relies entirely on naturally occurring physical, chemical and biological processes (e.g., dilution, dispersion and degradation) to reduce contaminant concentrations.

2.3 Institutional Controls

Institutional controls may include access restrictions and deed restrictions. Access restrictions, such as eliminating access to the site landfill by fencing and posting of signs warning of the presence of contamination/hazardous waste, are considered potentially applicable to the site. Deed restrictions could be imposed by the Village of Cuba to limit uses of and activities at site, and possibly around the site. Restrictions could be developed by the Village and implemented through the building permit approval process. The implementation of the restrictions and the responsibility for enforcement would be essentially with the Village. Deed restrictions, in addition to zoning which prohibit/restrict future use and development of the site, and possibly downgradient of the site, would be a potentially applicable institutional control.

2.4 Waste/Soil Remediation Technologies

2.4.1 Isolation/Containment

Potentially applicable isolation and containment technologies include surface barriers, such as permeable covers and low permeability caps. These technologies are designed to prevent direct contact with and migration of contaminants from the area of concern, and do not provide any treatment for the isolated/contained waste or contaminated soil. Various forms of surface barriers currently exist to significantly reduce the infiltration of precipitation into waste and contaminated soil, and minimize surface runoff and contact with contaminated material. These barriers include RCRA (Resource Conservation and Recovery Act) caps, soil and stone cover, and pavement. However, as discussed previously, in accordance with TAGM HWR-92-4044 "Accelerated Remedial Actions at Class 2, Non-RCRA Regulated Landfills," the Presumptive Remedy for this site will be a final cover consistent with the requirements of 6NYCRR Part 360. The following provides a discussion of a Part 360 cap.

2.4.1.1 - Part 360 Cap

Technology Description: This cap consists of a four-layered system comprised of a vegetated topsoil upper layer, underlain by a drainage/barrier protection layer followed by a low permeability layer (10^{-7} cm/sec) comprised of clay (18 inches) or a flexible membrane liner (FML), followed by a gas venting layer. The thickness of the Part 360 cap is 3 1/2 to 5 feet depending on whether a FML or clay is used for the low permeability layer. This cap mitigates direct contact with waste and contaminated soil, infiltration of precipitation into waste and runoff of contaminants.

Initial Screening Results: Since this type of cap provides for adequate containment/ isolation of waste and contaminated soil, this technology will be considered further as a Presumptive Remedy.

2.4.2 Excavation and Off-Site Disposal

Technology Description: Excavation and off-site disposal would include removal of all waste at the Cuba Municipal Waste Disposal Site and disposal of the waste at an off-site permitted landfill. Excavated areas where the waste has been removed would be replaced with clean fill. The estimated volume of waste disposed at the Cuba Municipal Waste Disposal Site is 70,000 cubic yards. This estimate was based on 18,700 lineal feet of trench with each trench approximately 10 feet wide and 10 feet deep.

Initial Screening Results: This technology is not consistent with the TAGM for accelerated remedial actions at landfills. However, for some landfills this remedial action is appropriate if the volume of waste is small and a disposal facility is available to accept the waste at a reasonable cost. The large volume of waste requiring removal at the Cuba Municipal Waste Disposal site would make this remedial action extremely costly. An estimated cost for this remedial action could be between $10 million and $20 million. This is two to four times more than twice the estimated cost of capping which is discussed in the following sections of this feasibility study. Therefore, this technology will not be considered further.

2.4.3 Consolidation

Technology Description: Consolidation is a process where waste is partially excavated and placed in the area of unexcavated waste thereby reducing the area of waste requiring capping. Consolidation is particularly applicable at landfills where the depth to waste is shallow and where limited excavation can significantly reduce the area requiring capping.

Initial Screening Results: As described above, consolidation is a technology that would only be effective if combined with the capping. Due to the method utilized for placement of waste at the Cuba Municipal Waste Disposal Site (trenching) and the relatively shallow depth of waste (reportedly 4 to 10 feet), consolidation may be an effective technology to reduce overall costs of capping the site. Therefore, this technology will be considered further.

2.5 Hydraulic Barrier Technologies

Although a low permeability cap will significantly reduce the generation of leachate, since waste likely has been buried to bedrock, it is likely that groundwater will come into contact with waste, at least during periods of high precipitation and snowmelt, and continue to generate leachate. In order too minimize groundwater flow through the landfill, subsurface hydraulic barriers can be constructed upgradient of the site to divert groundwater around the waste. Two subsurface barriers, low permeability walls and high permeability diversion trenches, are described below.

2.5.1 Low Permeability Walls

Technology Description: This technology, which is in wide use, consists of construction of a low permeability subsurface wall into a low permeability underlying material, such as clay or competent bedrock, which would serve as the lower confining barrier. The wall would comprise a bentonite slurry with a thickness of about 3 feet and depth of approximately 10 feet at the site. Groundwater migrating onto the landfill site from the upgradient tributary area would be diverted around the waste mass.

Initial Screening Results: Due to the fractured bedrock at the site, it would not be possible to key a slurry wall into an effective confining layer. In addition, the native soil at the site is not highly permeable and would not readily convey water along the wall. As a result, groundwater could migrate under the wall and contact waste. Therefore, this technology by itself will not be considered further.

2.5.2 Diversion Trenches

Technology Description: Diversion trenches are constructed with a highly permeable material, such as gravel or stone, that is used to collect/intercept groundwater and divert it around a given area. Similar to slurry walls, interceptor trenches have been used successfully to divert groundwater when the depth to groundwater is fairly shallow and generally where there is fairly low permeability material below the trench. However, to maximize the effectiveness of diversion trenches, a low permeability material, such as bentonite/slurry wall, is placed immediately downgradient of the trench to prevent groundwater from migrating beyond the permeable material.

Initial Screening Results: Due to the shallow depth to groundwater and bedrock at the site, diversion trenches would be somewhat effective in diverting groundwater around the site. However, to be effective at the Cuba Municipal Waste Disposal Site, construction of a diversion trench would be required with a companion low permeability barrier/wall. Therefore, this technology, together with a downgradient slurry wall, will be considered further.

2.6 Leachate Collection Technologies

Low levels of contaminants have been detected in the groundwater in the shallow overburden and bedrock on- and off-site. Because groundwater in the bedrock is not highly contaminated, is difficult and costly to collect, and likely will be significantly less contaminated as a result of implementation of the Presumptive Remedy, consideration of groundwater remediation will be limited to the water in the shallow overburden at the site. Because of the thinness of this shallow groundwater system (less than 10 feet), it can be considered as leachate.

Leachate collection is a remedial technology generally used in combination with treatment technologies to control and remove contaminants in landfill leachate. Two collection technologies, extraction wells and interceptor trenches, are described below.

2.6.1 Extraction Wells

Technology Description: The use of wells to pump contaminated leachate to the surface for treatment is in wide use as a remedial technology. With this technology, contaminated leachate can be extracted for on-site or off-site treatment.

Initial Screening Results: Due to the shallow depth to groundwater/leachate and bedrock, the sporadic shallow groundwater and leachate flow due to seasonal influences, and the low hydraulic conductivity of the overburden, extraction wells are not a potentially viable technology for collection of leachate at the site. Therefore, this technology will not be considered further.

2.6.2 Interceptor Trenches

Technology Description: As opposed to wells, interceptor trenches have been used successfully to extract leachate in situations where the depth to groundwater/leachate is shallow. Shallow trenches are constructed using high permeability material downgradient of leachate flow and allow for leachate to flow into the trench. Leachate is collected from the trench using perforated pipes and pumps. Similar to the discussion of diversion trench above in Section 2.5.2, a low permeability material placed immediately downgradient of the trench will improve effectiveness in capturing leachate.

Initial Screening Results: Due to the shallow depth to leachate and bedrock at the site, interceptor trenches would be effective in controlling and collecting leachate at the site. Therefore, this technology will be considered further.

2.7 Leachate Treatment Technologies

Once collected, leachate must be treated to meet discharge standards. Treatment technologies include biological, chemical and physical processes. Technologies which could be applicable to treatment of leachate contaminated with volatile organic compounds, metals and other contaminants detected at the Cuba Municipal Waste Disposal Site are evaluated below.

2.7.1 Air Stripping

Technology Description: Air stripping involves a process by which volatile organic compounds (VOCs) are partitioned from water by greatly increasing the surface area of the contaminated water exposed to air. Types of aeration methods include packed towers, diffused aeration, tray aeration and spray aeration. Air stripping is a widely used, proven and commercially available technology.

The applicability and effectiveness of air stripping will depend on the potential for inorganic or biological fouling of the equipment. Clogging of the stripping column packing material due to inorganics in the water, in particular dissolved ferrous iron which precipitates out as insoluble ferrous hydroxide species upon aeration, and biofouling are common problems if not taken into consideration during design. In addition, the Henry's Law constant of the VOCs in the aqueous stream will determine the effectiveness of air stripping.

Initial Screening Results: Air stripping represents a potentially viable technology for treatment of VOC contaminated leachate at the site. Therefore, this technology will be retained for further evaluation.

2.7.2 Carbon Adsorption

Technology Description: Carbon adsorption involves a process by which water is pumped through a series of canisters containing activated carbon onto which dissolved contaminants adsorb. The technology requires periodic replacement or regeneration of saturated carbon. Carbon adsorption is a widely used, proven and commercially available technology. The applicability and effectiveness of carbon adsorption may be limited by the presence of certain compounds which can foul the system, high contaminant concentration levels and the physical properties of the contaminants, among other factors.

Initial Screening Results: This technology has been very effective in the removal of VOCs, as well as semivolatile and non-volatile contaminants, including PCBs and pesticides, from contaminated water. Therefore, this technology will be retained for further evaluation.

2.7.3 Oxidation

Technology Description: Ultraviolet (UV) radiation, ozone and/or hydrogen peroxide is used to destroy contaminants as water flows into a treatment tank. An ozone destruction unit is used to treat off-gas from the treatment tank. UV oxidation is a commercially available technology which is effective in the treatment of volatile and semivolatile organic compounds.

Initial Screening Results: Oxidation is a potentially viable technology for treatment of organic contaminants in leachate at the site. Therefore, this technology will be retained for further evaluation.

2.7.4 Biological Treatment

Technology Description: Typically, this technology involves the introduction of water into biological treatment units where enzymes and microorganisms decompose organic contaminants into carbon dioxide, water and nonhazardous by-products. Supplemental nutrients may be added to assist the biological process. Biological treatment occurs at the rate of decomposition, which may be low. Biodegradation may also be accomplished in-situ through the same biological processes.

Initial Screening Results: Biological treatment is generally less effective than available alternative technologies for chlorinated organic contaminants which are present in the water at the site and not effective for removal of metals. However, it is effective in the treatment of nitrogen compounds which are typically found in leachate. Therefore, this technology will be considered further.

2.7.5 Reverse Osmosis

Technology Description: Osmosis is a process which occurs when two solutions of different solute concentrations reach equilibrium across a semi-permeable membrane. The solvent (water in this case) will naturally flow from the less concentrated solution into the more concentrated solution. To reverse this process, the solution with the high concentrations must be pressurized to a level higher than the osmotic pressure. At sufficiently high pressures, usually 200 to 800 pounds per square inch (psi), the water will flow out of the more concentrated solution, leaving the contaminants trapped on the other side of the semi-permeable membrane.

The volume of the concentrated waste is generally 10 to 20% of the feed volume. This concentrated waste will require additional treatment. Reverse osmosis has been demonstrated to be effective for treatment of brackish waters, aqueous inorganic wastes and radionuclides, and recent findings indicate that it is useful in removing some specific organic compounds from solution. The effectiveness of this process is highly dependent on the chemical composition of the waste solution to be treated and the characteristics of the membrane.

Initial Screening Results: Since more effective and proven methods for treatment of volatile organic and inorganic contaminants are readily available, and large volumes of reject water would be generated, reverse osmosis will be costly. Therefore, this technology will not be considered further.

2.7.6 Filtration

Technology Description: Filtration is a process in which suspended and colloidal particles, which are not readily settleable, are removed from water by physical entrapment on a media. Fluid flow through the filter media may be accomplished by gravity or it may be pressure induced. Beds of granular material, such as sand and anthracite, are commonly used filters in water treatment. Other types of filters include vacuum filters, plate and frame filters, and belt filters. These filters are often used to dewater sludges produced by processes, such as sedimentation and chemical precipitation. Packed beds of granular material are usually backwashed to remove the filter cake. The collected solids will require disposal and costs for disposal will depend on whether the material is hazardous or nonhazardous.

Initial Screening Results: Filtration is used to remove suspended solids and colloidal particles as part of a water treatment process. Therefore, this technology will be retained for further consideration as part of an overall treatment process for leachate.

2.7.7 Ion Exchange

Technology Description: Ion exchange is a process in which ions are removed from solution by exchange with non-toxic ions supplied by the ion exchange material. Inorganic compounds can be removed by this process. Generally, a train of resin beds in series containing different resins for cation and anion removal are used. The beds must be monitored for breakthrough and must be regenerated using a variety of regeneration chemicals which may themselves be hazardous. Ion exchange can be used both as a pretreatment and as a polishing step.

Initial Screening Results: The ion exchange process is suitable for the removal of inorganic compounds from extracted leachate as part of an overall treatment alternative. Therefore, this technology will be retained for further consideration.

2.7.8 Chemical Precipitation and Clarification

Technology Description: Precipitation is a physical and chemical technique that can be used to remove metals from an aqueous stream. The metals can be precipitated out of solution by changing the chemical equilibrium of the solution. This is generally achieved by adding a chemical that reacts directly with the contaminant to form an insoluble settleable product. When used prior to other treatment technologies, this process eliminates the probability of reduced efficiency due to dissolved metals precipitation during later phases of treatment. The pH can be adjusted to optimize the precipitation process. Metals can be precipitated as hydroxides, carbonates and sulfides. Typical precipitating agents include calcium oxide, caustic soda, sodium sulfide, ferrous sulfide and hydrogen sulfide gas.

Initial Screening Results: Chemical precipitation may be utilized for the removal of inorganics as part of an overall treatment process. Therefore, this technology will be retained for further consideration.

2.7.9 Phytoremediation

Technology Description: Phytoremediation is a developing technology in which vegetation is used to remediate contaminants in groundwater, leachate and soil. The process involves the use of vegetation to remove contaminants from the aqueous media and soil, and convert the contaminants to less toxic metabolites. In addition, the vegetation allows for the transfer of oxygen to the root zone for the enhancement of aerobic degradation of organic contaminants. Through the increase of organic carbon in the shallow root zone, the migration of organic chemicals and metals is reduced. Therefore, even if the vegetation cannot remove the contaminants, the vegetation may mitigate the movement of the contaminants either off-site or from reaching groundwater. Significant research has been completed using hybrid poplar trees. These trees are extremely fast growing and appear to tolerate high concentrations of organics. The rooting system of these trees are to a depth of 6 to 8 feet below ground surface. In addition to acting as a remediation technology, the trees have been used as a buffer for many landfills.

Initial Screening Results: Due to the shallow depth of groundwater/leachate in the overburden at the Cuba Municipal Waste Disposal Site and the presence of organic and inorganic contaminants in leachate at the site, phytoremediation may be an applicable remediation technology for containment/treatment of leachate. Therefore, this technology will be considered further for remediation of leachate at the site.

2.7.10 Off-Site Disposal of Untreated Leachate

Technology Description: Under this option, collected untreated leachate would be disposed off-site. One option is to transport the leachate to a publicly owned treatment works (POTW). The leachate would be required to meet standards required by the POTW. Other off-site, privately owned disposal/treatment facilities could also be used for disposal of the leachate.

Initial Screening Results: Off-site disposal represents a potentially viable option assuming the POTW and/or other disposal facility requirements could be met. Therefore, this technology will be retained for further evaluation.

2.7.11 Natural Attenuation

Technology Description: Natural attenuation is an alternative whereby natural processes, such as dilution, dispersion, volatilization, biodegradation, adsorption and chemical reactions with subsurface materials, are allowed to reduce contaminant concentrations to acceptable levels. Consideration of this option requires evaluation of contaminant degradation rates to determine feasibility and special approvals may be needed. In addition, groundwater and leachate sampling and analysis must be conducted throughout the process to confirm that attenuation is proceeding at a rate consistent with meeting cleanup objectives and that any potential receptors will not be impacted. Several disadvantages of natural attenuation include: intermediate degradation products may be more mobile and more toxic than the original contaminant; it should be considered only in low-risk situations; it should be considered only where there are no potential impacts on receptors; contaminants may migrate before they are degraded; regulatory agency acceptability is generally not favorable; and community acceptability is poor.

constructed on-site and would also need to be evaluated to determine if there would be any potential impacts on the leachate collection system.

Initial Screening: Due to the limited space on the site and potential adverse impacts on the leachate collection system, and generation of leachate if the infiltration gallery is installed upgradient of the site, this technology will not be considered further.

2.8.3 Recharge Basin

Technology Description: This technology involves discharge of treated leachate to a recharge basin. This option, if implemented, would have to be evaluated with respect to potential impact on the leachate collection system and ability to construct a recharge basin of adequate capacity on-site given the shallow thickness of the overburden and limited space outside of the area of waste.

Initial Screening: This option will be difficult to implement at the site, since there is little area for on-site recharge basins downgradient or sidegradient of the landfill, and recharge upgradient of the landfill would be limited due to the shallow depth of the overburden and could result in the generation of leachate by increasing groundwater flow through the landfill.

2.8.4 Surface Water Discharge

Technology Description: Discharge to surface water would require construction of a piping system to convey treated leachate to nearby receiving surface waters.

Initial Screening: Due to the close proximity of surface water to the site, this option will be retained for further evaluation at this time. However, prior to final selection of this option, a drainage area analysis would need to be performed to ensure that the intermittent streams/creeks planned for discharge could accept storm water and treated leachate from the site.

2.9 Summary Evaluation of Remedial Technologies

Based on the screening of remedial technologies, provided below and in Table 2-1, is a summary of the technologies that are retained for further consideration, either as remedial alternatives in and of themselves, or in combination with other technologies to form alternatives.

Waste/Soil Remediation

- Isolation/Containment
  - Part 360 cap

- Consolidation
  - Part 360 Cap

Leachate Remediation

- Hydraulic Barrier
  - groundwater diversion trench with a low permeability wall
- Collection
  - leachate interceptor trench with a low permeability wall
- Treatment
  - air stripping
  - carbon adsorption
  - oxidation
  - biological treatment
  - filtration
  - ion exchange
  - chemical precipitation and clarification
  - phytoremediation
  - off-site disposal of untreated leachate
- Discharge
  - surface water discharge

Table 2-1

SUMMARY OF SCREENING OF REMEDIATION TECHNOLOGIES
CUBA MUNICIPAL WASTE DISPOSAL SITE

General Response Action	Remedial Technology	Description	Summary of Initial Screening Results
Waste/Soil Remediation Technologies	Part 360 Cap	Placement of a low permeability cap to isolate waste and reduce infiltration of precipitation and leachate generation.	Retained for further consideration.
	Excavation and Off-site Disposal	All on-site waste excavated and disposed off-site at permitted disposal facility.	Not retained for further consideration due to significant cost.
	Consolidation	Waste partially excavated and replaced on the remaining area of waste creating a smaller landfill footprint.	Retained for further consideration when combined with a Part 360 cap.
Hydraulic Barrier Technologies	Low Permeability Walls	Low permeability subsurface barriers constructed to divert groundwater around landfill.	Not retained by itself due to low permeability soils in the overburden and absence of a shallow confining unit below the wall.
	Diversion Trenches	High permeability trenches constructed to intercept and divert groundwater around landfill.	Retained for further consideration together with low permeability wall.

Table 2-1 (continued)

SUMMARY OF SCREENING OF LEACHATE REMEDIATION TECHNOLOGIES
CUBA MUNICIPAL WASTE DISPOSAL SITE

General Response Action	Remedial Technology	Description	Summary of Initial Screening Results
Leachate Collection Technologies	Extraction Wells	Extraction wells constructed to pump leachate to the surface for treatment.	Not retained for further consideration due to the shallow depth to leachate and bedrock.
	Interceptor Trenches	Trenches constructed to intercept leachate for treatment.	Retained for further consideration.
	Air Stripping	VOCs partitioned from water phase to gas phase utilizing packed tower or aeration.	Retained for further consideration for VOC removal.
	Carbon Adsorption	Leachate pumped through canisters containing activated carbon or alternate adsorbent.	Retained for further consideration for VOC and semi-VOC removal.
	Oxidation	Contaminants destroyed by ultraviolet radiation.	Retained for further consideration for VOC removal.
	Biological Treatment	Microorganisms decompose organic contaminants in treatment units.	Retained for further consideration for nitrogen removal.
	Reverse Osmosis	Semi-permeable membrane and high pressure used to obtain a concentrated solution of contaminants.	Not retained for further consideration since more cost-effective and proven methods are available for treatment of chlorinated organic contaminants.

Table 2-1 (continued)

SUMMARY OF SCREENING OF LEACHATE REMEDIATION TECHNOLOGIES
CUBA MUNICIPAL WASTE DISPOSAL SITE

General Response Action	Remedial Technology	Description	Summary of Initial Screening Results
Treated Leachate Discharge Technologies	Injection Wells	Treated leachate reinjected to groundwater through a series of wells.	Not retained for further consideration due to shallow thickness of overburden and difficulties with injection into bedrock at the site.
	Infiltration Gallery	Treated leachate discharged to a series of leaching pools, subsurface piping network or trench.	Not retained for further consideration due to the shallow depth to bedrock and low permeability soils, and potential difficulties in infiltration into bedrock at the site.
	Recharge Basin	Discharge of treated leachate to recharge basin.	Not retained for further consideration due to shallow depth to bedrock and space limitation at the site.
	Surface Water Discharge	Convey treated leachate to surface water body.	Retained for further consideration.

3.0 DEVELOPMENT AND PRELIMINARY EVALUATION OF ALTERNATIVES

Based on the screening of remedial technologies in Section 2.0, the next phase of the feasibility study process is to develop remedial alternatives for preliminary evaluation for effectiveness, implementability and cost. These alternatives can comprise either a single technology if only one medium at a site is of concern and/or only one treatment process is required, or a combination of technologies if multiple media are of concern and/or multiple treatment processes are required.

As described previously, the media of concern identified for the Cuba Municipal Waste Disposal Site are waste and leachate. Based on the media identified for evaluation, five alternatives have been developed for the site. A description of these alternatives, and the general remedial technologies that form the alternatives and the media they address, is provided below.

Alternative	Media	Technology
1	• Waste	Part 360 Cap
	• Leachate	Groundwater Diversion Trench, and Leachate Interceptor Trench and Treatment
1A	• Off-site Leachate Treatment	
1B	• On-site Leachate Treatment	
2	• Waste	Part 360 Cap
	• Leachate	Groundwater Diversion Trench and Phytoremediation
3	• Waste	Part 360 Cap
	• Leachate	Groundwater Diversion Trench
4	• Waste	Consolidation and Part 360 Cap
	• Leachate	Groundwater Diversion Trench
5	• No Action	

Based on the evaluation of technologies in Section 2.0, the contaminants known and expected to be found in leachate, discharge requirements and experience, the following treatment process has been selected for the development and evaluation of Alternative 1B for treatment of leachate at the site: air stripping for VOC removal; chemical precipitation and clarification for metals removal; biological treatment for nitrogen removal; and carbon absorption for PCB and pesticide removal.

3.1 Estimation of Leachate Generation

The generation of leachate from the Cuba Municipal Waste Disposal Site was estimated using two methods. The first method involved evaluating the water budget of the site considering the hydrogeologic characteristics of the site and surrounding area observed during the remedial investigation. The second method involved the use of the Hydrologic Evaluation of Landfill Performance (HELP) model to estimate the amount of water percolating through the ground surface and subsequent generation of leachate.

3.1.1 Water Budget Evaluation

The site is located in a relatively small surface water drainage basin amid steep topography. These factors have a significant influence on the flow of water through the site, making the determination of precipitation and subsequent surface water runoff, evapotranspiration and infiltration fairly straightforward.

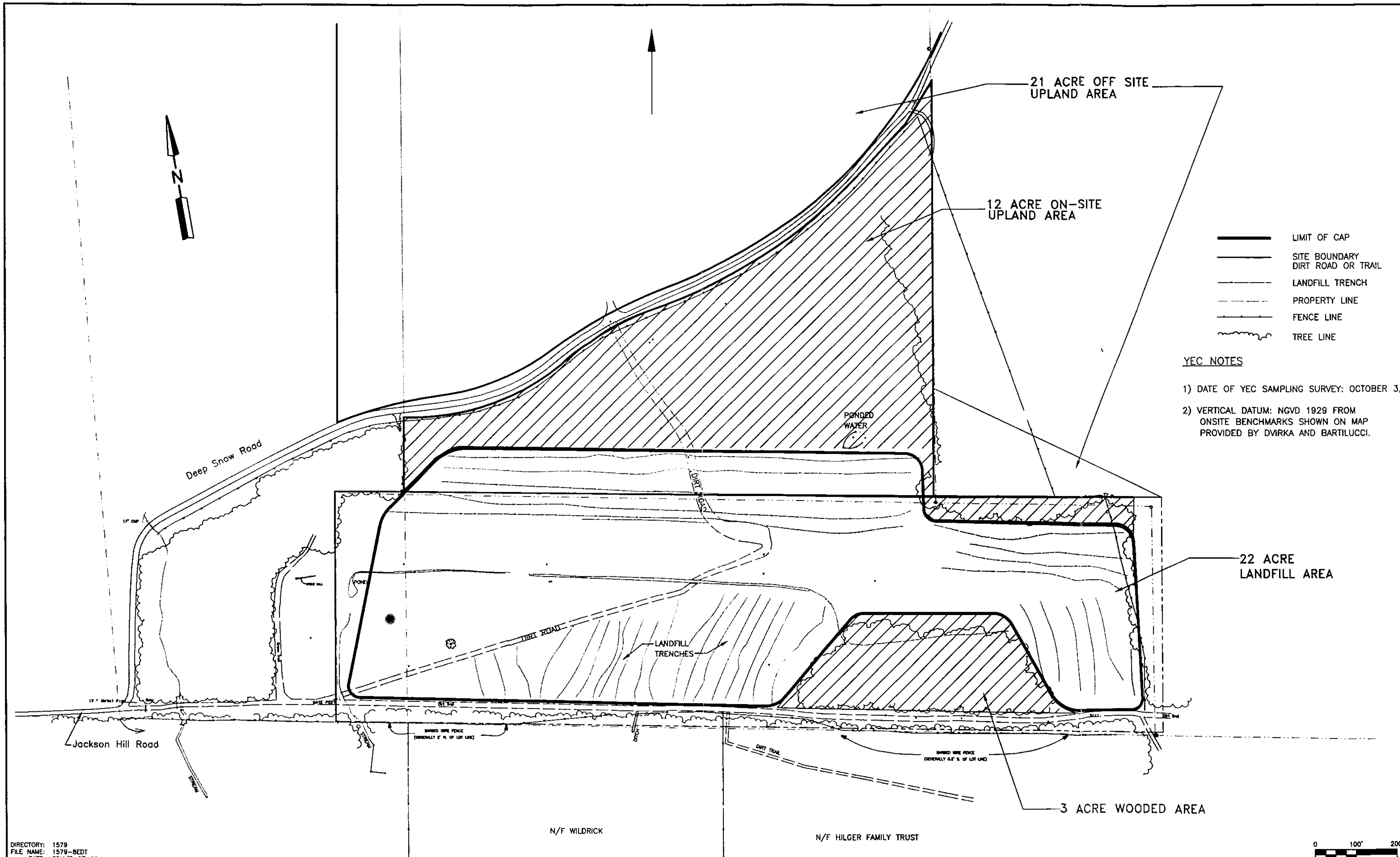
For the purpose of the evaluation of leachate generation, it was assumed that most shallow groundwater flowing through the site—that is, groundwater in the thin overburden above bedrock—has been exposed to waste and discharges in groundwater seeps on, or downgradient, of the site. For the purpose of flow calculations and the determination of leachate volumes requiring treatment, all shallow groundwater is considered to be leachate.

The total amount of leachate generated on the site is a function of the relationship of precipitation onto the site, groundwater entering the site from upgradient areas, surface water runoff, evapotranspiration and groundwater recharge/infiltration. Precipitation for the area is

37 inches per year (1.9 gpm per acre) (Golder, 1991). Evapotranspiration for the area is 24 inches per year according to the U.S. Water Atlas (Geraghty et al., 1973). Groundwater entering the site, surface water runoff and groundwater recharge are discussed below.

The amount of groundwater flow through the Cuba Landfill site can be determined by the sum of water entering the site as lateral groundwater flow from the tributary area upgradient of the site and the amount of water in the form of precipitation infiltrating through the ground surface of the site. Based on data obtained during the field investigation from observation of water levels in monitoring wells, and location of groundwater seeps and surface water bodies, it has been determined that the water table follows the topography and that groundwater flow directions mimic undiverted surface water flow directions. The land tributary to the site consists of those areas topographically higher than the site from which surface water and groundwater could flow onto the site. These areas were determined through site observations and analysis of topographic maps of the area. The upland area tributary to the site comprises 18 acres located north of Deep Snow Road and 3 acres located northeast of the landfill area for a total of 21 acres (see Figure 3-1).

Water that flows from a tributary land area is typically a combination of lateral groundwater flow and surface runoff; however, surface water runoff onto the site has been observed to be nonexistent from the area north of Deep Snow Road. The land tributary upland of the site is relatively flat and is well vegetated. Drainage culverts and berms along Deep Snow Road appear to divert any upland surface water generated around the site. Water flowing southwest through the culverts flows by the western portion of the site and does not contact waste. Water that flows northeast along Deep Snow Road drains to a tributary of Van Campen Creek that flows southward at a distance of approximately 800 feet east of the site. As a result of this surface water diversion, the only contribution of water to the site from upland tributary land is through infiltration of precipitation and resulting lateral groundwater flow. As a result, infiltration regarding the upland area is 13 inches per year, which is the difference between precipitation (37 inches) and evapotranspiration (24 inches). Therefore, the upland tributary area contributes 14 gpm (lateral groundwater flow) to leachate generation.



DIRECTORY: 1579
FILE NAME: 1579-BEDT
DATE: SDM/7-27-99

CUBA MUNICIPAL WASTE DISPOSAL SITE
VILLAGE OF CUBA, NEW YORK

DVIRKA AND BARTILUCCI
CONSULTING ENGINEERS
A DIVISION OF WILLIAM F. COSULICH ASSOCIATES, P.C.

LEACHATE GENERATION EVALUATION
DRAINAGE/RECHARGE AREAS

FIGURE 3-1

Groundwater flow originating on the Cuba Municipal Waste Disposal Site can also be estimated. While the steep slopes of Cuba landfill site promote runoff, many of the landfill trenches at the site have subsided leaving long depressions that collect surface water runoff. Fractures in the ground surface and loose surface soil enhance the infiltration of surface water. The location of many trenches parallel to land surface contours facilitates the capture of surface water that may otherwise flow off site without infiltrating and contacting buried waste. All precipitation/runoff on the portion of the site which was used for waste disposal, as defined by the waste trenches, test pits, soil borings and observations (22 acres), is assumed to be collected in the trenches, and therefore, the infiltration over this area is 13 inches per year. The remaining 15 acres of the site (12 acres uphill of the landfill area/trenches and the 3-acre treed area in the southeastern portion of the site downhill of the landfill area) are absent of trenches and runoff is estimated to be 6 inches per year and infiltration is 7 inches per year based on the HELP model results discussed below. (Note that the 6 inches of runoff from the 12-acre portion of the site is not considered to come into contact with waste and generate leachate since this offsets the conservative assumption that all runoff on the landfill portion of the site will infiltrate the waste and generate leachate.)

Therefore, the groundwater recharge attributable to precipitation over the 40-acre site is 22 gpm, which is the sum of infiltration over the 22-acre landfill area (15 gpm) and infiltration over the 15 acre non-landfill portion of the site (5 gpm). The resulting total groundwater flow through the site from off-site tributary flow (14 gpm) and on-site flow (20 gpm) is 34 gpm. Assuming all shallow groundwater is leachate, approximately 49,000 gallons per day (gpd) are generated under existing site conditions.

The estimated groundwater flow through the site of 34 gpm appears reasonable when compared to the observed groundwater outflows during the remedial investigation. Outflows have been observed at a rate of about 16 gpm. The outflow of groundwater includes leachate observed at the base of the landfill and base flow of the stream that supplies and drains the small pond on the west central portion of the site. This flow has been measured at approximately 4 gpm. Two springs (SP-1 and SP-2) located near the southern boundary of the site have been observed flowing at approximately 1 gpm each. Ten other groundwater seeps have been observed at various locations downhill of the site and flow rates similar to the measured springs. It is assumed that groundwater from these seeps originates on the site. Based on these observations, the total observed flow from the site is about 16 gpm. The remaining 18 gpm of groundwater flow is likely discharging through seeps that are hidden beneath leaves and shallow roots on the forest floor south of the site and in channels of the tributaries to Van Campen Creek that flow south of the site. A small component of groundwater probably flows into a deeper intermediate or regional groundwater flow system.

The placement of a low permeability (99% efficient) cap and the construction of surface water and groundwater diversion systems will significantly reduce leachate generation. A landfill cap covering 22 acres of the site will likely reduce groundwater flow due to infiltration over the capped area from 15 gpm to 0.2 gpm. The surface water and groundwater diversion systems will eliminate/minimize the flow from the 21-acre off-site tributary area and the 12-acre uncapped area of the site tributary/upgradient of the cap. For all practical purposes, upgradient and sidegradient flow contributing to leachate generation is assumed to be zero (0) gpm. The 3-acre wooded area in the southeastern portion of the site, which will not be capped, will contribute infiltration (1.1 gpm) to leachate generation. Therefore, approximately 1.3 gpm or 2,000 gallons of leachate per day will be generated subsequent to capping, and surface water and groundwater diversion.

3.1.2 HELP Model

Leachate quantities specific to the Cuba Municipal Waste Disposal Site were also calculated using the Hydrologic Evaluation of Landfill Performance (HELP) model. Version 3.01 of the model was run to simulate existing site conditions. A two-layer landfill was modeled to simulate existing conditions. The top layer was considered material texture number 7 in the model. This layer consists of a fine sandy loam and silty sand mixture. The top layer was designated a 1-foot thick percolation layer for one series of model runs and a 2-foot thick vertical percolation layer for another series of runs to simulate varying cover thicknesses observed at the landfill.

Layer two was modeled as a 10-foot thick, vertical percolation layer with material texture designation 18, municipal waste. The vegetation on the site was assigned a maximum leaf area index of 2, which is described in the model as a fair stand of grass. The entire modeled area was considered capable of run-off, and meteorological data was used for the years 1974 through 1978 for Ithaca, New York. Ithaca has the closest set of meteorological data available in the model. Annual precipitation was modeled at 40.16 inches per year, which is slightly greater than 37 inches per year reported for the study area. The model was run several times using varying slopes (1%, 5%, 15%, 20% and 25%) to simulate the variation in slopes found at the site.

The results of the model indicate infiltration of precipitation into the waste layer (termed percolation in the HELP model output) of about 10.5 inches per year for a 12-inch soil cover with 8-inch evaporative zone. A 24-inch soil cover with 20-inch evaporative zone yields infiltration rates of about 8.8 inches per year. Model results also indicate that slopes varying from 1% to 25% have little influence on the amount of percolation through the ground surface into waste due to the significant vegetation at the site. For the 12-inch cover scenario, infiltration varied from 10.54 inches at 1% slope to 10.48 inches at 25% slope. Similarly, infiltration varied in the 24-inch soil cover scenario from 8.83 inches at 1% slope and 8.77 inches at 25% slope.

The percolation results from the HELP model can be used to calculate leachate generation. As described in the water budget discussion above, all infiltration becomes shallow groundwater and is considered to contact waste, and is therefore leachate. The calculation of leachate quantity includes infiltration over the entire 40-acre site and the 21 acres upgradient and tributary to the site that potentially flows through waste. Using the modeled infiltration rate of 10.5 inches per year (to arrive at conservatively high leachate quantities) leachate flow rates have been estimated to be 33 gallons per minute or approximately 48,000 gallons per day under existing conditions.

The placement of a low permeability (99% efficient) cap and the construction of surface water and groundwater diversion systems will significantly reduce leachate generation. Based on the HELP Model results, a landfill cap covering 22 acres of the site will likely reduce infiltration over the capped area to 0.11 inches per year or 0.1 gpm. The surface water and groundwater diversion systems will minimize the flow from all noncapped areas tributary to the cap including upgradient and sidegradient locations. For all practical purposes, upgradient and sidegradient flow contributing to leachate generation is assumed to be zero (0) gpm. The 3-acre wooded area in the southeastern portion of the site, which will be capped, will contribute infiltration (1.7 gpm) to leachate generation. Therefore, according to HELP Model results, approximately 1.8 gpm or 3,000 gallons of leachate per day will be generated subsequent to capping and surface water and groundwater diversion.

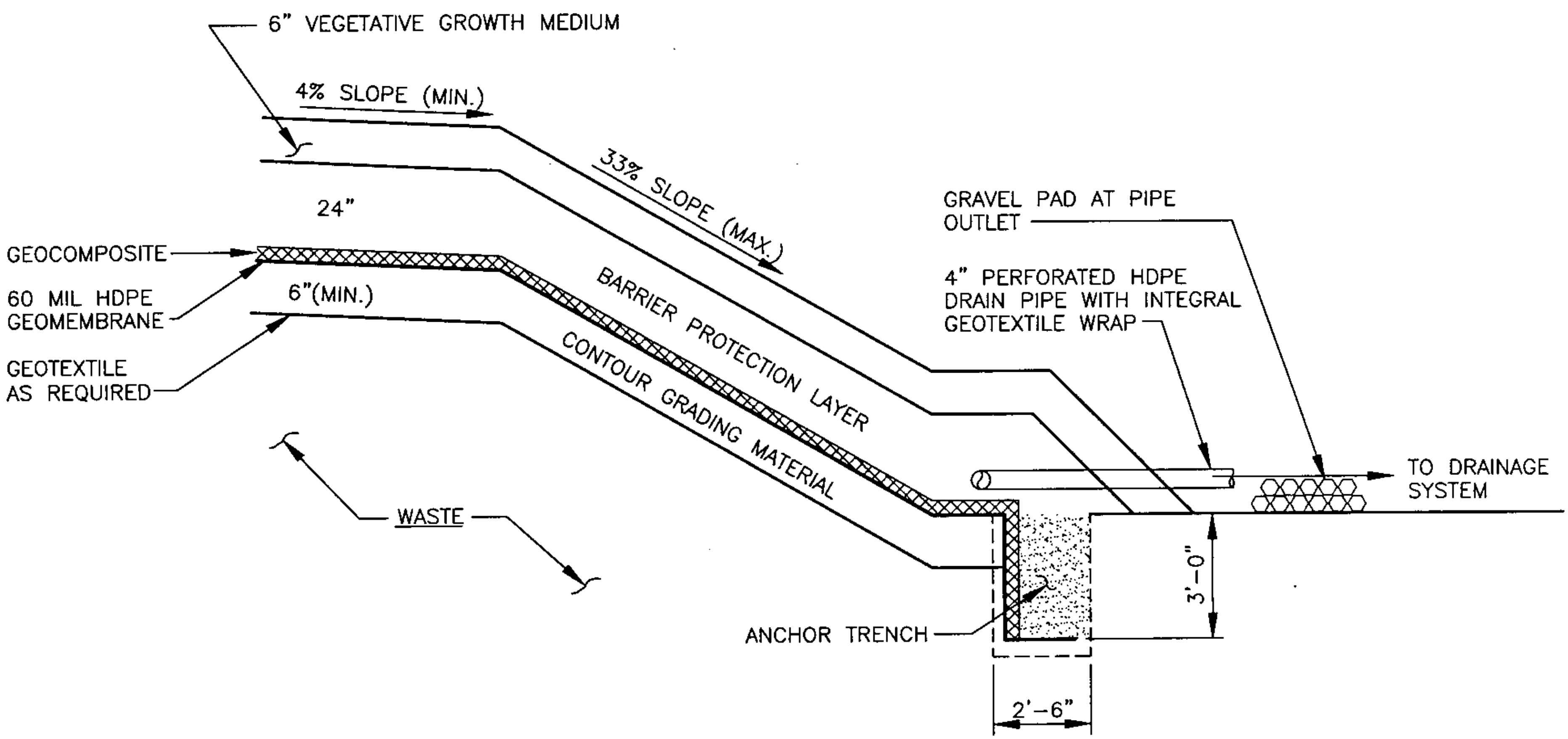
3.1.3 Summary of Leachate Calculations

Based on the calculations above, leachate generation occurring under existing site conditions is estimated to be 49,000 gallons per day using the water budget evaluation and 48,000 gallons per day using the HELP Model, and is fairly consistent with on-site observations. Constructing a 22-acre landfill cap will reduce leachate generation to between 2,000 and 3,000 gallons per day. For leachate collection and treatment cost estimation purposes, an average of 2,500 gallons per day is utilized.

3.2 Description of Remedial Alternatives

3.2.1 Alternative 1 - Part 360 Cap and Leachate Collection and Treatment

This alternative addresses remediation of all media of concern identified for the Cuba Municipal Waste Disposal Site, comprising waste and leachate. A low permeability cap will provide isolation of the buried waste and any contaminated soil. This cap will comprise from bottom to top, a minimum of 12 inches of soil cover over waste, including 6 inches of select contour grading material, 60-mil high density polyethylene (HDPE) geomembrane, geocomposite



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CUBA MUNICIPAL WASTE DISPOSAL SITE
VILLAGE OF CUBA, NEW YORK

CAP CROSS-SECTION

FIGURE 3-2

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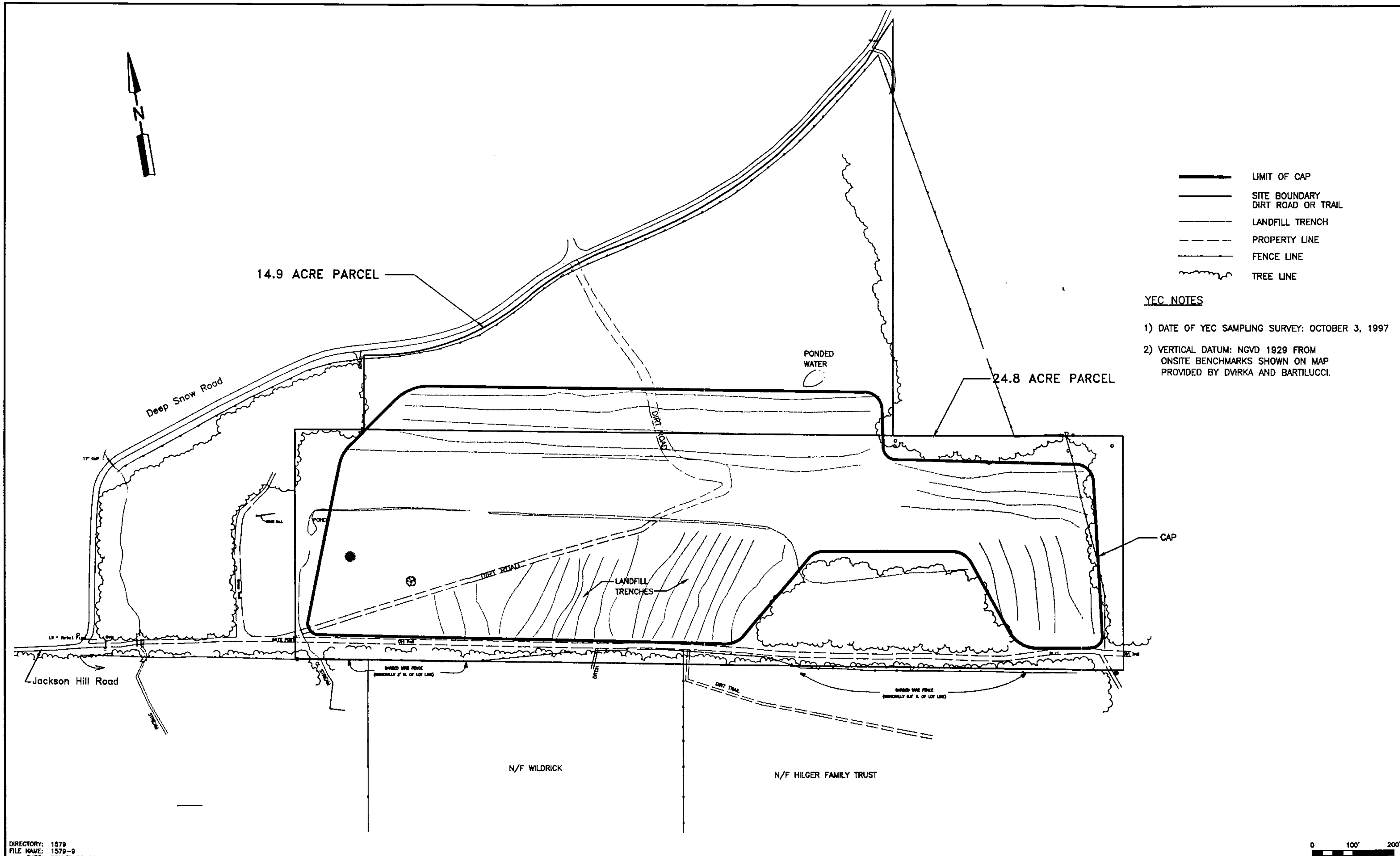
Due to the large volumes of water expected to be generated during a 25-year design storm event and groundwater diversion, and limited space available on the site, detention of water will be difficult. Discharge of water to the streams will also need to be addressed regarding potential flooding during storm events.

The area of the site to be capped is approximately 22 acres and the limits of the cap are shown on Figure 3-3. Although the cap appears to cover areas of the site where trenches have not been reported, based on observations of the site, waste may also have been buried in these areas. In addition, capping the entire site will reduce leachate generation through the reduction of infiltration of precipitation upgradient of the trenches/waste.

Remediation of leachate will be accomplished through the construction of an interceptor trench along the southern boundary of the landfill where leachate seeps have been observed. This leachate interceptor trench will be installed to a depth of approximately 10 feet. The trench will be backfilled with gravel or stone, and perforated pipe will be placed in the trench for removal of the leachate. Similar to the groundwater diversion trench, the leachate interceptor trench will be combined with a low permeability/slurry wall on the downgradient side of the trench to further prevent leachate from migrating off site. Leachate will be pumped from the trench at various points along the southern boundary of the site into a force main and on-site storage tank for either off-site treatment (Alternative 1A) or on-site treatment (Alternative 1B) as described below.

The anticipated volume of leachate (2,500 gpd), as well as the concentrations of contaminants detected in the leachate during the remedial investigation, indicate that leachate can be transported daily by tanker truck to the Village of Cuba publicly owned treatment works (POTW) for treatment. Preliminary discussions with the Village have indicated that they would be able to accept the leachate at their facility. The POTW is currently accepting leachate from the Allegany County Landfill on a routine basis. Other possible treatment locations include POTWs in Friendship and Olean, New York. Disposal of leachate at the Village of Cuba POTW is defined as Alternative 1A.



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DATE: SDM/7-26-99

CUBA MUNICIPAL WASTE DISPOSAL SITE
VILLAGE OF CUBA, NEW YORK

LIMIT OF CAP

DVIRKA AND BARTILUCCI
CONSULTING ENGINEERS
A DIVISION OF WILLIAM F. COSULICH ASSOCIATES, P.C.

FIGURE 3-3

If the leachate cannot be accepted by a POTW, it will require on-site treatment and discharge to the tributary of Van Campen Creek. The collected leachate will be treated for those contaminants which exceed surface water discharge (Class D) standards, which are VOCs, pesticides, PCBs and metals, and although not analyzed for, it is anticipated that the leachate will also exhibit elevated levels of typical leachate constituents, such as nitrogen compounds. The treatment process to address these contaminants would be in the following sequence from influent to effluent: chemical precipitation to remove metals; air stripping to remove VOCs; biological treatment to remove nitrogen compounds; and carbon absorption to remove PCBs and pesticides, and other leachate contaminants. Costs for treatment of the leachate on site, and operation and maintenance of an on-site treatment system, have been incorporated into the costs for this alternative. On-site treatment of leachate is defined as Alternative 1B.

Monitoring of groundwater for a 30-year period is also included as part of Alternatives 1A and 1B to determine the effectiveness of the remediation system. The monitoring network would consist of sampling one upgradient well and five existing downgradient wells quarterly for the first 5 years, semiannually for the next 5 years and annually for the remaining 20 years. Three of the downgradient wells are installed in shallow bedrock on site and two are installed in deeper bedrock off site. Based on the results of monitoring the existing wells, installation of additional monitoring wells downgradient of the site may be warranted.

3.2.2 Alternative 2 – Part 360 Cap and Leachate Phytoremediation

This alternative includes remediation of the waste and any contaminated soil through placement of a low permeability Part 360 cap and groundwater diversion trench as discussed for Alternative 1. In lieu of installation of the leachate interceptor trench, poplar trees will be planted along the southern boundary of the landfill for collection and remediation of the leachate. Moisture and chemicals in the leachate will be utilized by the trees for growth and development. Contaminants that can not be taken up by the trees will either degrade in the soil surrounding the trees through enhancement of the naturally occurring aerobic degradation process, or will be leachate generated from the capped landfill (with storm water and groundwater diversion) of 2,500 gallons per day (900,000 gallons per year).

Storm water management will be accomplished as discussed in Alternative 1, and also as discussed in Alternative 1, four gas vents will be installed per acre to vent any gases that may accumulate below the geomembrane. Long-term monitoring will be consistent with the monitoring discussed for Alternative 1.

3.2.3 Alternative 3 - Part 360 Cap

This alternative addresses only remediation of the waste and contaminated soil through the placement of a low permeability Part 360 cap and groundwater diversion trench as discussed for Alternatives 1 and 2. The same storm water management system would be constructed and landfill gases would be addressed through the installation of passive vents as described for Alternatives 1 and 2. The same long-term monitoring program as defined for Alternatives 1 and 2 will be conducted to determine the effectiveness of the remediation system. No collection or treatment of leachate will be conducted. It is anticipated that the cap and groundwater diversion trench will substantially reduce generation of leachate and residual leachate will be remediated through natural attenuation.

3.2.4 Alternative 4 - Consolidation and Part 360 Cap

This alternative includes the consolidation of waste in a smaller area prior to placement of the Part 360 cap and construction groundwater diversion trench. As with Alternative 3, this alternative will only address remediation of the waste and any contaminated soil. Instead of placement of a cap over the entire landfill (approximately 22 acres), the landfill footprint will be reduced from 22 acres to 15 acres, and the cap will only be placed on the 15 acres. Under this alternative, approximately 30,000 cy of waste material from the trenches will be excavated from the eastern portion of the landfill and replaced onto the western portion of the landfill. During excavation of the waste it is assumed that hazardous waste, possibly contained in drums, may be encountered. It is estimated that approximately 10 percent of the waste encountered will be hazardous. Due to the potential for very high levels of PCBs (>500 ppm) and the possibility that drums may be encountered, this waste will likely need to be incinerated. Storm water management and long-term groundwater monitoring will be conducted in the same manner as identified for the previous alternatives. No collection or treatment of leachate will be conducted as part of this alternative.

3.2.5 Alternative 5 - No Action

This alternative provides no active remediation and relies solely on natural attenuation for remediation of the waste, any contaminated soil and leachate. The "no action" alternative will provide for improvement and maintenance of the existing fence around the landfill and long-term groundwater monitoring. Groundwater monitoring would consist of monitoring four wells quarterly for 30 years.

Provided below is the preliminary evaluation of these alternatives for effectiveness, implementability and relative cost.

3.3 Evaluation of Remedial Alternatives

3.3.1 Alternative 1

Effectiveness

Alternative 1 will meet all of the remedial action objectives established for the Cuba Municipal Waste Disposal Site as discussed in Section 1.4 of this document. This alternative will be fully protective of human health and the environment, and will contain hazardous waste known to be disposed at the site. The low permeability cap will prevent direct contact with waste and together with the groundwater diversion trench, will prevent precipitation and mitigate groundwater from infiltrating through waste and generating leachate. In addition, the leachate have been proven effective. Although phytoremediation is a developing technology, it has been proven effective for the contaminants detected in the leachate and will prevent/mitigate off-site migration of any leachate generated.

Implementability

As discussed for Alternative 1, construction, and operation and maintenance of the technologies associated with Alternative 2 are readily implementable and the necessary labor, equipment, materials and supplies are commercially available. Potential difficulties may occur with storm water management on site. Planting and maintenance of poplar trees is readily implementable.

Cost

The cost of Alternative 2 will be less than Alternative 1, since planting and maintenance of the poplar trees will not be as costly as installation of a leachate collection system, and either on-site or off-site treatment. Similar to Alternative 1, the major cost associated with this alternative is the landfill cap. The cost of Alternative 2 would be low to moderate.

3.3.3 Alternative 3

Effectiveness

Alternative 3 will meet all but one of the remedial action objectives relative to impacts caused by the site. This alternative will not prevent migration of leachate off site, but will substantially reduce the volume of leachate generated by installation of a low permeability cap and groundwater diversion trench.

Implementability

Construction, and operation and maintenance of all the technologies associated with Alternative 3 are readily implementable. The necessary labor, equipment, materials and supplies are commercially available. Similar to Alternatives 1 and 2, difficulties may occur regarding construction of a storm water detention system on site due to the site space, topography and geology.

Cost

The cost of Alternative 3 will be less than Alternatives 1 and 2, since leachate collection and treatment are not elements of this alternative. The major cost associated with this alternative is the landfill cap. The cost of Alternative 3 would be low to moderate.

3.3.4 Alternative 4

Effectiveness

Similar to Alternative 3, this alternative will meet three of the four remedial action objectives established for the site. This alternative will significantly reduce the volume of leachate generated, but will not prevent off-site migration of leachate.

Implementability

Consolidation of the waste material and construction of an on-site storm water management system will be the only portions of this alternative that may be difficult. Excavation of the waste may cause odors and hazardous waste, possibly contained in drums, may be encountered and cause handling difficulties. However, all of the labor, equipment, materials and supplies necessary for this alternative are commercially available, and maintenance of the cap is easily implemented. Similar to Alternatives 1, 2 and 3, there may be difficulties with storm water management on site, however, the difficulties may be less, since consolidation would make an area available on site for detention of storm water, at least in part.

Cost

The cost of Alternative 4 will be higher than Alternative 3, but less costly than Alternatives 1 and 2 (moderate to high), if significant quantities of hazardous waste are not encountered; however, the cost of Alternative 4 could be high if substantial amounts of hazardous waste are found during excavation.

3.3.5 Alternative 5

Effectiveness

Alternative 5 will not meet any of the remedial action objectives, since no physical remedial action, other than construction of a fence and long-term monitoring, will be undertaken. This alternative relies solely on natural attenuation to mitigate generation and migration of leachate. There would be the potential for contact with waste and contaminated surface runoff if the current landfill cover is eroded, and continued generation of leachate, contamination of groundwater and off-site migration of contaminants. As a result, this alternative is not effective.

Implementability

Although this alternative is readily implementable physically, since no action does not mitigate the potential for contact with waste or the potential for generation and migration of leachate and contamination of groundwater, it is not implementable from a regulatory perspective.

Cost

The cost of Alternative 5 will be significantly less than Alternatives 1, 2, 3 and 4. The approximate cost for Alternative 5, which involves only fencing and monitoring, is low.

3.4 Summary Evaluation of Alternatives

Provided in Table 3-1 is a summary of the preliminary evaluation of the remedial alternatives developed for the Cuba Municipal Waste Disposal Site.

With regard to selection of alternatives to be evaluated further in detail in order to select a remedial plan for the site, all of the remedial alternatives discussed above (Alternatives 1 through 4) are considered viable and will be evaluated in further detail, together with the no action alternative (Alternative 5) as required by CERCLA and the New York State Superfund Program.

3.5 Evaluation of Presumptive Remedy Relative to Guidance

In addition to evaluation of the alternatives relative to feasibility study criteria as described above in Sections 3.1 through 3.3, evaluation of the selection of the Part 360 Cap Presumptive Remedy must also be performed to ensure that it is consistent with NYSDEC requirements as contained in the Division Technical and Administrative Guidance Memorandum (TAGM) "Accelerated Remedial Actions at Class 2, Non-RCRA Regulated Landfills." Provided below is a comparison of the Presumptive Remedy for the Cuba Municipal Waste Disposal Site to the technical considerations contained in the TAGM.

Technical Consideration	Presumptive Remedy
• Meet or exceed the Part 360 capping requirements	Part 360 cap with NYSDEC-approved variances will be constructed.
• Remediation of "hot spots" (e.g., hazardous waste, highly contaminated soil, drums, etc.) prior to capping	Not required since "hot spots" were not detected based on the results of the remedial investigation.

Table 3-1

SUMMARY OF PRELIMINARY EVALUATION OF REMEDIAL ALTERNATIVES
CUBA MUNICIPAL WASTE DISPOSAL SITE

Remedial Alternative		Effectiveness	Ease of Implementation	Relative Cost	Retained
Alternative 1	Low Permeability Cap, Groundwater Diversion, Leachate Collection and Treatment, and Long-term Monitoring	High	Moderate to low (potential difficulty with detention/disposal of storm water runoff and possibly treated leachate)	Moderate to High (1A/off-site treatment) to High (1B/on-site treatment)	Yes
Alternative 2	Low Permeability Cap, Groundwater Diversion, Leachate Phytoremediation and Long-term Monitoring	High	Moderate to low (possible difficulty with detention/ disposal of storm water runoff)	Low to Moderate	Yes
Alternative 3	Low Permeability Cap, Groundwater Diversion and Long-term Monitoring	Moderate	Moderate to low (possible difficulty with detention/disposal of storm water runoff)	Low to Moderate	Yes
Alternative 4	Consolidation, Low Permeability Cap, Groundwater Diversion and Long-term Monitoring	Moderate	Moderate (possible difficulty with detention/disposal of storm water runoff, creation of odors during consolidation and handling of hazardous waste)	Moderate to High	Yes
Alternative 5	No Action with Fencing and Long-Term Monitoring	Low	Very low (will likely not be acceptable to regulatory agencies or the public)	Low	Yes (required by feasibility study guidance)

Technical Consideration	Presumptive Remedy
• Landfill Gas Controls	Since significant levels of methane were not detected during the remedial investigation, a gas-venting layer will not be installed. However, four passive vents per acre (along the trenches) will be installed to address the potential for collection of gas beneath the cap in accordance with NYSDEC-approved variances to a Part 360 cap.
• Leachate Collection System	A leachate collection system will be installed as part of Alternative 1, and a leachate phytoremediation system will be installed as part of Alternative 2, if selected. For Alternatives 3 and 4, leachate generation is expected to significantly decrease once the cap and groundwater diversion system are installed.
• Treatment of Leachate	Collected leachate will either be treated at a POTW or on-site if Alternative 1 is selected. Leachate will be treated/contained utilizing phytoremediation if Alternative 2 is selected.

4.0 DETAILED ANALYSIS OF ALTERNATIVES

Based on the preliminary evaluation of the remedial alternatives developed for the Cuba Municipal Waste Disposal Site in Section 3.0, all five of the alternatives for the site (six including Alternatives 1A and 1B) have been retained for detailed analysis. The alternatives being considered are: a low permeability Part 360 cap with a groundwater diversion trench, leachate collection and off-site treatment (Alternative 1A) or on-site treatment (Alternative 1B), and long-term groundwater monitoring; low permeability Part 360 cap with a groundwater diversion trench, phytoremediation of leachate and long-term monitoring (Alternative 2); low permeability Part 360 cap with a groundwater diversion trench and long-term groundwater monitoring (Alternative 3); consolidation, low permeability Part 360 cap with a groundwater diversion trench and long-term monitoring (Alternative 4); and no action with fencing and long term monitoring (Alternative 5).

Provided below is a detailed evaluation of Alternatives 1, 2, 3, 4 and 5. Based on this detailed evaluation, a remedial plan for the site will be recommended for regulatory agency and public comment. In accordance with USEPA and NYSDEC "Guidance for Selection of Remedial Actions at Superfund Sites," as described in Section 1.4, the following feasibility study evaluation criteria will be addressed in the detailed evaluation of alternatives.

- Threshold Criteria
  - Protection of human health and the environment
  - Compliance with standards, criteria and guidelines
- Balancing Criteria
  - Short-term impacts and effectiveness
  - Long-term effectiveness and permanence
  - Reduction in toxicity, mobility and volume through treatment
  - Implementability
  - Cost

In addition to the above threshold and balancing criteria, the guidance also provides the following modifying criteria:

- Modifying Criteria
  - Regulatory agency acceptance
  - Community acceptance

A detailed description of each of these criteria is provided in Section 1.4 of this report.

Provided below is a comparative analysis of the remedial alternatives to each of the detailed evaluation criteria presented above.

4.1 Protection of Human Health and the Environment

Alternative 1 will be protective of human health and the environment through the placement of a low permeability cap which will prevent potential direct contact with waste, installation of a groundwater diversion trench, which, together with the cap, will mitigate leachate generation and adverse impacts on groundwater, and construction of a leachate collection system which will mitigate off-site leachate migration and potential contact with contaminated leachate.

Alternative 2, which includes placement of a low permeability cap, installation of a groundwater diversion trench and phytoremediation of leachate will also be protective of human health and the environment through prevention of the potential for direct contact with waste and leachate. The cap and diversion trench will also significantly reduce the generation of leachate, and combined with phytoremediation, will mitigate off-site migration of leachate and adverse impacts to groundwater.

Alternative 3 will also be protective of human health and the environment through the placement of the cap which will prevent potential direct contact with waste, and together with a groundwater diversion trench, will significantly reduce leachate generation and contamination of groundwater. However, since there is the potential for groundwater to discharge to waste from the underlying bedrock aquifer and there will be no leachate collection and treatment system associated with this alternative, there is the potential for leachate migration off-site which will not prevent the potential for direct contact with leachate.

Alternative 4 also will be protective of human health and the environment through the placement of a cap and elimination of the potential for contact with waste. Leachate generation will be reduced through placement of the cap and groundwater diversion trench. However, this alternative will not provide collection and treatment of leachate and potential for contact with leachate.

Alternative 5 will not be protective of human health and the environment since natural attenuation of contaminants in the waste and leachate likely will not be effective in the 30-year planning period. A fence will discourage receptors from gaining access to the site and potential contact with waste; however, the continued infiltration of precipitation and flow of groundwater through waste, and resulting generation and release of leachate could impact both on-site and off-site receptors.

In summary, Alternatives 1 and 2 essentially would be equally protective of human health and the environment followed by Alternatives 3 and 4. Alternative 1 may be somewhat more protective than Alternative 2, since the standard approach to leachate collection, utilizing an interceptor trench, and ex-situ treatment is a more proven technology as compared to phytoremediation. Alternative 5 would not be protective of human health and the environment.

4.2 Compliance with Standards, Criteria and Guidelines

Alternative 1 will be compliant with all regulatory standards, criteria and guidelines (SCGs), and applicable or relevant and appropriate requirements (ARARs) established for the site as described in Section 1.4. The source of contamination (municipal solid waste and industrial waste) will be remediated (capped) in accordance with the New York State Part 360 regulations and leachate will be collected and treated off-site or on-site to meet all applicable SCGs/ARARs. Implementation of this alternative will be in compliance with all federal, state and local requirements.

Alternative 2 will also be compliant with all SCGs and ARARs, and will be implemented in compliance with all federal, state and local requirements.

Alternatives 3 and 4 will be compliant with SCGs and ARARs with the exception of preventing migration of leachate off-site. Although leachate generation will likely be significantly reduced though installation of the cap and groundwater diversion trench, and natural attenuation of the contaminants in the residual leachate will likely occur once the waste is isolated, there will be the continued potential for some leachate generation and off-site migration.

Alternative 5 will not be compliant with any of the SCGs and ARARs established for the site, in particular, since it will not mitigate leachate generation and contamination of groundwater, and will not mitigate on-site seeps and off-site leachate migration.

In summary, Alternatives 1 and 2 essentially would comply equally with applicable SCGs and ARARs followed by Alternatives 3 and 4. However, as discussed in Section 4.1, Alternative 5 would not be in compliance with applicable SCGs and ARARs.

4.3 Short-Term Impacts and Effectiveness

Alternative 1 can be fully implemented within about 18 to 24 months of selection of this alternative and issuance of the Record of Decision, including design and construction, and will be immediately effective in mitigating the potential for direct contact with waste, and generation and off-site migration of contaminated groundwater and leachate. With proper implementation of a construction health and safety plan, and construction quality assurance plan, there will be no adverse impacts on human health and the environment during construction of the cap, groundwater diversion trench, and leachate collection and on-site treatment system. During construction, no significant disruption of the community is expected. Any waste that will be generated during construction will be properly and safely handled, and disposed on-site under the cap or off-site, if necessary.

Alternative 2 can also be fully implemented within about 18 to 24 months. Planting of poplar trees for phytoremediation of leachate will not impact the implementation of this alternative. Mitigation of the potential for contact with waste and generation of leachate will be effective immediately. Somewhat mature poplar trees can be planted which will likely begin mitigation off-site migration of leachate, as well as leachate impacts to groundwater, within approximately 2 months of planting. With proper implementation of construction health and safety and quality assurance plans, no adverse impacts on human health and the environment are expected, and no significant disruption of the community is anticipated in the implementation of this alternative.

Alternative 3 can also be fully implemented within about 18 to 24 months. Similar to Alternatives 1 and 2, Alternative 3 will also be immediately effective in mitigating the potential for direct contact with waste and generation of landfill leachate. However, this alternative likely will not be as effective as Alternatives 1 and 2 in mitigating off-site migration of leachate nor as effective in mitigating contamination of groundwater, since leachate collection and treatment is not included as part of this alternative. No short-term impacts are expected with proper implementation of construction health and safety and quality assurance plans. No significant disruption to the surrounding community is expected.

Alternative 4 will likely require additional time to implement due to the excavation and replacement of waste prior to placement of a cap. Although the majority of time required to implement the alternative would be placement of the cap and groundwater diversion trench, excavation and replacement of the waste may take an additional 2 to 4 months. The basis for the extended time results from the possibility that hazardous waste will be encountered, and the time required to handle the hazardous waste and complete the excavation of that waste material in a manner that would be protective of on-site and off-site receptors. With proper implementation of constructed related health and safety and quality assurance plans, no significant short-term impacts are expected; however, the potential for short-term impacts due to excavation and possible finding of hazardous waste is greater with this alternative that Alternatives 1, 2, 3 and 5.

Once completed, this alternative is expected to be immediately effective except for controlling off-site leachate migration.

Alternative 5 will not have any short-term construction related impacts and can be fully implemented immediately; however, while a fence may be effective in the short term in preventing potential contact with waste, this alternative will not be effective in preventing leachate generation and release of contaminants to the environment.

4.4 Long-Term Effectiveness and Permanence

Alternative 1 will provide long-term effectiveness and permanence in protecting human health and the environment by isolating and controlling exposure to and release of contaminants from waste. Placement of a low permeability cap, groundwater diversion trench, and leachate collection and treatment system is considered an effective long-term and permanent remedial action. The risk posed by the contaminants that remain on site would be minimal, since the contaminants will be isolated from direct exposure and direct contact with precipitation, and leachate migration will be controlled.

As discussed for Alternative 1, Alternative 2, which involves placement of a low permeability cap, construction of a groundwater diversion trench and phytoremediation of leachate, is considered an effective and permanent remedial action through isolating and controlling exposure to and release of contaminants from waste. Risk posed by remaining contaminants is minimal.

Alternatives 3 and 4 will provide less long-term effectiveness and permanence in protecting human health and the environment as compared to Alternatives 1 and 2. Although the waste will be isolated and leachate generation is expected to be significantly reduced by placement of the cap and groundwater diversion trench, and for Alternative 4, by reducing the volume of waste in contact with groundwater, generation of leachate will likely not be eliminated and there will be potential off-site migration and exposure to contaminated leachate and contamination of groundwater.

Alternative 5 will not provide for long-term effectiveness and permanence, since remediation of waste and leachate will not occur, and contaminants will continue to be released to the environment in significant unacceptable levels.

4.5 Reduction of Toxicity, Mobility or Volume Through Treatment

Alternative 1 will not reduce the toxicity or volume of waste in the landfill; however, it will significantly reduce the mobility of contaminants in the waste, not through treatment, but through isolation. Alternative 1 will reduce the volume of contaminated leachate generated as a result of placement of the cap and the groundwater diversion trench, and the leachate interceptor trench will reduce the toxicity and mobility of leachate through treatment of the leachate either on or off-site.

Alternative 2, which includes placement of a cap and phytoremediation of leachate, will reduce the mobility of the contaminants in the waste, but will not reduce the toxicity or volume of waste. The volume of contaminated leachate generated will be reduced and phytoremediation of leachate will reduce toxicity and mobility through conversion of the contaminants to less toxic metabolites and through degradation and containment of the contaminants in the soil.

Alternative 3 will also not reduce the toxicity or volume of waste in the landfill. It will, however, reduce the mobility of the contaminants through isolation and will significantly reduce the volume of leachate generated. This alternative will not, however, reduce the toxicity or mobility of leachate through collection and treatment.

Alternative 4 will reduce the volume and toxicity of waste if hazardous waste is encountered during consolidation and removed off-site. This alternative will also reduce the volume and mobility of leachate, but not prevent the off-site migration of leachate nor reduce its toxicity.

Alternative 5 will not be effective in reducing the toxicity, mobility or volume of the contaminants at the site, and as a result, contaminants will continue to be released to and migrate in the environment in significant, unacceptable levels.

In summary, Alternatives 1 and 2, respectively, would be the most effective in reducing the toxicity, mobility and volume of waste and contaminated leachate followed by Alternative 4, 3 and 5, respectively.

4.6 Implementability

The technologies associated with Alternative 1 are commercially available, and have been proven effective and reliable for mitigating the migration of contaminants from landfill sites. In addition, the components comprising this alternative, both related to capping, diversion of groundwater, and collection and treatment of leachate, can be easily constructed, maintained and operated. Labor, equipment, materials and supplies required to implement this alternative are readily available. The only potential difficulty with regard to this alternative, as with Alternatives 2 and 3, and possibly less regarding Alternative 4, is in the on-site detention of storm water prior to discharge to surface waters.

All the technologies associated with Alternative 2 are commercially available. Installation of the cap and groundwater diversion trenches have been proven effective and reliable for isolating waste and mitigating the generation and migration of contaminants from landfill sites, and can be easily constructed maintained and operated. Similarly, a phytoremediation system can be easily installed and maintained and does not require a leachate collection and physical treatment system. However, this technology is still developing, and not is proven as conventional leachate collection and treatment. The only potential difficulty is the on-site detention of storm water prior to discharge.

There are also little expected difficulties in implementation of Alternative 3. All labor, equipment, materials and supplies required for placement of the cap and groundwater diversion

4.9 Community Acceptance

Similar to the reasons provided above in Section 4.8 for acceptance of Alternatives 1 and 2, and possible acceptance of Alternatives 3 and 4 by the regulatory agencies, it is expected that these alternatives will also be accepted by the public in the same manner. It is unlikely that Alternative 5 will be acceptable to the community. However, similar to the discussion above regarding regulatory agency acceptance, final determination of community acceptance will be made following comments received from the public on the remedial action recommended for the site.

A summary of the comparative analysis of the alternatives is provided in Table 4-1.

4.10 Recommended Alternative

Based on the preliminary evaluation of the remedial alternatives described in Section 3.0 and the detailed evaluation of alternatives in this section, Alternative 2 is recommended for remediation of the Cuba Municipal Waste Disposal Site. This alternative meets all of the remedial action objectives identified for the site and all of the feasibility study evaluation criteria, in particular, protection of human health and the environment, and attainment of SCGs established for the site. An illustration showing a cross-section of the recommended alternative is provided in Figure 4-1.

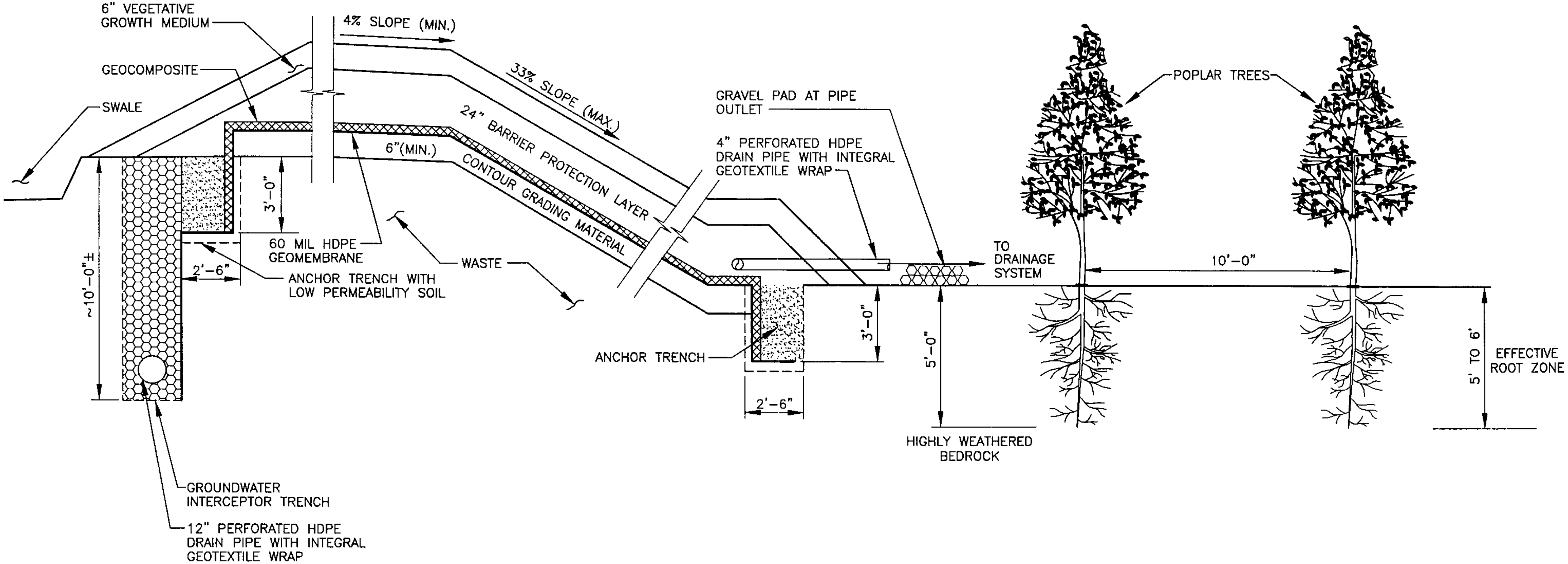
Although it is expected that the volume of leachate generated will be significantly reduced with placement of a low permeability cap and groundwater diversion trench, and although phytoremediation may not be as effective and proven as an interceptor trench and conventional on-site or off-site treatment for remediation of leachate, it is expected that phytoremediation of leachate should be sufficiently effective to meet the remedial objectives for the site at significantly lower cost ($1-$1.5 million) as compared to utilization of a leachate interceptor trench and ex-situ treatment.

Table 4-1

SUMMARY OF REMEDIAL ALTERNATIVE COMPARATIVE ANALYSIS
CUBA MUNICIPAL WASTE DISPOSAL SITE

Evaluation Criteria	Alternative 1 A (Cap, Groundwater Diversion, Leachate Collection and Off-site Treatment, and Long-Term Monitoring)	Alternative 1 B (Cap, Groundwater Diversion, Leachate Collection and On-site Treatment, and Long-Term Monitoring)	Alternative 2 (Cap, Groundwater Diversion, Leachate Phytoremediation and Long-Term Monitoring)	Alternative 3 (Cap, Groundwater Diversion, and Long-Term Monitoring)	Alternative 4 (Consolidation, Cap, Groundwater Diversion Trench, and Long-Term Monitoring)	Alternative 5 (No Action with Fencing and Long-Term Monitoring)
Protection of Human Health and the Environment	1	1	1	4	4	6
Compliance with SCGs	1	1	1	4	4	6
Short-term Impacts and Effectiveness	1	1	1	4	5	6
Long-term Effectiveness and Permanence	1	1	1	4	4	6
Reduction of Toxicity, Mobility or Volume through Treatment	1	1	1	4	5	6
Implementability	3	3	3	2	6	1
Cost	$5,677,000/4	$6,570,000/6	$5,091,000/3	$5,045,000/2	$6,279,000/5	$779,000/1
Regulatory Agency Acceptance	1	1	1	4	4	6
Community Acceptance	1	1	1	4	4	6
Total	15	16	13	32	41	46

Note: Lowest numerical score is highest ranking.



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NOT TO SCALE

CUBA MUNICIPAL WASTE DISPOSAL SITE
VILLAGE OF CUBA, NEW YORK

Dvirka and Bartilucci
Consulting Engineers
A Division of William F. Cosulich Associates, P.C.

RECOMMENDED ALTERNATIVE
CAP CROSS-SECTION AND LOCATION OF POPLAR TREES

FIGURE 4-1

As part of design of the recommended alternative, a determination will need to be made regarding the detention of storm water runoff and possibly diverted groundwater, including a drainage area study to determine if improvements will be required to the receiving surface waters. In addition, evaluation of and improvement to the moisture retention capacity of soils in the area of the phytoremediation system will need to be addressed during design to mitigate migration of leachate beyond the site boundary during the non-growing season.

APPENDIX A

NYSDEC DIVISION TECHNICAL AND ADMINISTRATIVE GUIDANCE MEMORANDUM (TAGM HWR-90-4030) SELECTION OF REMEDIAL ACTIONS AT INACTIVE HAZARDOUS WASTE SITES

(12-75)

D. Smith

New York State Department of Environmental Conservation

HWR-90-4030
REVISED MAY 15

MEMORANDUM

TO: Regional Hazardous Waste Remediation Engineers, Bureau Directors & Section Chiefs
FROM: Michael J. O'Toole, Jr., Director, Division of Hazardous Waste Remediation
SUBJECT: **REVISED TAGM - SELECTION OF REMEDIAL ACTIONS AT INACTIVE HAZARDOUS WASTE SITES**
DATE: MAY 15 1990

Attached is the revised Division Technical and Administrative Guidance Memorandum on Selection of Remedial Actions at Inactive Hazardous Waste Sites in its final form. The revisions are minor in nature and do not change the contents of the TAGM, originally issued on September 13, 1989.

The revision of the September 13, 1989 TAGM includes the following:

1. "Hierarchy of Remedial Technologies"

   Section 2.1 is revised to clarify the desirability of off-site land disposal of hazardous wastes.

2. Since New York State does not have ARARs in its statute and to avoid misinterpretation of New York State requirements, changes are made to replace "ARARs" with New York State Standards, Criteria and Guidelines (SCGs).

3. In accordance with the referenced TAGM, an alternative which does not meet the State Standards, Criteria and Guidelines (SCGs) and if a waiver to a SCG is not appropriate or justifiable such an alternative should not be further considered. It is possible that several alternatives may be dropped during the detailed analysis. Section 5.2.3 is rearranged so that alternatives are evaluated for criteria in the following order:

   (i) Compliance with New York SCGs;
   (ii) Protection of human health and the environment;
   (iii) Short-term effectiveness;
   (iv) Long-term effectiveness and permanence;
   (v) Reduction of toxicity, mobility and volume;
   (vi) Implementability; and
   (vii) Cost.

If there is any uncertainty as to whether documents should be withheld or released in a particular case, the program attorney or regional attorney should be consulted prior to sending out a response.

cc: E. Sullivan
G. Greeley
D. Markell
M. Gerstman
A. DeBarbieri
C. Goddard
E. McCandless
Regional Directors
Regional Engineers
RHW Engineers

(i) been successfully demonstrated on a full scale or a pilot scale under Federal Superfund Innovative Technology Evaluation (SITE) Program;

or

(ii) been successfully demonstrated on a full scale or pilot scale at a Federal Superfund site, at a Federal facility, at a State Superfund site anywhere in the country, at a PRP site overseen by a State environmental agency or USEPA;

or

(iii) a RCRA Part B permit;

or

(iv) a RCRA Research and Development permit.

or

(v) a documented history of successful treatment such as granulated activated carbon unit.

3. **DEVELOPMENT OF REMEDIAL ALTERNATIVES**: Alternatives are typically developed, concurrently with the Remedial Investigation (RI). In developing alternatives, two important activities take place. First, volumes or areas of environmental media (air, water, soil/sediment) are identified where contamination is present; the media to be treated are determined by information on the nature and extent of contamination, applicable or relevant and appropriate New York State Standards, Criteria and Guidelines (SCGs), cleanup criteria/standards, etc. SCGs also include federal standards which are more stringent than State Standards, Criteria and Guidelines. Second, the remedial action alternatives and associated technologies including alternative treatment technologies are screened to identify those that would be effective for the hazardous wastes and media of interest at the site. The information obtained during these two activities is used in assembling technologies and the media to which they will be applied into alternatives for the site or specific operable unit. This process should consist of five general steps as briefly presented below:

which is not feasible would not have been assembled. **Remedial alternatives which will be difficult to implement administratively should not be eliminated from further consideration for this reason alone.**

Implementability of each remedial alternative should be evaluated using Table 4.2. If an alternative does not score a minimum of eight out of a possible maximum 15, then the Project Manager has the option of screening out this alternative from further consideration.

5. DETAILED ANALYSIS OF ALTERNATIVES

5.1 Introduction

5.1.1 Purpose of the Detailed Analysis of Alternatives: The detailed analysis of alternatives is the analyses and presentation of the relevant information needed to allow decision-makers to select a site remedy. During the detailed analysis, each alternative is assessed against the seven evaluation criteria described in this chapter.

The specific requirements that must be addressed in the Feasibility Study (FS) report are listed below:

- o Be protective of human health and the environment
- o Attain SCGs (explain why compliance with SCGs was not needed to protect public health and the environment)
- o Satisfy the preference for treatment that significantly and permanently reduces toxicity, mobility, or volume of hazardous wastes as a principal element (or provide an explanation in the ROD as to why it does not)
- o Be cost-effective

Seven evaluation criteria have been developed to address the requirements and considerations listed above. These evaluation criteria serve as the basis for conducting the detailed analyses during the FS and for subsequently selecting an appropriate remedial action. The evaluation criteria are:

- o Short-term impacts and effectiveness
- o Long-term effectiveness and performance
- o Reduction of toxicity, mobility, or volume
- o Implementability
- o Compliance with SCGs
- o Overall protection of human health and the environment

o Cost

5.1.2 The Context of Detailed Analysis: The detailed analysis of alternatives follows the development and preliminary screening of alternatives and precedes the actual selection of a remedy. The extent to which alternatives are analyzed during the detailed analysis is influenced by the available data, the number and types of alternatives being analyzed, and the degree to which alternatives were previously analyzed during their development and screening.

The evaluations conducted during the detailed analysis phase build on previous evaluations conducted during the development and preliminary screening of alternatives. This phase also incorporates any treatability study data and additional site characterization information that may have been collected during the RI. The results of the detailed analysis serve to document the evaluations of alternatives and provide the basis for selecting a remedy.

5.2 Detailed Analysis of Remedial Alternatives

5.2.1 Alternative Definition: The alternatives that remain after preliminary screening may need to be refined more completely prior to the detailed analysis. Alternatives have already been developed and initially screened to match contaminated media with appropriate treatment processes. This matching is done by identifying specific remedial response objectives and sizing process units to attain the objective.

The information developed to define alternatives at this stage in the RI/FS process may consist of preliminary design calculations, process flow diagrams, sizing of key process components, preliminary site layouts, and a discussion of limitations, assumptions, and uncertainties concerning each alternative.

5.2.2 Overview of Evaluation Criteria: The detailed analysis provides the rationale for a remedy selection. The FS analysis must provide sufficient quantity and quality of information to support the selection of a remedy. The seven evaluation criteria listed encompass technical, cost, and institutional considerations; and compliance with specific statutory requirements.

The level of detail required to analyze each alternative against these evaluation criteria will depend on the type and complexity of the site, the type of technologies and alternatives being considered, and other project-specific considerations. The analysis should be conducted in sufficient detail such that decision-makers understand the significant aspects of each alternative and any uncertainties associated with their evaluation.

Each of the seven evaluation criteria has been further divided into specific factors to allow a thorough analysis of the alternatives. These factors are shown in Table 5-1 and discussed in the following sections. The weight for each criteria is also noted in Table 5-1.

irreversible reduction in contaminants mobility, or reduction of total volume of contaminated media.

This evaluation would focus on the following specific factors for a particular remedial alternative:

- o The amount of hazardous materials that will be destroyed or treated, including how the principal threat(s) will be addressed
- o The degree of expected reduction in toxicity, mobility, or volume measured as a percentage of reduction (or order of magnitude)
- o The degree to which the treatment will be irreversible
- o The type and quantity of treatment residuals that will remain following treatment

Table 5.6 lists typical questions to be addressed during the analysis of toxicity, mobility, or volume reduction.

Table 5.6 should be used as the basis for evaluation of remedial alternatives and in assigning score for this criteria.

5.2.3.6 Implementability (Relative Weight = 15): Of the total weight of 15, the technical feasibility shall receive a maximum score of 10 while administrative feasibility and availability of services and materials shall be assigned a combined maximum score of 5.

The implementability criterion addresses the technical and administrative feasibility of implementing an alternative and the availability of various services and materials required during its implementation. This criterion involves analysis of the following factors:

o Technical feasibility

Construction and operation - This relates to the technical difficulties and unknowns associated with a technology. This was initially identified for specific technologies during the development and preliminary screening of alternatives and is addressed again in the detailed analysis for the alternative as a whole.

Reliability of technology - This focuses on the ability of a technology to meet specified process efficiencies or performance goals. The likelihood that technical problems will lead to schedule delays should be considered as well.

Ease of undertaking additional remedial action - This includes a discussion of what, if any, future remedial actions may need to be undertaken and how difficult it would be to implement such additional actions. This is particularly applicable for an FS addressing an interim action at a site where additional operable units may be analyzed at a later time.

Monitoring considerations - This addresses the ability to monitor the effectiveness of the remedy and includes an evaluation of the risks of exposure should monitoring be insufficient to detect a system failure.

Table 5-5 should assist the evaluator in determining degree of technical feasibility among remedial alternatives. The maximum score for the technical feasibility is 10.

o Administrative feasibility

Activities needed to coordinate with other offices and agencies (e.g. obtaining permits for off-site activities or rights-of-way for construction)

o Availability of services and materials

Availability of adequate off-site treatment, storage capacity, and disposal services

Availability of necessary equipment, specialists and skilled operators and provisions to ensure any necessary additional resources

Availability of services and materials, plus the potential for obtaining competitive bids, which may be particularly important for alternative remedial technologies.

A combined scoring not to exceed five should be assigned to administrative feasibility and availability of services and materials.

Table 5.7 lists typical questions to be addressed during the analysis of administrative feasibility and availability of services and materials.

5.2.3.7 <u>Cost (Relative Weight = 15)</u>

The application of cost estimates to evaluation of alternatives is discussed in the following paragraphs.

(1) <u>Capital Costs</u>. Capital costs consist of direct (construction) and indirect (non-construction and overhead) costs. Direct costs include expenditures for the equipment, labor and materials necessary to install remedial actions. Indirect costs include expenditures for engineering and other services that are not part of actual installation activities but are required to complete the installation of remedial alternatives. Capital costs that must be incurred in the future as part of the remedial action alternative should be identified and noted for the year in which they will occur.

Direct capital costs may include the following:

o Construction costs - Costs of materials, labor (including fringe benefits and worker's compensation), and equipment required to install a remedial action

- o Equipment costs - Costs of remedial action and service equipment necessary to enact the remedy; (these materials remain until the site remedy is complete)

- o Land and site-development costs - Expenses associated with the purchase of land and the site preparation costs of existing property

- o Buildings and services costs - Costs of process and non-process buildings, utility connections, purchased services, and disposal costs

- o Relocation expenses - Costs of temporary or permanent accommodations for affected nearby residents

- o Disposal costs - Costs of transporting and disposing of waste material such as drums, contaminated soils and residues.

Indirect capital costs may include:

- o Engineering expenses - Costs of administration, design, construction supervision, drafting, and treatability testing

- o Legal fees and license or permit costs - Administrative and technical costs necessary to obtain licenses and permits for installation and operation

- o Start up and shakedown costs - Costs incurred during remedial action start up

- o Contingency allowances - Funds to cover costs resulting from unforeseen circumstances, such as adverse weather conditions, strikes, and inadequate site characterization.

(2) Operation & Maintenance Costs. Annual costs are post-construction costs necessary to ensure the continued effectiveness of a remedial action. The following annual cost components should be considered:

- o Operating labor costs - Wages, salaries, training, overhead, and fringe benefits associated with the labor needed for post-construction operations

- o Maintenance materials and labor costs - Costs for labor, parts and other resources required for routine maintenance of facilities and equipment

- o Auxiliary materials and energy - Costs of such items as chemicals and electricity for treatment plant operations, water and sewer services, and fuel

Accuracy of Cost Estimates. Site characterization and treatability investigation information should permit the user to refine cost estimates for remedial action alternatives. It is important to consider the accuracy of costs developed for alternatives in the FS. Typically, these "study estimate" costs made during the FS are expected to provide an accuracy of 50 percent to -30 percent and are prepared using data available from the RI. Costs developed with expected accuracies other than +50 percent to -30 percent should be identified as such in the FS.

Present Worth Analysis. A present worth analysis is used to evaluate expenditures that occur over different time periods by discounting all future costs to a common base year, usually the current year. This allows the cost of remedial action alternatives to be compared on the basis of a single figure representing the amount of money that, if invested in the base year and disbursed as needed, would be sufficient to cover all costs associated with the remedial action over its planned life.

In conducting the present worth analysis, assumptions must be made regarding the discount rate and the period of performance. It is recommended that a discount rate equivalent to the 30-year U.S. treasury bond rate taxes and after inflation be used in determining the present worth of an alternative. The period of performance should not exceed 30 years.

Cost Sensitivity Analysis. After the present worth of each remedial action alternative is calculated, individual costs may be evaluated through a sensitivity analysis if there is sufficient uncertainty concerning specific assumptions. A sensitivity analysis assesses the effect that variations in specific assumptions associated with the design, implementation, operation, discount rate, and effective life of an alternative have on the present worth for the alternative. These assumptions depend on the accuracy of the data developed during the site characterization and treatability investigation and on predictions of the future behavior of the technology. Therefore, these assumptions are subject to varying degrees of uncertainty from site to site. The potential effect on the cost of an alternative because of these uncertainties can be observed by varying the assumptions and noting the effects on estimated costs. Sensitivity analyses can also be used to optimize the design of a remedial action alternative, particularly when design parameters are interdependent (e.g., incinerator capacity for contaminated soil and the length of the period of performance).

Use of sensitivity analyses should be considered for the factors that can significantly change overall costs of an alternative with only small changes in their values, especially if the factors have a high degree of uncertainty associated with them. Other factors chosen for analysis may include those factors for which the expected (or estimated) value is highly uncertain. The results of such an analysis can be used to identify worst-case scenarios and to revise estimates of contingency or reserve funds.

The following factors are potential candidates for consideration in conducting a sensitivity analysis:

- The effective life of a remedial action
- The O&M costs
- The duration of cleanup
- The volume of contaminated material, given the uncertainty about site conditions
- Other design parameters (e.g. the size of the treatment system)
- The discount rate (a range of 3 to 10 percent may be used to investigate uncertainties)

The results of a sensitivity analysis should be discussed during the comparison of alternatives. Areas of uncertainty that may have a significant effect on the cost of an alternative should be highlighted, and a rationale should be presented for selection of the most probable value of the parameter.

An alternative with the lowest present worth shall be assigned the highest score of 15. Other alternatives shall be assigned the cost score inversely proportional to their present worth.

5.2.4 Presentation of Individual Analysis

The analysis of individual alternatives against the seven criteria should be presented in the FS report as a narrative discussion accompanied by a summary table. This information will be used to compare the alternatives and support a subsequent analysis of the alternatives made by the decision-maker in the remedy selection process. The narrative discussion should, for each alternative, provide (1) a description of the alternative and (2) a discussion of the individual criteria assessment.

The alternative description should provide data on technology components (use of innovative technologies should be identified), quantities of hazardous materials handled, time required for implementation, process sizing, implementation requirements, and assumptions. These descriptions will also serve as the basis for selecting the New York SCGs. Therefore, the key SCGs for each alternative should be identified and integrated into these discussions.

The narrative discussion of the analysis should, for each alternative, present the assessment of the alternative against each of the seven criteria. This discussion should focus on how, and to what extent, the various factors within each of the seven criteria are addressed.

The uncertainties associated with specific alternatives should be included when changes in assumptions or unknown conditions could affect the analysis. The FS should also include a summary table highlighting the assessment of each alternative with respect to each of the seven criteria.

5.2.5 Comparative Analysis of Alternatives

Once the alternatives have been individually assessed against the seven criteria, a comparative analysis should be conducted to evaluate the relative performance of each alternative in relation to each specific evaluation criterion. This analysis is in contrast to the preceding analysis in which each alternative was analyzed independently without the consideration of interrelationships between alternatives. The purpose of this comparative analysis is to identify the advantages and disadvantages of each alternative relative to one another so that the key trade-offs to be evaluated by the decision-maker can be identified.

The first five criteria (short-term effectiveness; long-term effectiveness, and permanence; reduction of toxicity, mobility, and volume; implementability; and cost) will generally require more discussion than the remaining criteria because the key trade-offs or concerns among alternatives will most frequently relate to one or more of these five. The overall protectiveness and compliance with SCGs criteria will generally serve as threshold determinations in that they either will or will not be met. Community preference will likely be evaluated only preliminarily during the RI/FS because such information frequently is not available. Community preference can be addressed more thoroughly once comments on the RI/FS report and the proposed remedial action plan have been received and a final remedy selection decision is being made.

5.2.6 Presentation of Comparative Analysis

The comparative analysis should include a narrative discussion describing the strengths and weaknesses of the alternatives relative to one another with respect to each criterion, and how reasonable variations of key uncertainties could change the expectations of their relative performance. If destruction and treatment technologies are being considered, their potential advantages in cost or performance and the degree of uncertainty in their expected performance (as compared with conventional/isolation technologies) should also be discussed. The comparative analysis should also summarize the total sizing for each alternative.

The presentation of differences between alternatives can be measured either qualitatively or quantitatively, as appropriate, and should identify substantive differences (e.g. greater short-term effectiveness concerns, greater cost, etc) between alternatives, differences in total scores, etc. Quantitative information that was used to assess the alternatives (e.g. specific cost estimates, time until response objectives would be obtained, and levels of residual contamination) should be included in these discussions.

The Final Draft RI/FS or the Proposed Remedial Action Plan (PRAP) should present the remedial alternative recommended for the site and clear rational for the recommendation.

6. **COMMUNITY ASSESSMENT**: This assessment incorporates public comment into the selection of a remedy. There are several points in the RI/FS process at which the public may have previously provided comments (e.g. first phase of the RI/FS). The Department will solicit public comments on the remedial alternatives and the recommended alternative in accordance with the New York State Inactive Hazardous Waste Site Citizen Participation Plan and statutory and regulatory requirements. A document titled, "New York State Inactive Hazardous Waste Site Citizen Participation Plan," dated August 30, 1988, should be used as a guidance to solicit the public comments on the remedial alternatives and the recommended alternative. The public comments shall be considered. The remedy for the site will be selected and documented in accordance with the Organization and Delegation Memorandum #89-05 Policy - Records of Decision for Remediation of Class 2 Inactive Hazardous Waste Disposal Sites.

Table 4.1

SHORT-TERM/LONG-TERM EFFECTIVENESS
(Maximum Score = 25)

Analysis Factor	Basis for Evaluation During Preliminary Screening		Score
1. Protection of community during remedial actions.	° Are there significant short-term risks to the community that must be addressed? **(If answer is no, go to Factor 2.)**	**Yes** ___ **No** ___	0 4
	° Can the short-term risk be easily controlled?	**Yes** ___ **No** ___	1 0
	° Does the mitigative effort to control short-term risk impact the community life-style?	**Yes** ___ **No** ___	0 2
Subtotal (maximum = 4)			
2. Environmental Impacts	° Are there significant short-term risks to the environment that must be addressed? (If **answer is no, go to Factor 3.)**	**Yes** ___ **No** ___	0 4
	° Are the available mitigative measures reliable to minimize potential impacts?	**Yes** ___ **No** ___	3 0
Subtotal (maximum = 4)			
3. Time to implement the remedy.	° What is the required time to implement the remedy?	**≤ 2yr.** ___ **> 2yr.** ___	1 0
	° Required duration of the mitigative effort to control short-term risk.	**≤ 2yr.** ___ **> 2yr.** ___	1 0
Subtotal (maximum = 2)			
4. On-site or off-site treatment or land disposal	° On-site treatment* ° Off-site treatment* ° On-site or off-site land disposal		3 1 0
Subtotal (maximum = 3)			
*treatment is defined as destruction or separation/ treatment or solidification/ chemical fixation of inorganic wastes			
5. Permanence of the remedial alternative.	° Will the remedy be classified as permanent in accordance with Section 2.1(a), (b), or (c). **(If answer is yes, go to Factor 7.)**	**Yes** ___ **No** ___	3 0
Subtotal (maximum = 3)			

Table 4.1 (cont'd)

SHORT-TERM/LONG-TERM EFFECTIVENESS
(Maximum Score = 25)

Analysis Factor	Basis for Evaluation During Preliminary Screening	Score	
6. Lifetime of remedial actions.	° Expected lifetime or duration of of effectiveness of the remedy.	25-30yr. ____	3
		20-25yr. ____	2
		15-20yr. ____	1
		< 15yr. ____	0
Subtotal (maximum = 3)			
7. Quantity and nature of waste or residual left at the site after remediation.	i) Quantity of untreated hazardous waste left at the site.	**None** ____	3
		≤ 25% ____	2
		25-50% ____	1
		≥ 50% ____	0
	ii) Is there treated residual left at the site? **(If answer is no, go to Factor 8.)**	**Yes** ____	0
		No ____	2
	iii) Is the treated residual toxic?	**Yes** ____	0
		No ____	1
	iv) Is the treated residual mobile?	**Yes** ____	0
		No ____	1
Subtotal (maximum = 5)			
3. Adequacy and reliability of controls.	i) Operation and maintenance required for a period of:	**< 5yr.** ____	1
		> 5yr. ____	0
	ii) Are environmental controls required as a part of the remedy to handle potential problems? **(If answer is no, go to "iv")**	**Yes** ____	0
		No ____	1
	iii) Degree of confidence that controls can adequately handle potential problems.	**Moderate to very confident** ____	1
		Somewhat to not confident ____	0
	iv) Relative degree of long-term monitoring required **(compare with other remedial alternatives)**	**Minimum** ____	2
		Moderate ____	1
		Extensive ____	0
Subtotal (maximum = 4)			
TOTAL (maximum = 25)			

IF THE TOTAL IS LESS THAN 10, PROJECT MANAGER MAY REJECT THE REMEDIAL ALTERNATIVE FROM FURTHER CONSIDERATION.

Table 4.2

IMPLEMENTABILITY
(Maximum Score = 15)

Analysis Factor	Basis for Evaluation During Preliminary Screening		Score
1. Technical Feasibility			
a. Ability to construct technology.	i) Not difficult to construct. No uncertainties in construction.	____	3
	ii) Somewhat difficult to construct. No uncertainties in construction.	____	2
	iii) Very difficult to construct and/or significant uncertainties in construction.	____	
b. Reliability of technology.	i) Very reliable in meeting the specified process efficiencies or performance goals.	____	3
	ii) Somewhat reliable in meeting the specified process efficiencies or performance goals.	____	2
c. Schedule of delays due to technical problems.	i) Unlikely	____	2
	ii) Somewhat likely	____	1
d. Need of undertaking additional remedial action, if necessary.	i) No future remedial actions may be anticipated.	____	2
	ii) Some future remedial actions may be necessary.	____	1
Subtotal (maximum = 10)			
2. Administrative Feasibility			
a. Coordination with other agencies.	i) Minimal coordination is required.	____	2
	ii) Required coordination is normal.	____	1
	iii) Extensive coordination is required.	____	0
Subtotal (maximum = 2)			
3. Availability of Services and Materials			
a. Availability of prospective technologies.	i) Are technologies under consideration generally commercially available for the site-specific application?	**Yes** ____	1
		No ____	0
	ii) Will more than one vendor be available to provide a competitive bid?	**Yes** ____	-
		No ____	0

Table 4.2 (cont'd)

IMPLEMENTABILITY
(Maximum Score = 15)

Analysis Factor	Basis for Evaluation During Preliminary Screening		Score
b. Availability of necessary equipment and specialists.	i) Additional equipment and specialists may be available without significant delay.	**Yes** ___ **No** ___	1 0

Subtotal (maximum = 3)

TOTAL (maximum = 15)

IF THE TOTAL IS LESS THAN 8, PROJECT MANAGER MAY REJECT THE REMEDIAL ALTERNATIVE FROM FURTHER CONSIDERATION.

Table 5.1

CRITERIA FOR DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES

COMPLIANCE WITH APPLICABLE OR RELEVANT AND APPROPRIATE NEW YORK STATE STANDARDS, CRITERIA AND GUIDELINES (SCGs)(10)

- Compliance With Contaminant-Specific SCGs
- Compliance With Action-Specific SCGs
- Compliance With Location-Specific SCGs

PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT (20)

- Environmental Impacts
- Transport of Hazardous Materials
- Health Impacts

SHORT-TERM EFFECTIVENESS (10)

- Protection of Community During Remedial Actions
- Protection of Workers During Remedial Actions
- Environmental Impacts
- Time Until Remedial Action Objectives Are Achieved

LONG-TERM EFFECTIVENESS & PERMANENCE (15)

- Magnitude of Residual Risk
- Adequacy of Controls
- Reliability of Controls

REDUCTION OF TOXICITY, MOBILITY AND VOLUME (15)

- Treatment Process Used and Materials Treated
- Amount of Hazardous Materials Destroyed or Treated
- Degree of Expected Reductions in Toxicity, Mobility and Volume
- Degree to Which Treatment is Irreversible
- Type and Quantity of Hazardous Residuals Remaining After Treatment

IMPLEMENTABILITY (15)

- Ability to Construct and Operate the Technology
- Reliability of the Technology Based on its Acceptable Demonstrations
- Ease of Undertaking Additional Remedial Actions, if Necessary
- Ability to Monitor Effectiveness of Remedy
- Availability of Necessary Equipment and Specialists
- Timing of New Technology Under Consideration

COST (15)

- Immediate Capital Costs
- Operating and Maintenance Costs
- Future Capital Costs
- Cost to Future Land Use
- Present Worth Cost

Table 5.2

COMPLIANCE WITH APPLICABLE OR RELEVANT AND APPROPRIATE NEW YORK STATE STANDARDS CRITERIA AND GUIDELINES (SCGs)

(Relative Weight = 10)

Analysis Factor	Basis for Evaluation During Detailed Analysis		Score
1. Compliance with chemical-specific SCGs	Meets chemical specific SCGs such as groundwater standards	Yes ___ No ___	4 0
2. Compliance with action-specific SCGs	Meets SCGs such as technology standards for incineration or landfill	Yes ___ No ___	3 0
3. Compliance with location-specific SCGs	Meets location-specific SCGs such as Freshwater Wetlands Act	Yes ___ No ___	3 0

TOTAL (Maximum = 10)

Table 5.3

PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT
(Relative Weight = 20)

Analysis Factor	Basis for Evaluation During Detailed Analysis		Score
1. Use of the site after remediation.	Unrestricted use of the land and water. **(If answer is yes, go to the end of the Table.)**	**Yes** ___	20
		No ___	0
TOTAL (Maximum = 20)			
2. Human health and the environment exposure after the remediation.	i) Is the exposure to contaminants via air route acceptable?	**Yes** ___	3
		No ___	0
	ii) Is the exposure to contaminants via groundwater/surface water acceptable?	**Yes** ___	4
		No ___	0
	iii) Is the exposure to contaminants via sediments/soils acceptable?	**Yes** ___	3
		No ___	0
Subtotal (maximum = 10)			
3. Magnitude of residual public health risks after the remediation.	i) Health risk	**≤ 1 in 1,000,000** ___	5
	ii) Health risk	**≤ 1 in 100,000** ___	2
Subtotal (maximum = 5)			
4. Magnitude of residual environmental risks after the remediation.	i) Less than acceptable	___	5
	ii) Slightly greater than acceptable	___	3
	iii) Significant risk still exists	___	0
Subtotal (maximum = 5)			
TOTAL (maximum = 20)			

Table 5.4

SHORT-TERM EFFECTIVENESS
(Relative Weight = 10)

Analysis Factor	Basis for Evaluation During Detailed Analysis			Score
1. Protection of community during remedial actions.	° Are there significant short-term risks to the community that must be addressed? **(If answer is no, go to Factor 2.)**	**Yes**	___	0
		No	___	4
	° Can the risk be easily controlled?	**Yes**	___	1
		No	___	0
	° Does the mitigative effort to control risk impact the community life-style?	**Yes**	___	0
		No	___	2
Subtotal (maximum = 4)				
2. Environmental Impacts	° Are there significant short-term risks to the environment that must be addressed? **(If answer is no, go to Factor 3.)**	**Yes**	___	0
		No	___	4
	° Are the available mitigative measures reliable to minimize potential impacts?	**Yes**	___	3
		No	___	0
Subtotal (maximum = 4)				
3. Time to implement the remedy.	° What is the required time to implement the remedy?	**≤ 2yr.**	___	1
		> 2yr.	___	0
	° Required duration of the mitigative effort to control short-term risk.	**≤ 2yr.**	___	1
		> 2yr.	___	0
Subtotal (maximum = 2)				
TOTAL (maximum = 10)				

Table 5.5

LONG-TERM EFFECTIVENESS AND PERMANENCE
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis		Score
1. On-site or off-site treatment or land disposal	° On-site treatment*		3
	° Off-site treatment*		1
	° On-site or off-site land disposal		0
Subtotal (maximum = 3)			
*treatment is defined as destruction or separation/ treatment or solidification/ chemical fixation of inorganic wastes			
2. Permanence of the remedial alternative.	° Will the remedy be classified as permanent in accordance with Section 2.1(a), (b), or (c). **(If answer is yes, go to Factor 4.)**	**Yes** ____	3
		No ____	0
Subtotal (maximum = 3)			
3. Lifetime of remedial actions.	° Expected lifetime or duration of of effectiveness of the remedy.	25-30yr.____	3
		20-25yr.____	2
		15-20yr.____	1
		< 15yr.____	0
Subtotal (maximum = 3)			
4. Quantity and nature of waste or residual left at the site after remediation.	i) Quantity of untreated hazardous waste left at the site.	**None** ____	3
		≤ 25% ____	2
		25-50% ____	1
		≥ 50% ____	0
	ii) Is there treated residual left at the site? **(If answer is no, go to Factor 5.)**	**Yes** ____	0
		No ____	2
	iii) Is the treated residual toxic?	**Yes** ____	0
		No ____	1
	iv) Is the treated residual mobile?	**Yes** ____	0
		No ____	1
Subtotal (maximum = 5)			

Table 5.5 (cont'd)

LONG-TERM EFFECTIVENESS AND PERMANENCE
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis		Score
5. Adequacy and reliability of controls.	i) Operation and maintenance required for a period of:	< 5yr. ___	1
		> 5yr. ___	0
	ii) Are environmental controls required as a part of the remedy to handle potential problems? **(If answer is no, go to "iv")**	**Yes** ___	0
		No ___	1
	iii) Degree of confidence that controls can adequately handle potential problems.	**Moderate to very confident** ___	1
		Somewhat to not confident ___	0
	iv) Relative degree of long-term monitoring required **(compare with other remedial alternatives)**	**Minimum** ___	2
		Moderate ___	1
		Extensive ___	0

Subtotal (maximum = 4)

TOTAL (maximum = 15)

Table 5.6
REDUCTION OF TOXICITY, MOBILITY OR VOLUME
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis		Sco.
1. Volume of hazardous waste reduced (reduction in volume or toxicity). **If Factor 1 is not applicable, go to Factor 2.**	i) Quantity of hazardous waste destroyed or treated. **Immobilization technologies do not score under Factor 1.**	99-100% ____	8
		90-99% ____	7
		80-90% ____	6
		60-80% ____	4
		40-60% ____	2
		20-40% ____	1
		< 20% ____	0
	ii) Are there untreated or concentrated hazardous waste produced as a result of (i)? **If answer is no, go to Factor 2**	Yes ____	0
		No ____	2
Subtotal (maximum = 10) If subtotal = 10, go to Factor 3	iii) After remediation, how is the untreated, residual hazardous waste material disposed?	Off-site land disposal ____	0
		On-site land disposal ____	1
		Off-site destruction or treatment ____	2
2. Reduction in mobility of hazardous waste. **If Factor 2 is not applicable, go to Factor 3**	i) Quality of Available Wastes Immobilized After Destruction/ Treatment	90-100% ____	2
		60-90% ____	1
		< 60% ____	0
	ii) Method of Immobilization		
	- Reduced mobility by containment	____	0
	- Reduced mobility by alternative treatment technologies	____	3
Subtotal (maximum = 5)			
3. Irreversibility of the destruction or treatment or immobilization of hazardous waste	Completely irreversible	____	5
	Irreversible for most of the hazardous waste constituents.	____	3
	Irreversible for only some of the hazardous waste constituents	____	2
	Reversible for most of the hazardous waste constituents.	____	0
Subtotal (maximum = 5)			
TOTAL (maximum = 15)			

Table 5.7

IMPLEMENTABILITY
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis		Score
1. Technical Feasibility			
a. Ability to construct technology.	i) Not difficult to construct. No uncertainties in construction.	___	3
	ii) Somewhat difficult to construct. No uncertainties in construction.	___	2
	iii) Very difficult to construct and/or significant uncertainties in construction.	___	1
b. Reliability of technology.	i) Very reliable in meeting the specified process efficiencies or performance goals.	___	3
	ii) Somewhat reliable in meeting the specified process efficiencies or performance goals.	___	2
c. Schedule of delays due to technical problems.	i) Unlikely	___	2
	ii) Somewhat likely	___	1
d. Need of undertaking additional remedial action, if necessary.	i) No future remedial actions may be anticipated.	___	2
	ii) Some future remedial actions may be necessary.	___	1
Subtotal (maximum = 10)			
2. Administrative Feasibility			
a. Coordination with other agencies.	i) Minimal coordination is required.	___	2
	ii) Required coordination is normal.	___	1
	iii) Extensive coordination is required.	___	0
Subtotal (maximum = 2)			
3. Availability of Services and Materials			
a. Availability of prospective technologies.	i) Are technologies under consideration generally commercially available for the site-specific application?	**Yes** ___ **No** ___	1 0
	ii) Will more than one vendor be available to provide a competitive bid?	**Yes** ___ **No** ___	1 0

Table 5.7 (cont'd)

IMPLEMENTABILITY
(Relative Weight = 15)

Analysis Factor	Basis for Evaluation During Detailed Analysis			Score
b. Availability of necessary equipment and specialists.	i) Additional equipment and specialists may be available without significant delay.	**Yes**	____	1
		No	____	0

Subtotal (maximum = 3)

TOTAL (maximum = 15)

RESPONSIVENESS SUMMARY
TECHNICAL AND ADMINISTRATIVE GUIDANCE MEMORANDUM (TAGM) FOR THE SELECTION OF REMEDIAL ACTIONS AT INACTIVE HAZARDOUS WASTE SITES

1. IMPLEMENTATION OF REMEDIAL ACTIONS:

Comment No. 1.1: In the proposed policy's hierarchy of remedial actions, solidification/fixation technologies are only considered for inorganic wastes. These technologies are also applicable to organic wastes.

Response No. 1.1: Recently solidification/fixation technologies have been used for organic wastes. Adequate long term data are not available to determine the effectiveness of solidification/fixation of hazardous wastes, containing high concentrations of organic constituents; however, use of solidification/fixation technologies for waste containing "low" level of organic constituents should be evaluated on site specific basis.

Comment No. 1.2: Destruction will result in the treated materials having "no residue containing unacceptable levels of hazardous wastes." How would this apply to an incinerator ash containing RCRA-regulated waste? What level would be considered unacceptable?

Response No. 1.2: Acceptable cleanup criteria for organic and inorganic hazardous constituents will be developed by the department, in cooperation with the New York State Department of Health (DOH). If concentrations of hazardous constituents of the incinerator ash residue are less than the acceptable cleanup criteria levels, then the remedy will be considered to be permanent reduction in the toxicity of hazardous wastes.

Comment No. 1.3: Section 27-1313, 5) d of the Environmental Conservation Law, notes, "The goal of any such remedial program shall be a complete cleanup of the site through the elimination of the significant threat to the environment posed by the disposal of hazardous wastes at the site and of the imminent danger of irreversible or irreparable damage to the environment caused by such disposal." Therefore, elimination of the significant threat to the environment is the legislatively mandated cleanup goal. However, the draft policy identifies a cleanup goal which "would result in a permanent and significant decrease in the toxicity, mobility or volume of hazardous wastes." While we appreciate and support the DEC's reliance on Superfund Amendment and Reauthorization Act (SARA) and the emphasis on permanent cleanups, we believe that the state goal of eliminating significant threats at the site should be included, as it is a critical and overriding goal of the remedial selection, that needs to be spelled out in the goals statement.

The definition of "reduction of toxicity, mobility, or volume" only includes a decrease of the threat or risk associated with the hazardous substance. State law states that "elimination of the significant threat to the environment" is the remedial goal.

For the requirement, "Be protective of human health and the environment", we recommend adding "with a cleanup goal of achieving pre-existing conditions."

Response No. 1.3: To state that the remediation goal is to eliminate all threats to the environment is inappropriate. The statutory mandate set forth in ECL 27-1313 (5)(d) is the elimination of the significant threat to the environment, not elimination of all threats or achieving pre-existing conditions. The statements contained in the draft policy are consistent with this mandate. In addition, the statutory mandate refers only to those programs implemented by the Department, whereas, the TAGM will apply to the selection of remedy at all sites.

Comment No. 1.4: We strongly support the review of all remediated sites, whether or not hazardous wastes have been left at the site, and the requirement for public comment on any department action. However, waiting five years before reviewing a "remediated" site with leftover contaminants, is inappropriately long. We recommend a review after one year with a public comment period to allow citizens to have input into the specifics of the review process. For instance, it may be appropriate to have water, soil and wildlife testing done at the site, to fully assess the impact of the leftover contamination.

Response No. 1.4: If a remedial action leaves any hazardous wastes at the site, periodic monitoring and operation and maintenance will be required at the site to evaluate the effectiveness of the implemented remedy. The monitoring will include sampling and analysis of appropriate environmental samples. Such sampling and analysis will begin upon construction completion at a specified frequency. Depending upon the nature of the site, sampling may be required quarterly or even monthly.

In addition to this monitoring requirement, such remedial action which leaves any hazardous waste at the site shall be reviewed once each five years to assure that human health and the environment are being protected.

Comment No. 1.5: We strongly support the Department's decision to not include control and isolation technologies in the definition of "permanent remedies". We request the inclusion of one additional preference criteria for the evaluation of treatment technologies. Specifically, we recommend the addition of "(v) the documented preference of citizens or groups in the community where the site is located." We believe this is an important and necessary preference, in addition, to the ones listed in the draft document.

Response No. 1.5: During the feasibility study all alternative treatment technologies, including the technologies known at the time to be preferred by community groups, will be evaluated.

Comment No. 1.6: The guidance document, in Section 2, states that "permanent remedies are to be used wherever practicable". This is different from EPA's criteria of maximum extent practicable. The difference is that EPA's "maximum extent" is, to the best of my knowledge, tied to a cost multiplier. Whereas the term practicable, literally means, possible to perform.

Response No. 1.6: The guidance document states that "permanent remedies are to be used wherever practicable", which means if an alternative is practicable to implement, in light of its evaluation for the seven criteria, it should be considered for implementation.

2. DEVELOPMENT AND PRELIMINARY SCREENING OF REMEDIAL ALTERNATIVES

Comment No. 2.1: The proposed document excludes cost in the screening of remedial alternatives. It is EPA's policy to use cost as a screening factor when there is an order of magnitude differential. This policy differential is mitigated in the detailed analysis section through use of a cost sensitivity analysis - an idea which EPA would be wise to incorporate on a formal basis.

Response No. 2.1: It is our opinion that cost should not be used as a criterion to guide the initial development and screening of remedial alternatives during preliminary screening in order to avoid rejection of permanent remedies. During the preliminary screening, only two (2) criteria, effectiveness and implementability will be considered in evaluating remedial alternatives. It is appropriate to consider cost as a factor only during the detailed analysis of screened alternatives.

Comment No. 2.2: We support the Department's decision to not use cost as a screening criteria in the initial screening process.

Response No. 2.2: Please refer to response No. 2.1.

Comment No. 2.3: **When the Department staff are conducting the initial screening of technologies, what sources will be utilized, besides EPA's SITE program and the SUNY Buffalo Center for Hazardous Waste Management?**

Response No. 2.3: The feasibility study in general is performed by an engineering consultant for USEPA, NYSDEC or a PRP. The consultant will use all available sources to compile remedial technologies. In addition, NYSDEC intends to procure a consultant to prepare written reports as Technical Resource Documents outlining the state-of-the-art of all alternative treatment technologies which are applicable to the remediation of inactive hazardous waste sites. These technical resource documents will be available to consultants, PRPs, NYSDEC staff and the public.

Comment No. 2.4: Removing a remedial alternative from the screening process if it is expected to fail within 15 years, is an environmentally unsound and arbitrary decision. The goal of the remediation should be to permanently address the contamination.

Response No. 2.4: Concur with the comment. Appropriate changes are made. Please refer to Section 4.1.

3. DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES

Comment No. 3.1: The required assignment of weights to seven evaluation criteria will eliminate the flexibility which is so essential to the effective implementation of the superfund program. For this very reason, the proposed National Contingency Plan (NCP) does not consider the use of weights for its evaluation criteria.

Response No. 3.1: It is our opinion that the assigned weights to seven evaluation criteria will provide uniformity and consistency in evaluation and selection of remedial actions.

Comment No. 3.2: Since Applicable or Relevant and Appropriate Requirements (ARARs) and protectiveness are threshold criteria, i.e. statutory mandates which must be met at every site (in the absence of an ARAR waiver), the utility of weights for these criteria is questionable.

Response No. 3.2: Since there may be instances where part of the ARARS may not be met, for an alternative, it is prudent to have weighting factors so that a remedial alternative which meets the ARARs will be given greater weight than the one which does not meet all or some of the ARARs.

Although, it is a statutory mandate that all remedies meet environmental and health protectiveness, some remedial actions provide greater protectiveness than others and, hence, the utility of a weighing factor is justified.

Comment No. 3.3: Division of implementability into its technical and administrative components is a moot point if an alternative is not implementable for any reason. In addition, assigning points to an unimplementable alternative will not create an implementable remedy.

Response No. 3.3: Alternatives will be evaluated based on implementability and effectiveness during the preliminary screening. An alternative not being technically feasible for implementation will not be considered in the detailed analysis.

However, alternatives which pass the preliminary screening will have several degrees of implementability. Some technologies will be more reliable than others; some remedial alternatives will need less administrative requirements than others; availability of services and materials may be easier for some remedial technologies than others. The implementability criterion will consider such factors in the detailed analysis of alternatives.

Comment No. 3.4: How will the contaminant-specific cleanup criteria and ARARs be determined?

Response No. 3.4: Contaminant-Specific cleanup criteria and ARARs will be determined for every site, in cooperation with the Department of Health on a site-specific basis.

Comment No. 3.5: We oppose having cost as one of the seven evaluation criteria in detailed analysis of alternatives. The law requires the selection of a cost-effective remedial method, not a less-expensive method. We recommend the establishment of a third tier using cost as a final selector after the remedial methods have been screened according to the six proposed criteria. Thus, the Department would select a number of remedial methods based on their effectiveness, performance, and environmental and health goals, and then, it would determine which of the resulting methods is the most cost-effective. By allowing cost to be included in the second decision-making tier, it negatively offsets the human health, environment and ARARs criteria. This is inappropriate and, we believe, a divergence from the intent of the Environmental Conservation Law.

Although we support DEC's written clarification of the remedy selection process, we believe that considerations of cost-effectiveness should play a narrow role in the cleanup selection process, and should not interfere with the attainment of permanent and health-protective cleanups.

Response No. 3.5: Under the proposed procedure for evaluating remedies, cost does not negatively offset human health, environment and ARARs criteria. Effectiveness of each remedial alternative in protecting human health and the environment is evaluated during the preliminary screening. It is to be noted that cost is not considered during the preliminary screening. Only those remedies which meet this requirement pass through to the second stage of detailed analysis. In order to effectively complete a detailed comparison of remedial alternatives, the cost of each alternative must be analyzed. Since cost is only one of the seven factors being considered and since a determination will have already been required that the remedies being analyzed are protective of human health and the environment, this analysis ensures that the selection of the remedy meets all statutory requirements under both state and federal laws.

Comment No. 3.6: We strongly endorse the approach required by the federal Superfund Amendments and Reauthorization Act, which allows consideration of cost-effectiveness only after EPA has determined the appropriate level of environmental protection to be achieved. The State Superfund Management Board's current report recommends that the State adopt parallel requirements to those in SARA.

Response No. 3.6: The NYSDEC's approach is more stringent than the USEPA's approach currently being used or outlined in the proposed NCP. USEPA considers cost as a criterion in the preliminary screening process. The NYSDEC's guidance document includes only effectiveness in protecting human health and the environment and implementability in the preliminary screening. Cost is considered only in the detailed analysis for remedial alternatives which pass the preliminary

Comment No. 4.2: Section 5.2.2 states that "community acceptance" is encompassed in the seven evaluation criteria. How do the seven criteria encompass "community acceptance"? Also, there is an important distinction between community "acceptance" and community preference or the community's recommendation. One assumes a passive community with the underlying assumption being that the Department has to convince the community of its decision. Whereas community preference assumes a meaningful public participation process where the Department incorporates in its decision-making process, the recommendations of the community residents who will be impacted by the remedial method chosen. Community recommendations is an accurate and respectful term.

There is obviously not a lot of time for meaningful community input when the "final remedy selection decision is being made", thus the Department staff should conduct a proactive outreach effort at this critical stage of the decision-making process.

Response No. 4.2: The distinction between "community acceptance" and "community preference" is recognized and appropriate changes are made in the document. The department will solicit public comments and input in accordance with the document titled, "New York State Inactive Hazardous Waste Site Citizen Participation Plan, dated August 30, 1988 and other statutory and regulatory requirements.

Public comments will be solicited on the first phase of the RI/FS report. The first phase of the RI/FS report usually includes the first set of environmental quality data describing conditions at the site and preliminary discussion of alternative remedial technologies. During this public comment opportunity, interested citizens can notify the Department of remedial technologies of interest to them. If the community preferred technologies are technically feasible for the site-specific conditions, they will be evaluated in the final phase of the RI/FS.

APPENDIX B

NYSDEC DIVISION TECHNICAL AND ADMINISTRATIVE GUIDANCE MEMORANDUM (TAGM HWR-92-4044) ACCELERATED REMEDIAL ACTIONS AT CLASS 2, NON-RCRA REGULATED LANDFILLS

HWR-92-4044
March 9, 1992

New York State Department of Environmental Conservation

MEMORANDUM

TO: Reg. Haz. Waste Remediation Engineers, Bur. Dir., & Section Chiefs
FROM: Michael J. O'Toole, Jr., Director, Div. of Haz. Waste Remediation
SUBJECT: DIVISION TECHNICAL AND ADMINISTRATIVE GUIDANCE MEMORANDUM: ACCELERATED REMEDIAL ACTIONS AT CLASS 2, NON-RCRA REGULATED LANDFILLS
DATE: MAR - 9 1992

Michael J. O'Toole

On January 14, 1992, Deputy Commissioner Sullivan signed the Strategic Plan: Accelerated Remedial Actions which provides guidance concerning Class 2, non-RCRA regulated landfills.

Since this Strategic Plan is an important element in the Division's program, it is also being issued as a Technical and Administrative Guidance Memorandum.

Attachment
cc: E. Sullivan
D. Markell
J. Eckl
R. Davies
R. Dana
C. Goddard
A. Carlson
E. McCandless
P. Counterman
A. Fossa
J. Kelleher
J. Colquhoun
D. Persson
M. Birmingham
D. Johnson
D. Ritter
Regional Directors
Regional Engineers
Regional Solid and Hazardous Waste Engineers
Regional Citizen Participation Specialists

January 14, 1992

STRATEGIC PLAN: ACCELERATED REMEDIAL ACTIONS

Issue: Accelerated Remedial Actions at Class 2, Non-RCRA Regulated Landfills

Priority: High

Responsible Person: Michael J. O'Toole, Jr.

OBJECTIVES:

The Department has adopted a policy favoring permanent remedies whenever feasibile at inactive hazardous waste sites. However, it is often obvious that major mixed waste landfills will not be amenable to complete permanent remedies and that a cap will be called for. In such cases, it may be appropriate to proceed rapidly to the design phase.

To mitigate the major source of contamination posed by Class 2 landfills as early as possible. The Remedial Investigation/Feasibility Study (RI/FS) process for Class 2 sites requires the identification of feasible remedial technologies which are screened and then organized into various remedial alternatives. For source control options at Class 2, non-RCRA regulated landfills, this process may be somewhat simplified and accelerated due to the typical large size and the composition of these landfills. Most Class 2 landfills are composed of substantial quantities of municipal solid waste (MSW) mixed with smaller quantities of hazardous waste (this is not true of pre-RCRA industrial landfills which are not addressed in this guidance). While a complete RI/FS is warranted at these sites to determine the full extent of contamination and any risks posed to human health and/or the environment, certain remedial measures should be evaluated very early in the RI/FS process for possible accelerated implementation based on historic data, early treatability tests, risk assessment or technologically based results with a bias for initiating appropriate remedial actions as early as possible in the remedial process.

STRATEGY:

Identify several remedial measures for Class 2, non-RCRA regulated landfills which would be evaluated, on a site-specific basis, for accelerated implementation. This document describes technical considerations which must be included in this evaluation. It is not intended to describe all remedial design considerations for these remedial actions, but rather to aid in making the decision to proceed with design. If accelerated remedial actions are identified prior to consent order negotiations, these remedial actions should be negotiated into the consent order with the appropriate timeframes for a focused FS or a Departmental analysis of alternatives, opportunity for public input including a public comment period, as appropriate, and Record of Decision.

capping. These areas would be identified by geophysical testing, test pits, soil borings, and soil/sediment testing.

4. The entire landfill area must be adequately defined to allow the determination of final grades and elevations. This may be determined by past disposal practices, geophysical testing, test pits, and soil borings.

5. The capping should be phased to allow deposition onto an uncapped area of drilling/trench spoils from monitoring well installation, groundwater recovery well installation, or leachate/groundwater collection trench excavations providing the phasing doesn't prolong the overall capping schedule. This will be influenced by the size of the landfill and the timing and duration of remedial design.

II. Source Control Technology #2:

A. A leachate collection system will be required at most Class 2, non-RCRA regulated landfills. The design and construction of this system must be integrated with the design and construction of the cap.

B. Technical considerations to be evaluated under leachate collection option:

1. The depth of waste and areal extent of waste must be adequately defined to allow determination of final elevations and location of leachate collection system.

2. Any potential for on-site consolidation of wastes which may affect the final location of the leachate collection system must be considered.

3. The pathways for leachate must be adequately defined to aid in total capture.

4. The need for a vertical barrier to minimize the collection of uncontaminated groundwater must be assessed.

5. All reasonable steps should be taken to prevent or control the impacts of leachate on human health.

III. Treatment Technology #1:

A. Treatment of collected leachate to meet discharge standards will be required at all Class 2, non-RCRA regulated landfills which require a leachate collection system. The reason it is considered separately from the leachate collection system in this guidance is due to the sequencing of events. While the design and construction of leachate collection systems must be integrated with the design and construction of the cap, the selection, design, and construction of a leachate treatment system may need to be done subsequent to cap construction. If a leachate treatment system is needed to coincide with the construction of the leachate collection system, the design and construction of a leachate treatment system should be concurrent with the cap design.

B. Technical considerations to be evaluated under leachate treatment option:

1. The leachate may have to be handled as a hazardous waste or it may be handled as any other non-hazardous, landfill leachate. If chemical analysis of the leachate reveals that there are no hazardous constituents in it which could have leached from or been derived from the known hazardous waste in the landfill and the leachate does not fail any RCRA characteristic tests (ignitable, corrosive, reactive, TCLP) or the leachate can be pretreated on site to those levels, then the leachate may be able to be handled as any other non-hazardous, landfill leachate.

2. The collected leachate should be economically treated in an environmentally sound manner in the short term until the final leachate/groundwater remedy is selected. One possibility would be to use a POTW for treatment if the POTW is willing to accept the leachate and can treat the contaminants contained in the leachate.

3. Leachate treatment options may need to be thoroughly evaluated in a feasibility study. This is perhaps the most important consideration in evaluating whether to proceed with the design of a leachate treatment option prior to completion of the RI/FS. Selection of a treatment technology which has been successful at other sites at the exclusion of other options could result in inefficiency or higher costs due to site-specific conditions and would not properly consider all available treatment technologies.

4. If treatment of contaminated groundwater is a strong possibility, it may make more sense to design one treatment system (after the Record of Decision) for both leachate and groundwater unless a modular leachate treatment system can be constructed such that it is easily expanded to treat groundwater or the leachate/groundwater contaminants and their concentrations are sufficiently different to warrant different treatment technologies.

5. The quantity of leachate requiring treatment must be considered along with available discharge points.

6. Provisions to reinject stabilized sludge from the leachate treatment system back into the landfill should be considered within the applicable regulatory and legal constraints.

IMPLEMENTATION PROCESS:

Source control measures described in this guidance when implemented must follow a clear, documented decision process as described below:

1. Recommendation of any or all of the above accelerated remedial actions will be made based on a careful evaluation of all technical considerations (at a minimum, the technical considerations in this guidance must be addressed).

2. A focused FS or Departmental analysis of alternatives must be performed to evaluate the feasibility of accelerating the construction of a cap/leachate system.

3. Any viable remedial actions which are identified in the focused FS or Departmental analysis of alternatives must be presented for public comment through the normal PRAP/ROD process in accordance with DHWR TAGM 4022 to the fullest extent possible.

The design of the early remedial measures should proceed as soon as possible after the responsiveness summary is mailed. Public participation during design and construction must, at a minimum, meet the requirements of the New York State Inactive Hazardous Waste Site Citizen Participation Plan.

An accelerated remedial action which is documented by a ROD must be tracked as a separate operable unit for that site, not as an IRM. However, the ROD will not be tracked as an RI/FS completion since there would only be a design and construction phase associated with that operable unit.

This Strategic Plan is hereby approved for use by the Division of Hazardous Waste Remediation.

Edward O. Sullivan

APPENDIX C

DETAILED ALTERNATIVE COST ESTIMATES

Alternative 1A
Cuba Municipal Waste Disposal Site
Low Permeability Cap, Groundwater Diversion Trench, Leachate Collection and Off-site Treatment and Long-term Monitoring
Cost Estimate

Item	Quantity	Units	Unit Cost	Total
Capital Costs				
Mobilization/demobilization*	-	Lump Sum	280,000	280,000
Site Preparation				
Clearing and grubbing	22	Acres	2,000	44,000
Geomembrane Cap				
General grading	36000	CY	3.00	108,000
Buy/haul/place contour grading material	18000	CY	8.50	153,000
Buy/haul/place 60 mil HDPE geomembrane	106000	SQ YD	4.50	477,000
Buy/haul/place geocomposite	106000	SQ YD	4.00	424,000
Buy/haul/place barrier protection layer	71000	CY	8.50	604,000
Buy/haul/place 6" vegetative growth medium	18000	CY	17.50	315,000
Seed, fertilize and mulch	106000	SQ YD	0.70	74,000
Passive vents	88	Vents	3,200	282,000
Groundwater Diversion System				
Interceptor trench and piping	26000	SQ FT	5.00	130,000
Slurry wall	18000	SQ FT	3.50	63,000
Leachate Collection System				
Inteceptor trench and piping	18000	SQ FT	5.00	90,000
Slurry wall	18000	SQ FT	3.50	63,000
Storm Water Drainage System				
Upgradient diversion swale/berm	1800	FT	10.50	19,000
Detention basins	24000	CY	5.00	120,000
Off-site conveyance piping	1300	FT	150	195,000
Estimated Capital Cost				**3,441,000**
Contingency and Engineering Fees				
Contingency allowance (15%)				516,000
Engineering fees**				500,000
Estimated Contingency and Engineering Fees				1,016,000
Total Estimated Capital Cost				**4,457,000**

Annual Operating and Maintenance Costs				
Cap				
Site inspection	-	Lump Sum	15,000	15,000
Miscellaneous site work (including swale maintenance)	-	Lump Sum	5,000	5,000
Vegetation maintenance	-	Lump Sum	7,000	7,000
	Annual cost			27,000
	Present worth of annual operation & maintenance cost for 30 yrs (i=5%)			415,000
Leachate Collection System				
Power for pump	-	Lump Sum	5,000	5,000
Labor for maintenance	52	Mandays	240	12,000
	Annual cost			17,000
	Present worth of annual operation & maintenance cost for 15 yrs (i=5%)			176,000
Off-site Leachate Treatment				
Transport and disposal	900000	Gal	0.03	27,000
	Present worth of annual operation & maintenance cost for 15 yrs (i=5%)			280,000
Groundwater Monitoring Costs Per Event				
Groundwater sampling	3	Mandays	600	1,800
Purge water disposal	1	Drums	200	200
Equipment, materials and supplies	-	Lump Sum	1,000	1,000
Sample analysis	8	Samples	1,000	8,000
	Estimated per event monitoring costs			11,000
	Present worth of annual groundwater monitoring (30 yrs, i=5%)***			349,000
REMEDIAL ALTERNATIVE 1A TOTAL ESTIMATED COSTS				**5,677,000**

*Includes bonds, insurance, temporary facilities, pre-construction submittals and as built drawings
** Includes design and construction inspection.
***Sampling frequency includes 4 times per year for the first 5 years, 2 times per year for the next 5 years and 1 time per year for the next 20 years.

Alternative 1B
Cuba Municipal Waste Disposal Site
Low Permeability Cap, Groundwater Diversion Trench, Leachate Collection and On-site Treatment and Long-term Monitoring
Cost Estimate

Item	Quantity	Units	Unit Cost	Total
Capital Costs				
Mobilization/demobilization*	-	Lump Sum	280,000	280,000
Site Preparation				
Clearing and grubbing	22	Acres	2,000	44,000
Geomembrane Cap				
General grading	36000	CY	3.00	108,000
Buy/haul/place contour grading material	18000	CY	8.50	153,000
Buy/haul/place 60 mil HDPE geomembrane	106000	SQ YD	4.50	477,000
Buy/haul/place geocomposite	106000	SQ YD	4.00	424,000
Buy/haul/place barrier protection layer	71000	CY	8.50	604,000
Buy/haul/place 6" vegetative growth medium	18000	CY	17.50	315,000
Seed, fertilize and mulch	106000	SQ YD	0.70	74,000
Passive vents	88	Vents	3,200	282,000
Groundwater Diversion System				
Diversion trench and piping	26000	SQ FT	5.00	130,000
Slurry wall	18000	SQ FT	3.50	63,000
Leachate Collection System				
Inteceptor trench and piping	18000	SQ FT	5.00	90,000
Slurry wall	18000	SQ FT	3.50	63,000
Storm Water Drainage System				
Upgradient diversion swale/berm	1800	FT	10.50	19,000
Detention basins	24000	CY	5.00	120,000
Off-site conveyance piping	1300	FT	150	195,000
Leachate Treatment System				
Aeration for VOC removal	-	Lump Sum	85,000	85,000
Chemical precipitation for metals removal	-	Lump Sum	55,000	55,000
Biological treatment for nitrogen removal	-	Lump Sum	105,000	105,000
Carbon absorption for PCB and pesticide removal	-	Lump Sum	20,000	20,000
Building, electrical, etc.	-	Lump Sum	75,000	75,000
Estimated Capital Cost				**3,781,000**
Contingency and Engineering Fees				
Contingency allowance (15%)				567,000
Engineering fees**				700,000
Estimated Contingency and Engineering Fees				1,267,000
Total Estimated Capital Cost				**5,048,000**

Annual Operating and Maintenance Costs

Cap				
Site inspection	-	Lump Sum	15,000	15,000
Miscellaneous site work (including swale maintenance)	-	Lump Sum	5,000	5,000
Vegetation maintenance	-	Lump Sum	7,000	7,000
	Annual cost			27,000
	Present worth of annual operation & maintenance cost for 30 yrs (i=5%)			415,000
Leachate Collection and Treatment System				
Power for pump	-	Lump Sum	5,000	5,000
Residuals disposal	-	Lump Sum	15,000	15,000
Carbon replacement	-	Lump Sum	3,000	3,000
Labor for maintenance	208	Mandays	240	50,000
Equipment, materials and supplies	-	Lump Sum	1,000	1,000
Discharge sample analysis	12	Samples	1,000	12,000
	Annual cost			73,000
	Present worth of annual operation & maintenance cost for 15 yrs (i=5%)			758,000
Groundwater Monitoring Costs Per Event				
Groundwater sampling	3	Mandays	600	1,800
Purge water disposal	1	Drums	200	200
Equipment, materials and supplies	-	Lump Sum	1,000	1,000
Sample analysis	8	Samples	1,000	8,000
	Estimated per event monitoring costs			11,000
	Present worth of annual groundwater monitoring (30 yrs, i=5%)***			349,000
	REMEDIAL ALTERNATIVE 1B TOTAL ESTIMATED COSTS			**6,570,000**

*Includes bonds, insurance, temporary facilities, pre-construction submittals and as built drawings

** Includes design and construction inspection.

***Sampling frequency includes 4 times per year for the first 5 years, 2 times per year for the next 5 years and 1 time per year for the next 20 years.

Alternative 2
Cuba Municipal Waste Disposal Site
Low Permeability Cap, Groundwater Diversion Trench,
Phytoremediation and Long-term Monitoring
Cost Estimate

Item	Quantity	Units	Unit Cost	Total
Capital Costs				
Mobilization/demobilization*	-	Lump Sum	280,000	280,000
Site Preparation				
Clearing and grubbing	22	Acres	2,000	44,000
Geomembrane Cap				
General grading	36000	CY	3.00	108,000
Buy/haul/place contour grading material	18000	CY	8.50	153,000
Buy/haul/place 60 mil HDPE geomembrane	106000	SQ YD	4.50	477,000
Buy/haul/place geocomposite	106000	SQ YD	4.00	424,000
Buy/haul/place barrier protection layer	71000	CY	8.50	604,000
Buy/haul/place 6" vegetative growth medium	18000	CY	17.50	315,000
Seed, fertilize and mulch	106000	SQ YD	0.70	74,000
Passive vents	88	Vents	3,200	282,000
Groundwater Diversion System				
Interceptor trench and piping	26000	SQ FT	5.00	130,000
Slurry wall	18000	SQ FT	3.50	63,000
Leachate Phytoremediation				
Planting of poplar trees	-	Lump Sum	40,000**	40,000
Storm Water Drainage System				
Upgradient diversion swale/berm	1800	FT	10.50	19,000
Detention basins	24000	CY	5.00	120,000
Off-site conveyance piping	1300	FT	150	195,000
	Estimated Capital Cost			**3,328,000**
Contingency and Engineering Fees				
Contingency allowance (15%)				499,000
Engineering fees***				500,000
	Estimated Contingency and Engineering Fees			999,000
	Total Estimated Capital Cost			**4,327,000**

Annual Operating and Maintenance Costs				
Cap				
Site inspection	-	Lump Sum	15,000	15,000
Miscellaneous site work (including swale maintenance)	-	Lump Sum	5,000	5,000
Vegetation maintenance	-	Lump Sum	7,000	7,000
	Annual cost			27,000
	Present worth of annual operation & maintenance cost for 30 yrs (i=5%)			415,000
Groundwater Monitoring Costs Per Event				
Groundwater sampling	3	Mandays	600	1,800
Purge water disposal	1	Drums	200	200
Equipment, materials and supplies	-	Lump Sum	1,000	1,000
Sample analysis	8	Samples	1,000	8,000
	Estimated per event monitoring costs			11,000
	Present worth of annual groundwater and gas monitoring (30 yrs, i=5%)****			349,000
	REMEDIAL ALTERNATIVE 2 TOTAL ESTIMATED COSTS			**5,091,000**

*Includes bonds, insurance, temporary facilities, pre-construction submittals and as built drawings
**Price obtained from Ecolotree, Inc. Iowa City, Iowa
*** Includes design and construction inspection.
****Sampling frequency includes 4 times per year for the first 5 years, 2 times per year for the next 5 years and 1 time per year for the next 20 years.

Alternative 3
Cuba Municipal Waste Disposal Site
Low Permeability Cap, Groundwater Diversion Trench
and Long-term Monitoring
Cost Estimate

Item	Quantity	Units	Unit Cost	Total
Capital Costs				
Mobilization/demobilization*	-	Lump Sum	280,000	280,000
Site Preparation				
Clearing and grubbing	22	Acres	2,000	44,000
Geomembrane Cap				
General grading	36000	CY	3.00	108,000
Buy/haul/place contour grading material	18000	CY	8.50	153,000
Buy/haul/place 60 mil HDPE geomembrane	106000	SQ YD	4.50	477,000
Buy/haul/place geocomposite	106000	SQ YD	4.00	424,000
Buy/haul/place barrier protection layer	71000	CY	8.50	604,000
Buy/haul/place 6" vegetative growth medium	18000	CY	17.50	315,000
Seed, fertilize and mulch	106000	SQ YD	0.70	74,000
Passive vents	88	Vents	3,200	282,000
Groundwater Diversion System				
Interceptor trench and piping	26000	SQ FT	5.00	130,000
Slurry wall	18000	SQ FT	3.50	63,000
Storm Water Drainage System				
Upgradient diversion swale/berm	1800	FT	10.50	19,000
Detention basins	24000	CY	5.00	120,000
Off-site conveyance piping	1300	FT	150	195,000
Estimated Capital Cost				**3,288,000**
Contingency and Engineering Fees				
Contingency allowance (15%)				493,000
Engineering fees**				500,000
Estimated Contingency and Engineering Fees				993,000
Total Estimated Capital Cost				**4,281,000**

Annual Operating and Maintenance Costs				
Cap				
Site inspection	-	Lump Sum	15,000	15,000
Miscellaneous site work (including swale maintenance)	-	Lump Sum	5,000	5,000
Vegetation maintenance	-	Lump Sum	7,000	7,000
	Annual cost			27,000
	Present worth of annual operation & maintenance cost for 30 yrs (i=5%)			415,000
Groundwater Monitoring Costs Per Event				
Groundwater sampling	3	Mandays	600	1,800
Purge water disposal	1	Drums	200	200
Equipment, materials and supplies	-	Lump Sum	1,000	1,000
Sample analysis	8	Samples	1,000	8,000
	Estimated per event monitoring costs			11,000
	Present worth of annual groundwater and gas monitoring (30 yrs, i=5%)***			349,000
	REMEDIAL ALTERNATIVE 3 TOTAL ESTIMATED COSTS			**5,045,000**

*Includes bonds, insurance, temporary facilities, pre-construction submittals and as built drawings
** Includes design and construction inspection.
**Sampling frequency includes 4 times per year for the first 5 years, 2 times per year for the next 5 years and 1 time per year for the next 20 years.

Alternative 4
Cuba Municipal Waste Disposal Site
Consolidation, Low Permeability Cap, Groundwater Diversion Trench
and Long-term Monitoring
Cost Estimate

Item	Quantity	Units	Unit Cost	Total
Capital Costs				
Mobilization/demobilization*	-	Lump Sum	280,000	280,000
Site Preparation				
Clearing and grubbing	22	Acres	2,000	44,000
Consolidation				
Excavation and placement	30000	CY	5	150,000
Backfill	30000	CY	6	180,000
Hazardous waste disposal (local)**	3000	CY	60	180,000
Hazardous waste disposal (Texas)***	1500	CY	900	1,350,000
Geomembrane Cap				
General grading	30000	CY	3.00	90,000
Buy/haul/place contour grading material	12000	CY	8.50	102,000
Buy/haul/place 60 mil HDPE geomembrane	73000	SQ YD	4.50	329,000
Buy/haul/place geocomposite	73000	SQ YD	4.00	292,000
Buy/haul/place barrier protection layer	48000	CY	8.50	408,000
Buy/haul/place 6" vegetative growth medium	12000	CY	17.50	210,000
Seed, fertilize and mulch	107000	SQ YD	0.70	75,000
Passive vents	60	Vents	3,200	192,000
Groundwater Diversion System				
Interceptor trench and piping	20000	SQ FT	5.00	100,000
Slurry wall	14000	SQ FT	3.50	49,000
Storm Water Drainage System				
Upgradient diversion swale/berm	1400	FT	10.50	15,000
Detention basins	24000	CY	5.00	120,000
Off-site conveyance piping	1300	FT	150	195,000
Estimated Capital Cost				**4,361,000**
Contingency and Engineering Fees				
Contingency allowance (15%)				654,000
Engineering fees****				500,000
Estimated Contingency and Engineering Fees				1,154,000
Total Estimated Capital Cost				**5,515,000**

Annual Operating and Maintenance Costs
Cap

Site inspection	-	Lump Sum	15,000	15,000
Miscellaneous site work (including swale maintenance)	-	Lump Sum	5,000	5,000
Vegetation maintenance	-	Lump Sum	7,000	7,000
	Annual cost			27,000
	Present worth of annual operation & maintenance cost for 30 yrs (i=5%)			415,000

Groundwater Monitoring Costs Per Event

Groundwater sampling	3	Mandays	600	1,800
Purge water disposal	1	Drums	200	200
Equipment, materials and supplies	-	Lump Sum	1,000	1,000
Sample analysis	8	Samples	1,000	8,000
	Estimated per event monitoring costs			11,000
	Present worth of annual groundwater and gas monitoring (30 yrs, i=5%)*****			349,000

REMEDIAL ALTERNATIVE 4
TOTAL ESTIMATED COSTS **6,279,000**

*Includes bonds, insurance, temporary facilities, pre-construction submittals and as built drawings.
**Assumes 10% of soil and waste excavated will require disposal as a hazardous waste at permitted landfill .
***Assumes 5% of waste excavated will require disposal as a hazardous waste at an incinerator.
**** Includes design and construction inspection.
*****Sampling frequency includes 4 times per year for the first 5 years, 2 times per year for the next 5 years and 1 time per year for the next 20 years.

Alternative 5
Cuba Municipal Waste Disposal Site
No Action Alternative
Cost Estimate

Item	Quantity	Units	Unit Cost	Total
Capital Costs				
Fencing	4800	FT	20	96,000
	Estimated Capital Cost			96,000
Contingency and Engineering fees				
Contingency allowance (5%)				5,000
Engineering fees*				2,000
›ntingency and Engineering Fees				7,000
	Total Estimated Capital Cost			103,000
Groundwater Monitoring Costs Per Event				
Groundwater sampling	3	Mandays	600	1,800
Purge water disposal	1	Drums	200	200
Equipment, materials and supplies	-	Lump Sum	1,000	1,000
Sample analysis	8	Samples	1,000	8,000
	Estimated per event monitoring costs			11,000
	Present Worth of Annual Groundwater Monitoring Cost for 30 yrs (i=5%)*			676,000
	REMEDIAL ALTERNATIVE 5 TOTAL ESTIMATED COSTS			**779,000**

*Sampling frequency includes 4 times per year for 30 years