Final

Phase II Leachate Management Analysis of Six Landfills U.S. Military Academy West Point, New York

Contract No. DACA31-94-D-0025
Delivery Order No. 0023

Prepared for

Department of the Army
Baltimore District, Corps of Engineers
Baltimore, Maryland

Prepared by

EA Engineering, Science, and Technology
Newburgh, New York
(914) 565-8100

August 1996

60787.52

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CONTENTS

Page

Page

Page

Page

Page

Page

Page

LIST OF ACRONYMS

ARAR	Applicable or relevant and appropriate requirements
CFR	Code of Federal Regulations
EPA	U.S. Environmental Protection Agency
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
PVC	Polyvinyl chloride
RCRA	Resource Conservation and Recovery Act
TAL	Target Analyte List
TBC	To be considered
USACE	U.S. Army Corps of Engineers
USMA	U.S. Military Academy
VOC	Volatile organic compound

LIST OF FIGURES

LIST OF TABLES

1. INTRODUCTION

On 30 August 1994, the U.S. Army Corps of Engineers (USACE), Baltimore District, issued Delivery Order No. 0023 under Contract No. DACA31-94-D-0025 to EA Engineering, Science, and Technology. Under this Delivery Order, EA is tasked to conduct the Phase II Site Investigation and Leachate Management Analysis of Six Landfills (Post School Landfill, Parking Lot F Landfill, Organic Compost Landfill, Ski Lot Landfill, Motor Pool Landfill, and Parking Lot D Landfill) at the U.S. Military Academy (USMA), West Point, New York.

This project is being performed to provide a more comprehensive database on which to base future remedial actions. Project activities at this site will be conducted in accordance with provisions of the Installation Restoration Program, including AR 200-1 Executive Order 12580 and DA PAM 40-578.

This deliverable is provided as two individually bound documents. The first document was the Phase II Investigation Report which presented the analytical results from the ground-water and surface water sample collecting and methane as soil vapor analysis (EA 1995a). This document presents the Leachate Management Analysis and engineering assessment performed for the project.

1.1 SITE HISTORY AND DESCRIPTION

USMA is adjacent to the Town of Highland Falls in southeastern New York State. USMA consists of the West Point cantonment area, the range areas outside of West Point, Stewart Army Subpost, and Galeville. The academy is located along the west shore of the Hudson River at the base of several prominent hillsides (Figure 1-1). The area is dissected by several small streams and is the source for many ground-water springs (Frimpter 1970). Much of the original topography has been altered by construction of buildings and roads.

The academy currently consists of facilities and infrastructure which support the USMA's primary training mission. USMA has a population of residents living permanently onsite and additional workers who commute to the academy.

The Six Landfills are a group of sanitary landfills which are no longer in operation. A brief background discussion of each landfill is presented in the Phase II Investigation Report (EA 1995a) Chapters 4 through 9. More detailed descriptions of site histories were presented in the Work Plan (EA 1995b).

1.2 OBJECTIVES AND ACTIVITIES

1.2.1 Objectives

The objectives of the Phase II Investigation and Leachate Management Analysis include the following:

- Generate additional analytical data on ground water, surface water, and leachate at the Six Landfills for use in the Phase II Site Investigation and Leachate Management Analysis and future remedial design actions.

- Examine the type, concentration, and boundaries of organic vapors and methane at the Motor Pool, Post School, and Ski Lot landfills. The additional data will be used to indicate what, if any, remedial activities may be beneficial to mitigate potential impacts on the environment and human health and safety.

- Examine the components of the existing leachate collection systems at the Post School, Organic Compost, and Parking Lot F landfills and the effectiveness of the existing collection systems.

- Recommend the most cost effective method for the disposal of leachate collected in the existing leachate collection systems including, but not limited to, connection of the leachate tank discharges to the USMA sanitary sewer.

- Examine if connecting the tank discharges to the sanitary sewers would have adverse impacts on the USMA sanitary sewer collection system or wastewater treatment plant.

- Recommend the most cost effective alternative for the management of the leachate generated by the Six Landfills that meets all applicable federal, Army, state, and local laws, regulations, and codes.

1.2.2 Field Investigation Activities

In addition to the field activities discussed in the Phase II Site Investigation Report (EA 1995a), the following activities were conducted in order to provide additional information for the engineering assessment:

- Perform methane and soil vapor surveys at the Post School, Motor Pool, and Ski Lot landfills

- Perform *in situ* leachate flow estimates at established seep outbreaks located at the Post School, Parking Lot F, Ski Lot, and Motor Pool landfills.

- Perform permeameter tests of soil samples of the cover material at each landfill to determine the hydraulic conductivity using analytical method ASTM D-5084.

1.2.3 Engineering Activities

Interviews with USMA personnel, field observations, and review of utility drawings were used to assess the existing systems' effectiveness in collecting leachate generated by the landfills.

Alternatives for the disposal of the leachate collected by the existing collection systems at the Post School, Organic Compost, Parking Lot F, Ski Lot, and Motor Pool sites were evaluated. A preliminary assessment of the USMA wastewater treatment plant was performed to evaluate the potential impacts of the leachate on the treatment plant's operation, State Pollutant Discharge Elimination System permit, and sludge management. The analysis presented herein provides preliminary cost estimates for each alternative and a detailed cost estimate for the preferred alternative. It is recommended that the preferred alternatives be implemented as soon as possible as interim remedial actions pending the outcome of the long-term evaluation of the leachate management alternatives discussed below.

An engineering economics analysis was performed to evaluate the most cost effective alternative for management of leachate generated by the Six Landfills. The economic analysis evaluated short- and long-term alternatives as stated below:

- **Short-Term**—Evaluated alternatives for the collection and disposal of leachate from the Motor Pool and Ski Lot landfills, at locations where the leachate discharges to the ground surface.

- **Long-Term**—Evaluated alternatives for leachate management including, but not being limited to, comparing various methods of reducing leachate production with leachate collection and disposal/treatment. The analysis was performed on a site-by-site basis; i.e., the analysis recommended a preferred alternative for each landfill.

As part of the long-term evaluation of the leachate management alternatives, the quantity of leachate generated by each landfill was estimated.

Data gathered during the field investigation were incorporated into the following engineering objectives:

- Evaluation of the existing leachate collection systems at the Post School, Organic Compost, and Parking Lot F landfills

- Performance of an engineering economic analysis to evaluate long-term and short-term alternatives for management of the leachate from the Six Landfills

  — Short-term alternatives will be evaluated at the Motor Pool and Ski Lot landfills

  — Long-term alternatives will be evaluated at the Post School, Parking Lot F, Organic Compost, Ski Lot, and Motor Pool landfills

- Completion of a 30 percent remedial design for the preferred alternatives.

1.3 PREVIOUS INVESTIGATION RESULTS

Several previous studies have been performed on one or more of the landfills under investigation for this project. These include the following:

- Final Subsurface Investigation Report, U.S. Military Academy, West Point, New York (LAW 1994)
- Ground-Water Quality Survey, USMA, West Point, New York (USAEHA 1990)
- Environmental Program Review, USMA, West Point, New York (USAEHA 1989)
- Analysis of Existing Facilities, Draft Environmental Assessment Report, USMA, West Point, New York (PSS 1985)
- Draft Conceptual Design of Interim Leachate Collection Systems for the Post School and Parking Lot F Landfills for the Phase II Remedial Investigation and Leachate Management Analysis of Six Landfills, USMA, West Point, New York (EA 1995c)
- Draft Phase II Investigation Report of Six Landfills, USMA, West Point, New York (EA 1995a)

1.4 POTENTIAL APPLICABLE REGULATORY CRITERIA

Remedial action objectives and cleanup criteria are based upon the identification of the applicable or relevant and appropriate requirements (ARARs) and "to be considered (TBC) criteria" that alternatives will need to attain. The first step is to identify health-based requirements that will assure the protection of human and environmental health. The next step is to identify the appropriate federal and New York State regulatory requirements and TBC criteria which the response action should attain. In general, this process presumes that alternatives will be formulated and refined to ensure that they attain all of the appropriate ARARs and TBC criteria.

ARARs and TBC criteria can be subdivided into the following four categories:

1. Chemical-specific ARARs
2. Action-specific ARARs
3. Location-specific ARARs
4. Appropriate criteria, advisories, and guidance.

Chemical-specific ARARs are numerically-based standards that apply to a specific treated medium (e.g., compliance with ground-water standards for air stripping system). Action-specific ARARs are those that apply to a medium other than that being treated but which may be affected by the treatment process (e.g., compliance of air stripping unit to ambient guideline concentrations in air). Location-specific ARARs are those that apply when a treatment process (e.g., soil excavation) impacts local areas separate but proximal to the treated site (e.g., wetlands, historic sites). Appropriate criteria, advisories, and guidance are federal or New York State guidelines which have not been promulgated (e.g., New York State Department of Environmental Conservation [NYSDEC] metals cleanup levels in soils and sediments).

1.4.1 State Inactive Hazardous Waste Disposal Site Cleanup Laws

The NYSDEC Division of Hazardous Waste Remediation is responsible for remediation of non-National Priority List hazardous waste sites in New York State pursuant to the Environmental Conservation Law Article 27, Title 13 (Superfund Program). The Division of Hazardous Waste Remediation has developed cleanup criteria and/or standards based on New York State ARARs. The actual determination of which requirements are applicable or relevant and appropriate is made by the NYSDEC in consultation with the New York State Department of Health (NYSDOH). New York State waste disposal cleanup and water quality laws and regulations will be the primary structure to which the investigation and site remediation will respond.

1.4.2 Resource Conservation and Recovery Act Requirements

The Federal Resource Conservation and Recovery Act (RCRA) serves as the basis for development of technology-based requirements governing the identification and listing, storage, transportation, and disposal of hazardous wastes at active or proposed hazardous waste facilities (generators, transporters, storage, or disposal facilities). RCRA requirements include ground-water protection, landfill permitting, design and performance standards, and standards for waste piles and surface impoundments. For this project, potential ARARs under RCRA relate to offsite disposal of waste materials from the site and to siting and closure permitting for onsite treatment actions. Specifically, 40 Code of Federal Regulations (CFR) 261 (Identification and Listing of Hazardous Waste), 40 CFR 263 (Standards Applicable to Transporters of Hazardous Waste), and 40 CFR 268 (Land Disposal Restrictions) will apply to removal and transportation of waste materials (which are identified as characteristic hazardous wastes based on toxicity characteristic leaching procedure lead concentrations) from the site. In addition, certain provisions of 40 CFR 264 (Standards for owners and operators of hazardous waste treatment, storage, and disposal facilities) and 40 CFR 270 (U.S. Environmental Protection Agency [EPA]-administered permit programs: the Hazardous Waste Permit Program) will apply to any selected offsite hazardous waste disposal facilities and may apply to certain onsite treatment or disposal technologies and/or site closure by capping or other containment technology. All offsite disposal of any RCRA characteristic hazardous wastes will be at a RCRA-permitted treatment and disposal facility.

1.4.3 Federal/State Drinking Water Standards

The Federal Safe Drinking Water Act, passed by Congress in 1974 and amended by the Safe Drinking Water Act Amendments of 1986 (PL 99-339), and subsequent revisions, establishes national primary drinking water regulations. National primary drinking water regulations represent the maximum allowable level of selected contaminants which it is economically and technologically feasible to achieve in water of public water systems. National primary drinking water regulations are developed by EPA based upon maximum contaminant level goals. Maximum contaminant level goals are non-enforceable health goals at which there are no known or anticipated adverse effects on human health utilizing the water source. The Safe Drinking Water Act tasks EPA with development of national primary drinking water regulations and maximum contaminant level goals for drinking water contaminants. Pursuant to the Safe Drinking Water Act, EPA sets national primary drinking water regulations for drinking water contaminants as close to the maximum contaminant level goals as is possible, based upon toxicological, economic, and engineering feasibility.

The Safe Drinking Water Act also calls for EPA to establish health advisories for contaminants found in drinking water. Various advisories, including 1-day, 10-day, longer-term, and lifetime advisories, have been developed for many drinking water contaminants. This list is continually updated by EPA as health assessments of other environmental contaminants are compiled. EPA is also directed under the Safe Drinking Water Act to establish secondary national primary drinking water regulations which address aesthetic considerations such as odor, turbidity, and taste.

In New York, the State has primacy for the Safe Drinking Water Act. The NYSDEC Division of Water and NYSDOH are responsible for administration of the Safe Drinking Water Act in New York State.

1.4.4 Federal Ambient Water Quality Criteria

The Federal Water Pollution Control Act, as amended by the Clean Water Act of 1977 and the Water Quality Act of 1987, commonly known as the Clean Water Act, was enacted to restore and maintain the chemical, physical, and biological integrity of United States waters. Section 303 of the Clean Water Act establishes levels of specified pollutants that ambient water can contain and still be suitable for certain uses (i.e., recreation, fish and wildlife, water supply, agricultural, and industrial use). Section 301 of the Clean Water Act identifies criteria for listing toxic pollutants and establishing effluent guidelines and pretreatment standards. Section 307 establishes effluent standards for pretreatment and toxic substances based upon Best Available Technology for control.

Federal ambient water quality criteria documents currently have been published for pollutants listed as toxic under the Clean Water Act. The water quality criteria are generally listed in categories representative of differing surface water use designations. Concentrations represent the maximum level of a contaminant that, if not exceeded, should protect most aquatic life against acute and chronic toxicity. These criteria are unenforceable guidelines that may be used by states to set surface water quality standards.

1.4.5 State Water Quality Standards

New York State has developed standards and guidance values for the protection of surface and ground water and standards limiting the organic chemical contamination of drinking water under the administration of the NYSDEC (1991). Standards that have been promulgated for surface water are presented in 6 NYCRR Parts 701 and 702, and for ground-water protection in Part 703. These standards and guidance values are subdivided into water classes, including saline environments and encompass protection of drinking water supply and fish propagation.

The NYSDOH regulations, authorized under Sections 201 and 225 of the Public Health Law, are specific to the regulation of the sanitary aspects of municipal water supplies. The NYSDOH has been granted primacy by the EPA to regulate public water systems under the Safe Drinking Water Act.

1.4.6 Other Action-Specific Federal Applicable or Relevant and Appropriate Requirement and To Be Considered Criteria

The following is a listing of other federal regulations that may be action-specific ARARs, depending on the remedial action selected:

- ***OSHA Health and Safety Requirements (29 CFR, Parts 1910, 1926, and 1904)***— Addresses requirements for worker safety during remedial investigation and remedial action activities at hazardous waste sites.

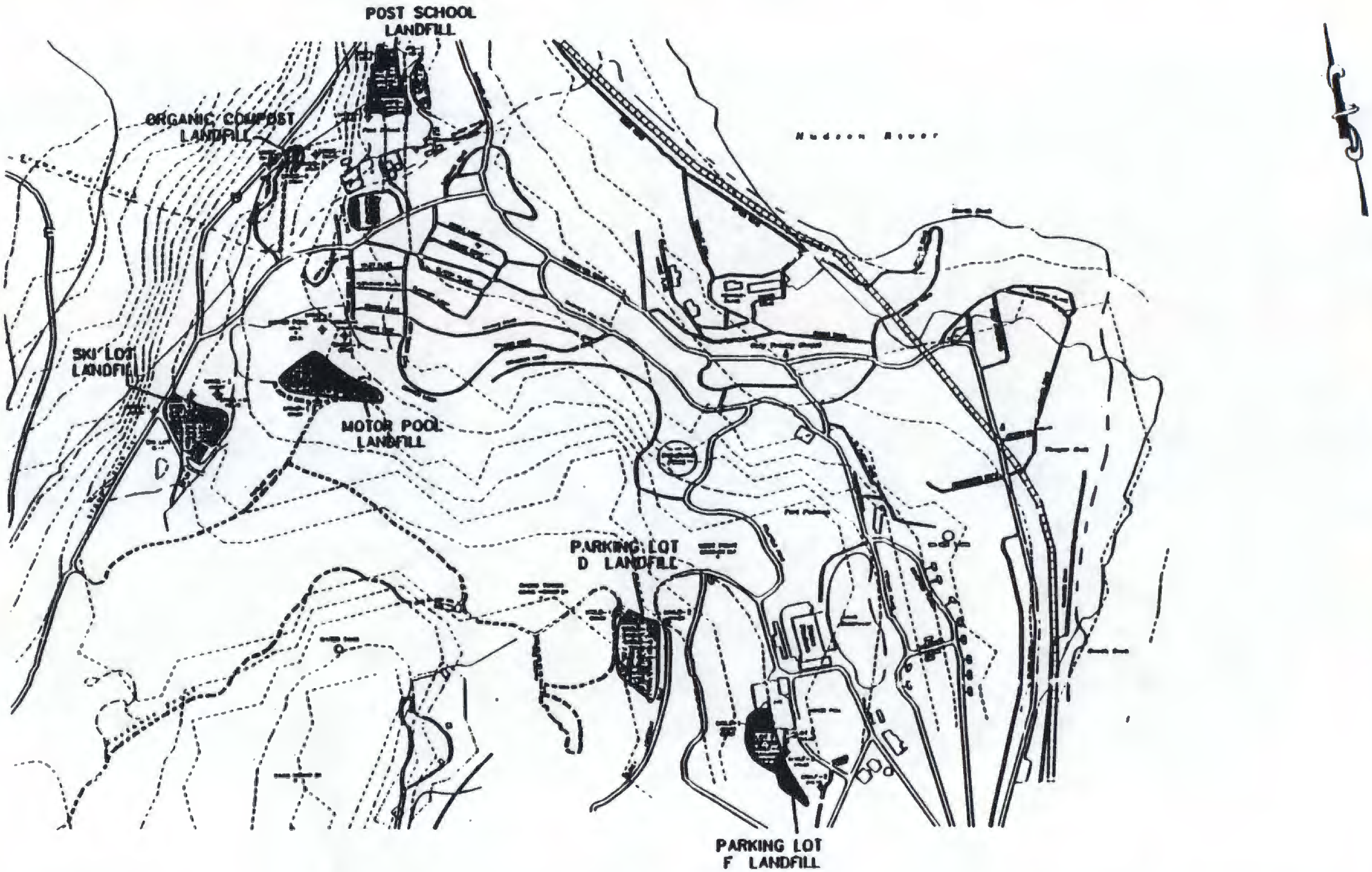
- ***New York State Department of Transportation Rules for Hazardous Materials Transport (49 CFR, Parts 107, 171.1-500)***—Addresses requirements for marking, manifesting, handling, and transport of hazardous materials; applicable if offsite treatment or disposal of wastes is required.

- ***Threshold Limit Values, American Conference of Governmental Industrial Hygienists***—Provides standards for respiratory protection; applicable to air concentrations during remedial activities.

1.4.7 Other Action-Specific State Applicable or Relevant and Appropriate Requirement and To Be Considered Criteria

In addition to the Federal and State ARARs addressed previously, the following New York State regulations may be action-specific ARARs, depending on the remedial alternative selected.

- 6 NYCRR Part 360 - Solid Waste Management Facilities
- 6 NYCRR Part 364 - Waste Transporter Permits
- 6 NYCRR Part 370 - Hazardous Waste Management System: General
- 6 NYCRR Part 371 - Identification and Listing of Hazardous Wastes
- 6 NYCRR Part 372 - Hazardous Waste Manifest System and Related Standards for Generators, Transporters, and Facilities
- 6 NYCRR Part 608 - Protection of Waters
- 6 NYCRR Parts 662 through 665 - Freshwater Wetlands Permitting, Requirements, Classification, and Implementation.



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EA ENGINEERING, SCIENCE, AND TECHNOLOGY	SIX LANDFILLS U.S. MILITARY ACADEMY WEST POINT, NEW YORK	FIGURE 1-1 SITE LOCATION MAP	DESIGNED BY	DRAWN BY PJW	DATE 09 OCT 1995	PROJECT NO. 60787.52
			CHECKED BY	PROJECT MGR. JHS	SCALE N.T.S.	FILE NO. 014

2. FIELD INVESTIGATION ACTIVITIES

This chapter briefly describes field activities performed at the Six Landfills specifically in support of the engineering assessment. Field activities performed specifically for the engineering assessment included: performance of methane and soil vapor surveys at the Post School, Motor Pool, and Ski Lot landfills; performance of *in situ* leachate flow estimates at established seep outbreaks located at the Post School, Parking Lot F, Ski Lot, and Motor Pool landfills; and collection of soil samples of the cover material at each landfill to determine the hydraulic conductivity using analytical method ASTM D-5084.

Other field activities were performed to support the site characterization and are discussed in the Phase II Investigation Report (EA 1995a). These activities included sampling of new and existing monitoring wells, surface water sampling and analysis, and leachate sampling and analysis.

2.1 FIELD ACTIVITIES

The field investigation program for this assessment included three specific activities:

1. Methane and soil vapor surveys
2. Estimating of leachate flow
3. Permeameter testing for hydraulic conductivity (ASTM D-5084).

2.1.1 Methane and Soil Vapor Surveys

Methane and soil vapor surveys were conducted at the Post School, Ski Lot, and Motor Pool landfills. The objective of each survey was to assess the presence of methane, non-chlorinated aromatic volatile organic compounds (VOC) (benzene, toluene, ethylbenzene, m/p-xylenes, and o-xylenes), and chlorinated VOC (trichloroethene and tetrachloroethene) using a field gas chromatograph equipped with flame ionization and electron capture detectors. Landfill perimeter and interior sampling points were collected at each of the landfills.

Following mobilization to each landfill, EA field personnel identified potential soil vapor sampling locations by establishing a symmetrical grid pattern focused in the areas of concern at each landfill. Designated sampling locations included 35 soil vapor sampling points at the Post School Landfill, 26 soil vapor sampling points at the Ski Lot landfill, and 47 soil vapor sampling points at the Motor Pool Landfill.

At the Post School Landfill, methane and soil vapor samples were collected from 33 of the 35 planned locations. Two locations could not be sampled due to aspiration of ground water into the soil vapor probe. At the Motor Pool Landfill, methane and soil vapor samples were collected from 30 of the 47 planned locations. Several of the grid points could not be sampled due to an inability to advance the soil vapor probe the required 3 ft into the ground. Samples were collected from all of the planned locations at the Ski Lot Landfill.

Soil vapor concentrations were calculated using the external standard method. The following equation was used to calculate the soil vapor concentrations:

$$C_i = CF_i * A_i * V_s / V_{std}$$

where

C_i = Vapor concentration of analyte of concern (ppm_v)
CF_i = Calibration factor for analyte of concern
A_i = Observed area of targeted analyte
V_s = Vapor volume of sample (ml)
V_{std} = Vapor volume of standard (ml).

CF_i is calculated by dividing the concentration of the target analyte in the calibration standard (ppm_v) by its observed peak area on the gas chromatogram.

The analytical results of the soil vapor surveys at the Post School, Ski Lot, and Motor Pool landfills are discussed in the Phase II Investigation Report (EA 1995a), Sections 4.4.4, 7.4.3, and 8.4.3, respectively. Figures 2-1, 2-2, and 2-3 present the spatial analyses of the methane survey results for the Post School, Ski Lot, and Motor Pool landfills, respectively.

2.1.2 Leachate Flow Estimating

On 23 August 1995, EA performed *in situ* leachate flow estimates at five seep sampling locations. With the exception of seep location PS95-LS-01, the estimates were done by excavating a small pit of known volume at each seep location, and measuring how much time was required to fill each pit to a certain depth. The flow estimate for the Post School seep location (PS95-LS-01) was performed by placing a graduated cylinder against the face of the rock outcrop to intercept and collect the leachate flow for a measure period of time. The results were then converted to quantities expressed in gallons per day (gpd). These results are summarized in the following table:

Landfill	Seep Location ID Number	Estimated Flow (gpd)
Post School	PS95-LS-01	587
Parking Lot F	LF95-LS-01	2,244
Parking Lot F	LF95-LS-03	544
Ski Lot	SL95-LS-02	12
Motor Pool	MP95-LS-01	113

Flow estimates could not be performed for the following locations since they were dry at the time of the activity: PS95-LS-02, SL95-LS-01, and MP95-LS-02.

2.1.3 Permeameter Testing

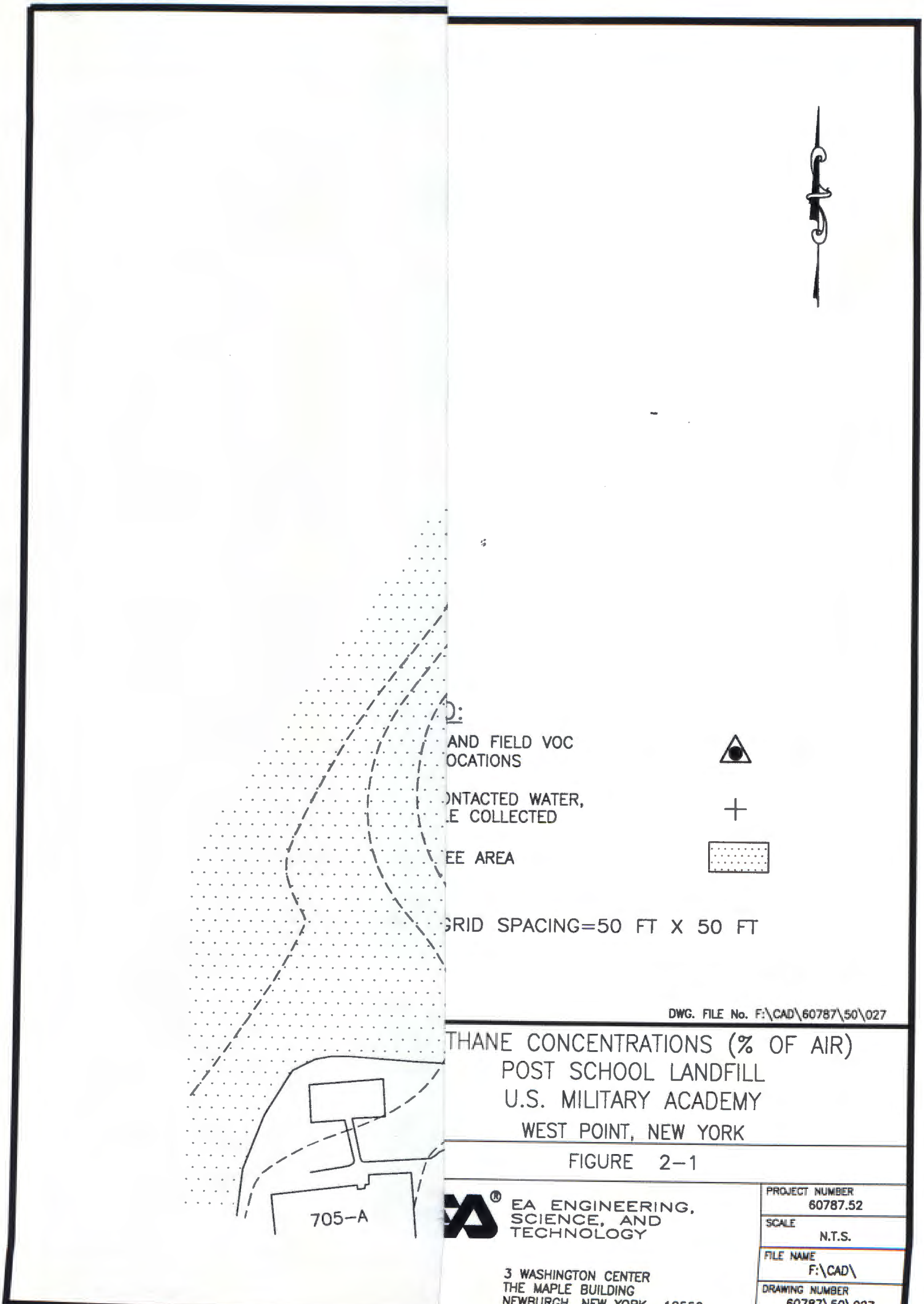
Permeameter testing was performed in place of the *in situ* percolation tests that were originally specified in the Scope of Work since it would provide a more quantitative estimate of the hydraulic conductivity of the cap material. The collection of soil samples started and was completed on 28 August 1995. All samples were collected by Parratt-Wolff, Inc. (Syracuse, New York) under the supervision of an EA geologist. Undisturbed soil samples of the cover material were collected from five of the six landfills at the following frequency:

- 6 locations at the Post School Landfill
- 6 locations at the Parking Lot F Landfill
- 1 location at the Organic Compost Landfill
- 1 location at the Ski Lot Landfill
- 1 location at the Motor Pool Landfill.

A soil sample was not collected at the Parking Lot D Landfill due to the new macadam cap and lack of any apparent leachate seeps.

The Work Plan modification specified the use of 3-in. outer diameter × 30-in. Shelby tubes for the collection and retention of geotechnical samples. All sampling locations were initially attempted with Shelby tubes, but use of this sampling device was accomplished only at the Organic Compost Landfill. The dense sand and gravel cap material at the remaining landfills required the use of a 3-in. outer diameter × 24-in. split-spoon sampler, equipped with a removable polyethylene liner, to collect the soil samples.

The soil samples were tested to determine the characteristics of hydraulic conductivity, moisture content, and density of the cover material at each landfill. The results of the tests for each landfill are identified in Table 2-1.



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THANE CONCENTRATIONS (% OF AIR)
POST SCHOOL LANDFILL
U.S. MILITARY ACADEMY
WEST POINT, NEW YORK

FIGURE 2-1

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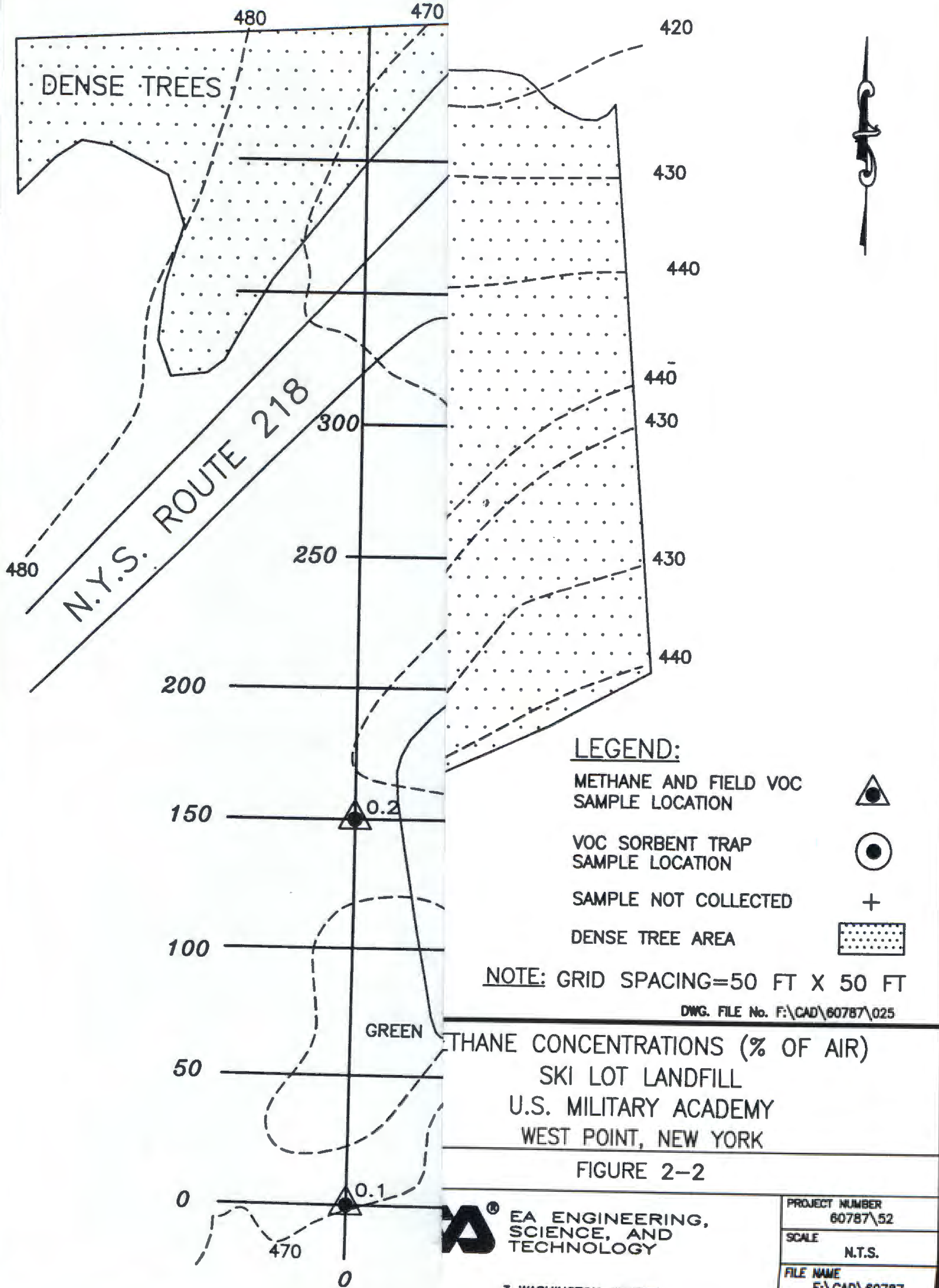

ETHANE CONCENTRATIONS (% OF AIR)
SKI LOT LANDFILL
U.S. MILITARY ACADEMY
WEST POINT, NEW YORK

FIGURE 2-2

EA ENGINEERING, SCIENCE, AND TECHNOLOGY

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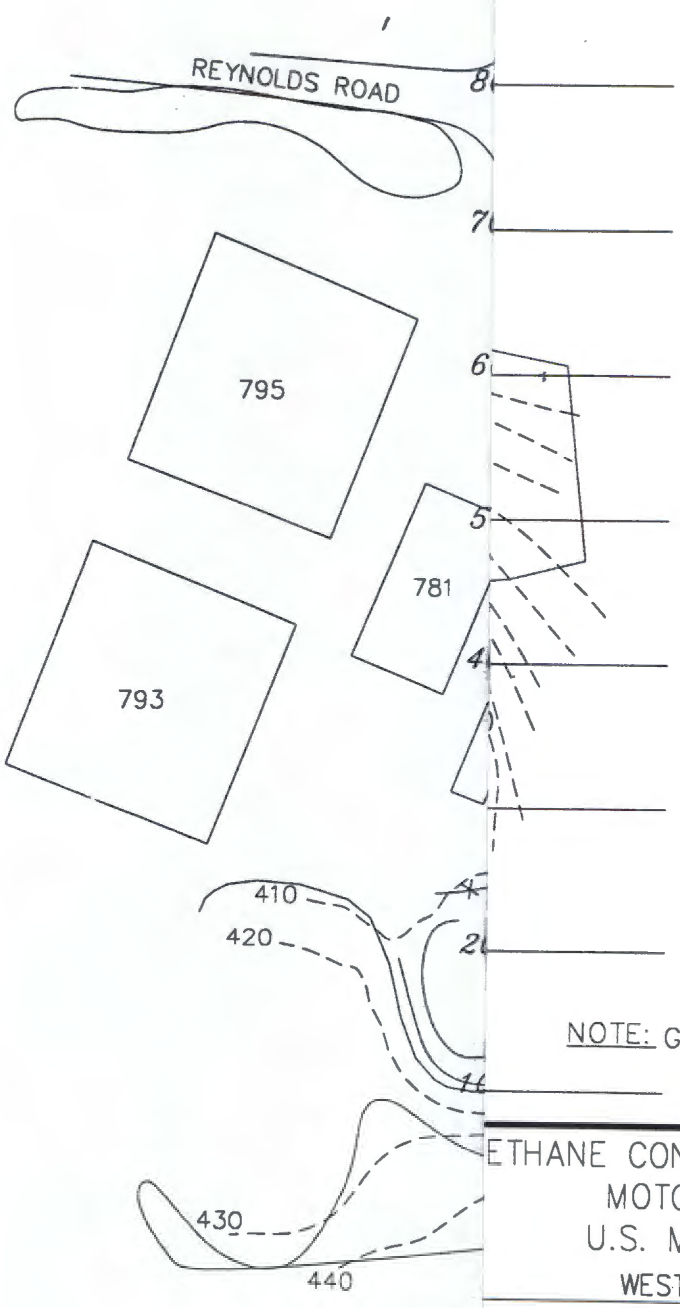

LEGEND:

METHANE AND FIELD VOC SAMPLE LOCATION

NO SAMPLE COLLECTED DUE TO ELECTRICAL SERVICE LINE

DENSE TREE AREA

FENCE LINE

NOTE: GRID SPACING=100 FT X 100 FT

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ETHANE CONCENTRATIONS (% OF AIR)
MOTOR POOL LANDFILL
U.S. MILITARY ACADEMY
WEST POINT, NEW YORK

FIGURE 2-3

EA ENGINEERING, SCIENCE, AND TECHNOLOGY

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TABLE 2-1 PERMEAMETER TEST RESULTS OF SOIL SAMPLES COLLECTED FROM COVER MATERIAL
SIX LANDFILLS, U.S. MILITARY ACADEMY, WEST POINT, NEW YORK

Landfill	Sample ID No.	Depth (ft)	Moisture Content (% of Dry Weight)	Density (lb/cf)		Average Hydraulic Conductivity (cm/sec)
				Dry	Moist	
Post School	GTS95-PS-01 (S-1)	1.0-3.0	10.7	70.5	78.0	1.02×10^{-5}
	GTS95-PS-02 (S-1)	1.0-3.0	13.7	97.2	110.5	3.22×10^{-5}
	GTS95-PS-03 (S-1)	0.5-2.0	8.5	111.3	120.8	6.68×10^{-5}
	GTS95-PS-04 (S-1)	1.0-2.1	2.2	119.1	121.9	5.02×10^{-5}
	GTS95-PS-05 (S-1)	0.1-1.8	5.1	96.0	100.9	5.01×10^{-5}
	GTS95-PS-06 (S-1)	---	3.4	101.5	105.0	5.90×10^{-5}
Parking Lot F	GTS95-LF-01 (S-1)	0.5-2.5	4.6	102.9	107.6	2.90×10^{-7}
	GTS95-LF-02 (S-1)	0.5-2.5	4.6	124.1	129.8	5.02×10^{-5}
	GTS95-LF-03 (S-1)	0.5-2.2	7.6	107.8	116.5	1.90×10^{-4}
	GTS95-LF-04 (S-1)	0.5-1.7	4.5	112.1	117.1	2.11×10^{-5}
	GTS95-LF-05 (S-1)	0.5-2.5	7.8	121.9	131.4	7.18×10^{-6}
	GTS95-LF-06 (S-1)	0.5-2.2	125.3[a]	(b)	85.8	1.86×10^{-6}
Organic Compost	GTT95-OC (T-1)	0.1-2.1	9.5	118.8	130.1	7.10×10^{-6}
Ski Lot	GTS95-SL-01 (T-1)	2.5-4.5	11.1	97.4	108.2	6.40×10^{-4}
	GTS95-SL-01 (S-1)	0.5-2.5	4.5	94.2	98.4	2.90×10^{-4}
Motor Pool	GTS95-MP-01 (S-1)	0.5-2.5	10.9	103.6	114.9	6.12×10^{-5}

(a) Material contained a significant amount of paper material.
(b) Dry density used to determine hydraulic conductivity could not be accurately calculated due to a significant amount of paper material.

NOTE: All samples except GTS95-LF-06 were remolded prior to hydraulic conductivity testing.
Dashes (---) indicate depth data not available.

3. LEACHATE MANAGEMENT ANALYSIS

Site-specific discussions of existing conditions, design and constructibility considerations, and future use that are related to each of the Six Landfills are presented in this chapter.

3.1 POST SCHOOL LANDFILL

3.1.1 Existing Conditions

A natural swale runs along the west side of the landfill and merges with a small stream along the north side (Figure 3-1). The stream enters a 24-in. culvert at a headwall located in the vicinity of the northeast corner of the landfill. Eventually, the 24-in. culvert crosses Lee Road near the entrance to Beauregard Place and drains to the top of the bank.

Several seeps have been identified in the vicinity of the landfill. One of the seeps (PS95-LS-02) is north of the stream on the northern side of the landfill, along the edge of the Beauregard Place service road and immediately next to the new monitoring Well PS66. This seep area covers approximately 10 ft^2. Another seep (PS95-LS-01), which is associated with the existing collection system, is located along the Barnard Loop service road, at the base of a large rock outcrop. This area, which shows orange discoloration, covers approximately 10 ft^2. The existing leachate collection system near seep PS95-LS-01 is discussed further in Section 3.1.2.

Ground water and surface water from surrounding upgradient areas enter the landfill from the west side. Seeps appear at locations where it is easiest for the water to surface, such as the base of the rock outcrop and the swale. Seepage has been observed throughout the year, with the lowest amount of flow occurring during summer months.

According to the Phase I report (LAW 1994), leachate generation at the seep location along Barnard Loop was estimated to be 40 gal/day on average. However, no calculations or data could be found to support this estimate.

In August 1995, EA performed an *in situ* flow estimate for seep location PS95-LS-01. The leachate flow at location PS95-LS-01 (along Barnard Loop) was estimated to be 587 gpd. A flow estimate could not be performed at that time for PS95-LS-02 since the area was dry. The calculations used for estimating the amount of flow are shown in Appendix A.

3.1.2 Existing Collection and Discharge System

The following observations were made for the existing leachate collection system at the Post School in June 1995 (Figure 3-2):

- A modified catch basin exists immediately next to the seep along the Barnard Loop service road to collect leachate; this seep consists of an area of orange discoloration, approximately 10 ft^2, which is found at the base of a large rock outcrop. The modified catch basin is connected to a collection tank with an 8-in. corrugated polyvinyl chloride (PVC) pipe and also receives storm water from another catch basin located approximately 15 ft to the south. It appeared that the basin located to the south drains to both the basin next to the seep and the existing storm drain along the gutter.

- Orange, stained water was observed entering the leachate tank through the inlet line. This inlet line was nearly half-clogged with debris and iron flocculent. The 6-in. PVC outlet line was clogged as well, but some flow was observed in the line. A 90-degree elbow is present at the outlet end of the tank, and it appears that the line connects to the sanitary sewer in the vicinity of Barnard Loop Housing Unit No. 241/242.

- The other catch basins along the service road are connected to a 6-in. storm drain which is found along the edge of the boundary gutter and is connected to the 24-in. culvert. However, additional seep areas have not been identified or associated with these basins.

The existing leachate system partially intercepts seepage from the rock outcrop along the Barnard Loop service road.

3.1.3 Design Considerations

Several areas of concern must be considered prior to the development of a new leachate collection system at the Post School. These include the following:

- Shallow bedrock outcrops and large boulders are common to this area, which could make excavation and or pipe trenching difficult to accomplish and potentially expensive.

- Available space in the vicinity of the Barnard Loop service road is limited due to the proximity of a residential area, the surrounding topography, and various underground utilities.

- Utility maps are available for the vicinity of the service road, but they do not indicate the recent installations made during the Summer of 1995, or locations of gas, water, or electrical utilities.

- The terrain is typically very steep west of the landfill and behind the seep located along the Barnard Loop service road.

3.1.3.1 Future Use

According to USMA representatives, future plans at the Post School Landfill call for the improvement of the surface of the landfill to include construction of new softball fields within the limits of the landfill area. Prior to any new construction, certain measures could be undertaken to reduce the amount of leachate being generated. These measures are discussed in Section 5.2.1.

3.1.3.2 Constructibility

Several areas of concern must be considered prior to the construction of a leachate collection system at the Post School Landfill. These include the items discussed in Section 3.1.3, as well as the following:

- Site control measures should be implemented by providing fencing or similar structures to prevent children or wildlife from gaining access during construction.

3.2 PARKING LOT F LANDFILL

3.2.1 Existing Conditions

The largest seep area (LF95-LS-01) is located in the woods between Parking Lot E and Parking Lot F, just west of the culvert head wall on the west side of Parking Lot F (Figure 3-3). The area of orange discoloration encompasses approximately 7,500 ft^2, with several seep discharge points apparent in this area. Leachate from this area eventually reaches the swale in the immediate vicinity of the culvert, where flow is directed below the surface of Parking Lot F via the culvert. No evidence of discoloration was found at the eastern end of the culvert.

Two additional seeps have been recently identified in the vicinity of the landfill. Separate seep areas were observed along the sides of the access road, approximately halfway between Fenton Road and monitoring wells LF-3 and LF-4. Both seeps appear as orange discoloration and occur on an intermittent basis. The seep visible along the western side of the road is confined to a small, marshy area. The seep along the eastern edge of the road (LF95-LS-03) empties into a concrete-lined gutter, which flows to the stormwater drain located next to an existing leachate collection tank. The existing collection system is discussed further in Section 3.2.2.

Ground water and surface water from surrounding upgradient areas enter the landfill from the west side. The existing swale along the west edge of the landfill partially intercepts the surface and ground-water flow. It should be noted that standing water was observed on the surface of the landfill at the northwest corner during the Summer of 1995, and that this condition remained even during extended dry periods.

Seeps appear at locations where it is easiest for the water to surface. Seepage has been observed throughout the year, with the lowest amount of flow occurring during summer months. According to the Phase I report (LAW 1994), leachate generation at the seep located between Parking Lot E and Parking Lot F was estimated to be 30 gal/day on average (EOC 1989a). However, no supporting calculations or data could be found to support this estimate.

In August 1995, EA performed an *in situ* flow estimate for seep locations LF95-LS-01 and LF95-LS-03. The leachate flow at location LF95-LS-01 was estimated to be 2,244 gpd. The leachate flow at location LF95-LS-03 was estimated to be 544 gpd. The calculations used for estimating the amount of flow are shown in Appendix A.

3.2.2 Existing Collection and Discharge System

The following observations were made for the existing leachate collection system at Parking Lot F in June 1995 (Figure 3-4):

- The concrete gutter along the eastern edge of the access road partially collects seepage from location LF95-LS-01, which is conveyed to the storm drain located upstream of the existing leachate tank.

- The purpose of the existing leachate tank, located at the intersection of the access road and Fenton Road, is unclear especially since it is higher in elevation than the nearby storm drain, and there is no evidence of any collection lines that would supply flow to it. It appears that the tank only collects water during storm events where a portion of the stormwater flow bypasses the existing storm drain and enters the tank. Utility maps do not indicate how or where the outlet end of the tank is connected either to the sanitary sewer or stormwater systems.

- The existing leachate collection system is located over 500 ft from seep location LF95-LS-01. Therefore, connection of a leachate collection system in that vicinity to the existing system below Parking Lot F would be impractical.

3.2.3 Design Considerations

Several areas of concern must be considered prior to the development of a new leachate collection system at Parking Lot F. These include the following:

- Shallow bedrock outcrops and large boulders are common to this area.

- Excavation and/or pipe trenching would be difficult to accomplish and expensive.

- The terrain is typically very steep in the vicinity of seep location LF95-LS-01.

- The landfill is several hundred feet from the nearest sanitary sewer connection.

- Construction activities in the vicinity of seep LF95-LS-01 must not significantly impact vegetation, since the foliage currently acts to conceal the stained area.

- Space is limited along the sides of the existing access road to the lot, as well as at the bottom of the access road in the vicinity of the existing leachate collection tank. In addition, the Holleder Center is located approximately 50 ft north of the collection tank, and there are practice fields located approximately 30 ft east of the tank.

3.2.3.1 Future Use

According to USMA representatives, Parking Lot F will continue to be used as a parking lot for events at Michie Stadium and the Holleder Center, as well as overflow parking for USMA cadets throughout the year. Future plans call for the repaving of the surface, which would act to reduce the amount of leachate being generated by the landfill. The reduction of leachate at Parking Lot F is discussed further in Section 5.2.2.

3.2.3.2 Constructibility

Several areas of concern must be considered prior to the construction of a leachate collection system at the Parking Lot F Landfill. These areas are previously identified and discussed in Section 3.2.3.

3.3 ORGANIC COMPOST LANDFILL

3.3.1 Existing Conditions

Ground water and surface water from surrounding upgradient areas enter the landfill from the west side. Leachate generation along the north and east edges of the Organic Compost Landfill was estimated to be 50 gal/day on average (EOC 1989b). However, no calculations or data could be found to support this estimate.

No seep outbreaks could be located by EA during field sampling activities conducted in May 1995. EA collected a sample from an intermittent stream (OC95-LS-01) located east of and downgradient to the landfill, approximately 50 ft from monitoring well OC-2A (Figure 3-5).

3.3.2 Existing Collection and Discharge System

According to the 1994 LAW report, the existing leachate collection system was installed in 1990 and appeared to collect both leachate and surface water runoff. A perforated PVC drainage pipe was installed along the edge of the access road and connected to a 750-gal tank. The intent of the system was to collect leachate with the line and tank, with periodic pumping of the tank and transporting of the contents to the USMA treatment plant via tanker truck.

The following observation was made for the existing leachate collection system at the Organic Compost landfill (Figure 3-4):

- A 750-gal leachate collection tank is located next to the entrance gate at the south end of the landfill. Storm water was present in the tank to a depth of approximately 1-2 ft when inspected in July 1995.

3.3.3 Design Considerations

Several areas of concern must be considered prior to the development of a new leachate collection system at the Organic Compost Landfill. These include the following:

- The terrain is typically very steep in the vicinity of the landfill.
- The landfill is several hundred feet from the nearest sanitary sewer connection.
- Space is limited along the sides of the landfill.

3.3.3.1 Future Use

According to USMA representatives, the Organic Compost Landfill will continue to be used as a storage area for materials and equipment. The reduction of leachate at the Organic Compost Landfill is discussed further in Section 5.2.3.

3.3.3.2 Constructibility

Several areas of concern must be considered prior to the construction of a new leachate collection system at the Organic Compost Landfill. These areas are previously identified and discussed in Section 3.3.3.

3.4 SKI LOT LANDFILL

3.4.1 Existing Conditions

Two seep discharge points have been identified in the vicinity of the landfill (Figure 3-6). The first seep (SL95-LS-01) is found in a swale near the southwest corner of Building 1227 and occurs on an intermittent basis. During the drier summer months, this seep dries up and the stained area is concealed by vegetation growing along and within the swale.

The second seep (SL95-LS-02) is present in the wooded area just west of monitoring well SL-2, and south of a small marshy area. Several seep discharge points are apparent in this area, and each is characterized by orange discoloration. Leachate from this area eventually drains to the swale along the west side of Motor Pool East, a landfill which is associated with the Four Landfills.

Ground water and surface water from surrounding upgradient areas enter the landfill from the west and south sides. The existing swale along the west edge of the landfill, next to the Golf Course, partially intercepts the surface and ground-water flow. Seeps appear at locations where it is easiest for the water to surface. Seepage has been observed throughout the year, with the lowest amount of flow occurring during summer months.

According to the Phase I report (LAW 1994), leachate generation at the seep located near Building 1227 was estimated to be 20 gal/day on average. However, no supporting calculations or data could be found to support this estimate.

In August 1995, EA performed an *in situ* flow estimate for seep location SL95-LS-02. The leachate flow at location SL95-LS-02 was estimated to be 12 gpd. A flow estimate could not be performed at that time at location SL95-LS-01 since the area was dry. The calculations used for estimating the amount of flow for seep location SL95-LS-02 only are shown in Appendix A.

3.4.2 Existing Collection and Discharge System

There is no existing leachate collection system at the Ski Lot Landfill.

3.4.3 Design Considerations

Several areas of concern must be considered prior to the development of a new leachate collection system at the Ski Lot Landfill. These include the following:

- Large boulders and trees are common to areas near seep SL95-LS-02, which would make excavation and or pipe trenching difficult to accomplish and potentially expensive.
- Seep SL95-LS-02 is several hundred feet from the nearest sanitary sewer connection.
- Construction activities in the vicinity of seep must not significantly impact vegetation, since the foliage currently acts to conceal the stained area.
- Space is limited in the vicinity of Building 1227.
- An access path or road may need to be constructed next to seep SL95-LS-02 to enable proper site access for construction equipment, and for maintenance equipment in the future.

3.4.3.1 Future Use

According to USMA representatives, the Ski Lot Landfill will continue to be used as a parking lot for the ski area and golf course, as well as USMA employees. The reduction of leachate at the Ski Lot Landfill is discussed further in Section 5.2.4.

3.4.3.2 Constructibility

Several areas of concern must be considered prior to the construction of a new leachate collection system at the Ski Lot Landfill. These areas are previously identified and discussed in Section 3.4.3.

3.5 MOTOR POOL LANDFILL

3.5.1 Existing Conditions

Two seeps have been identified in the vicinity of this landfill (Figure 3-7). The first seep (MP95-LS-01) is found along and within an intermittent stream north of the landfill.

The second seep (MP95-LS-02) is located in the vicinity of monitoring well MP-2, next to a small marshy area. Several seep discharge points are apparent in this area, and each is characterized by orange discoloration. Leachate generation in this area is localized.

In August 1995, EA performed an *in situ* flow estimate for seep location MP95-LS-01. The leachate flow at location MP95-LS-01 was estimated to be 113 gpd. A flow estimate could not be performed at that time at location MP95-LS-02 since the area was dry. The calculations used for estimating the amount of flow are shown in Appendix A.

3.5.2 Existing Collection and Discharge System

There is no existing leachate collection system at the Motor Pool Landfill.

3.5.3 Design Considerations

Several areas of concern must be considered prior to the development of a new leachate collection system at the Motor Pool Landfill. These include the following:

- Construction activities in the vicinity of seep MP95-LS-02 must not significantly impact vegetation, since the foliage currently acts to conceal the stained area.

- Space is limited in the vicinity of seep MP95-LS-01.

3.5.3.1 Future Use

According to USMA representatives, the Motor Pool Landfill will continue to be used as a storage area and parking lot for equipment and vehicles. The reduction of leachate at the Motor Pool Landfill is discussed further in Section 5.2.5.

3.5.3.2 Constructibility

Several areas of concern must be considered prior to the construction of a new leachate collection system at the Motor Pool Landfill. These areas are previously identified and discussed in Section 3.5.3.

3.6 PARKING LOT D LANDFILL

According to the Phase I report (LAW 1994), leachate generation was observed at a location in the vicinity of monitoring wells LD-4 and LD-5 (Figure 3-8). The amount of flow was estimated to be 10 gal/day. However, no supporting calculations or data could be found to support this estimate.

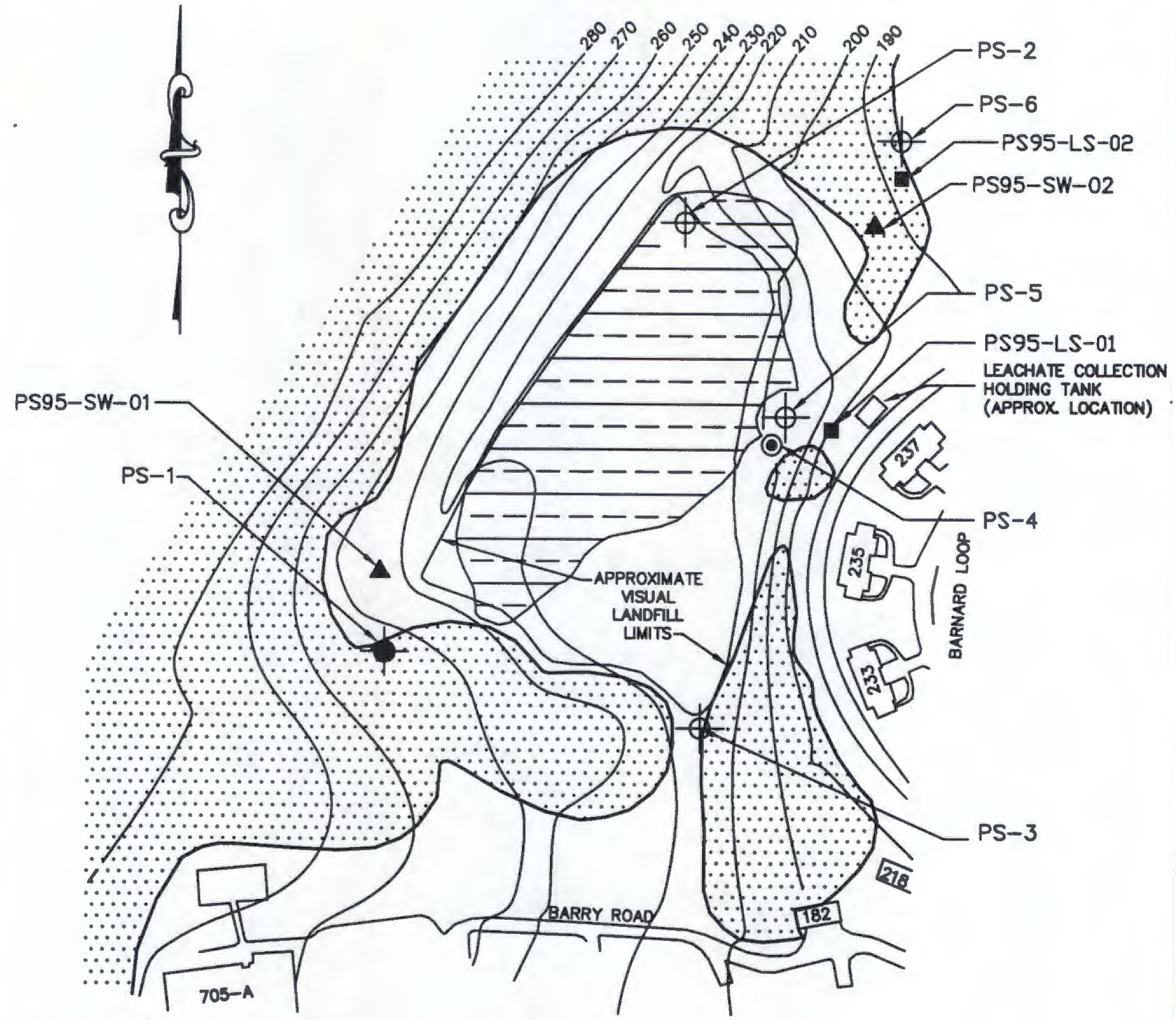
During field investigation activities conducted by EA in 1995, no evidence of any seep outbreaks could be found at or in the immediate vicinity of Parking Lot D. Thus, leachate generation at Parking Lot D is considered negligible at this time and an evaluation of leachate disposal and source reduction alternatives is unnecessary.

3.7 U.S. MILITARY ACADEMY WASTEWATER TREATMENT PLANT

The Target Hill Wastewater Treatment Plant went into operation in 1973. It is located along the edge of the Hudson River, next to the Target Hill athletic fields. It accepts raw sewage from both the north and south ends of the USMA, and treated effluent is discharged to the Hudson River. Sewage is fed to the plant primarily by gravity, although several buildings and at least one housing area require lift stations to pump sewage into the system.

The plant is lower in elevation than each of the landfills discussed in this report. Generally, the leachate collected at each landfill could be sent directly to the plant without the addition of new lift stations. However, some of the individual seep locations may be situated such that pumps would be required to send collected leachate to the sewer system, from which point the leachate would rely on gravity to reach the treatment plant.

The plant is rated at an overall capacity of 2.06 mgd. The average yearly flow to the plant is currently 1.854 mgd, or approximately 90 percent of the overall capacity (Figure 3-9). Considering the flow volume estimate for each seep location (as measured in August 1995), the average yearly flow would increase by approximately 0.2 percent if leachate was directed to the sanitary sewer from all of the seep locations (Table 3-1). The additional flow from the combined seep locations does not significantly alter the current average daily flows at the USMA wastewater treatment plant. Thus, there is sufficient capacity at the plant for the estimated leachate flows as measured in August 1995.



LEGEND:

- DOWNGRADIENT MONITORING WELL LOCATION
- UPGRADIENT MONITORING WELL LOCATION
- DEEP MONITORING WELL LOCATION
- SEEP SAMPLE LOCATION
- SURFACE WATER SAMPLE LOCATION
- INFERRED GEOPHYSICAL BOUNDARY OF LANDFILL
- DENSE TREE AREA

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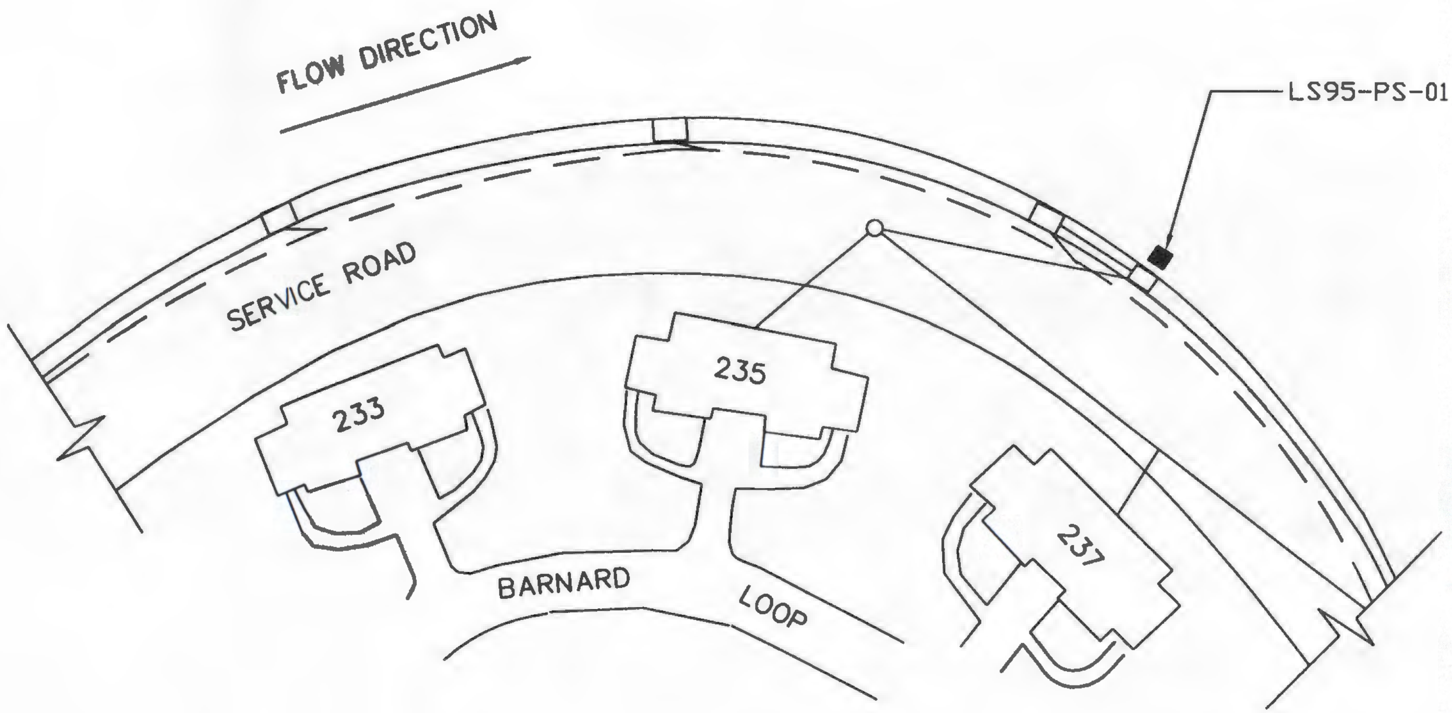
EA ENGINEERING, SCIENCE, AND TECHNOLOGY	SIX LANDFILLS U.S. MILITARY ACADEMY WEST POINT, NEW YORK	FIGURE 3–1 SAMPLE LOCATIONS POST SCHOOL LANDFILL

PROJECT MGR	DESIGNED BY	DRAWN BY	CHECKED BY	SCALE	DATE	PROJECT NO	FILE NO.
JHS	JCH	SY	JCH	N.T.S.	25 JUL 1995	60787.52	PSSMPLOC



LEGEND
- ■ SEEP LOCATION
- ▭ CATCH BASIN
- O MANHOLE
- – – STORM DRAIN
- —— SANITARY SEWER LINE

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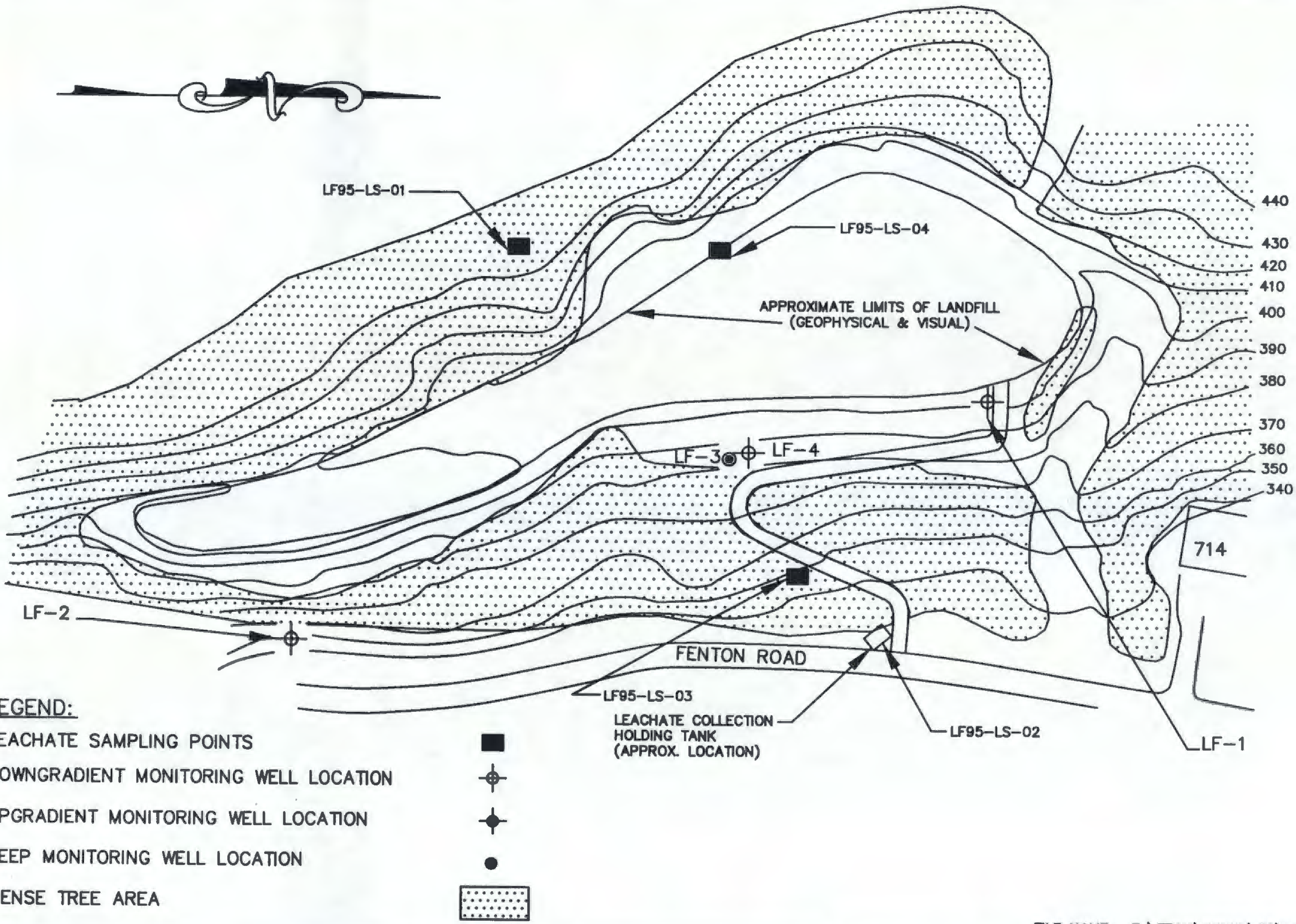
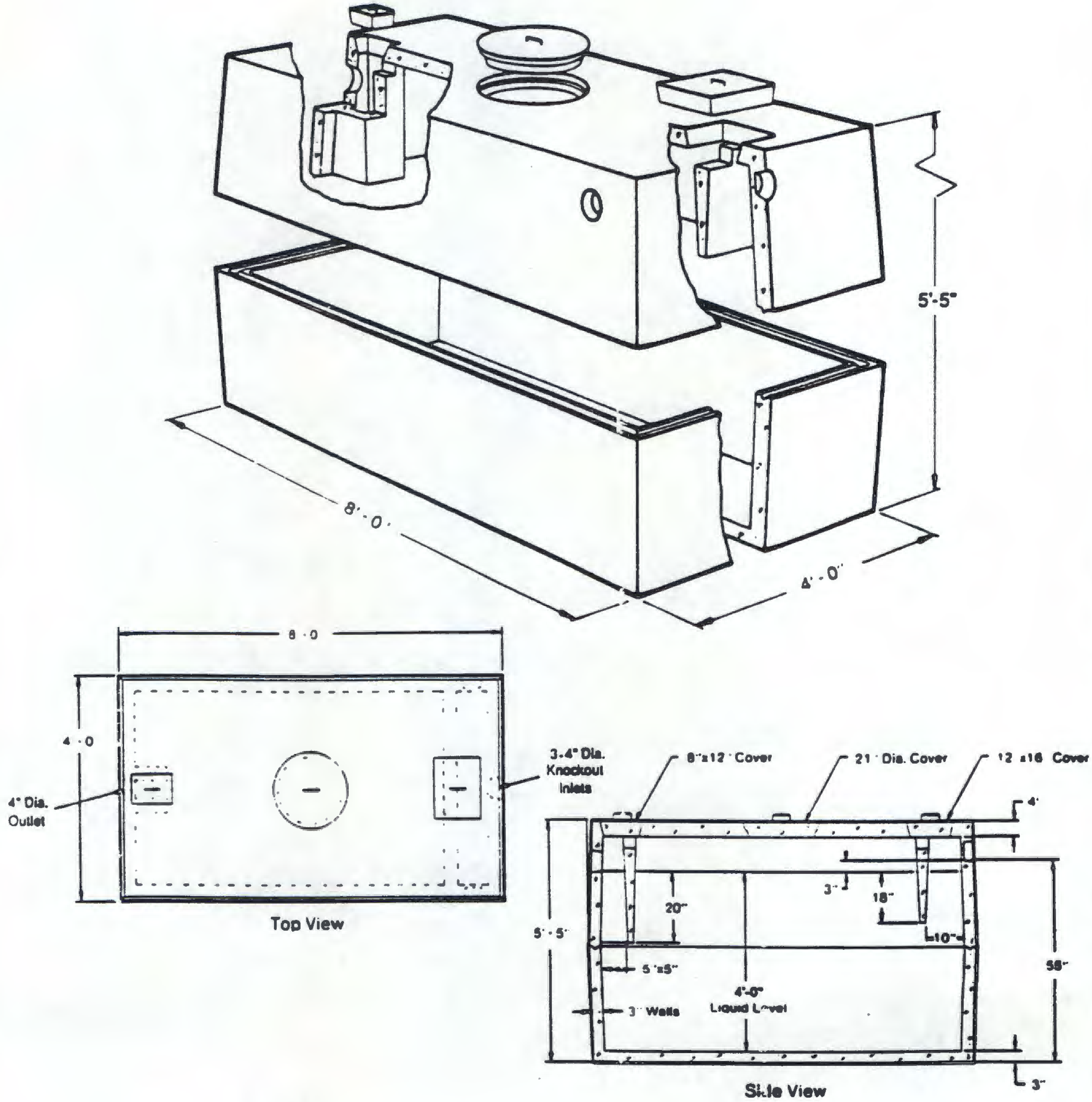
EA ENGINEERING, SCIENCE, AND TECHNOLOGY		SIX LANDFILLS U.S. MILITARY ACADEMY WEST POINT, NEW YORK				FIGURE 3-2 EXISTING COLLECTION SYSTEM POST SCHOOL LANDFILL	
PROJECT MGR JHS	DESIGNED BY JCH	DRAWN BY SY	CHECKED BY SMD	SCALE N.T.S.	DATE 08/12/96	PROJECT NO 60787.52	FILE No. 2-2



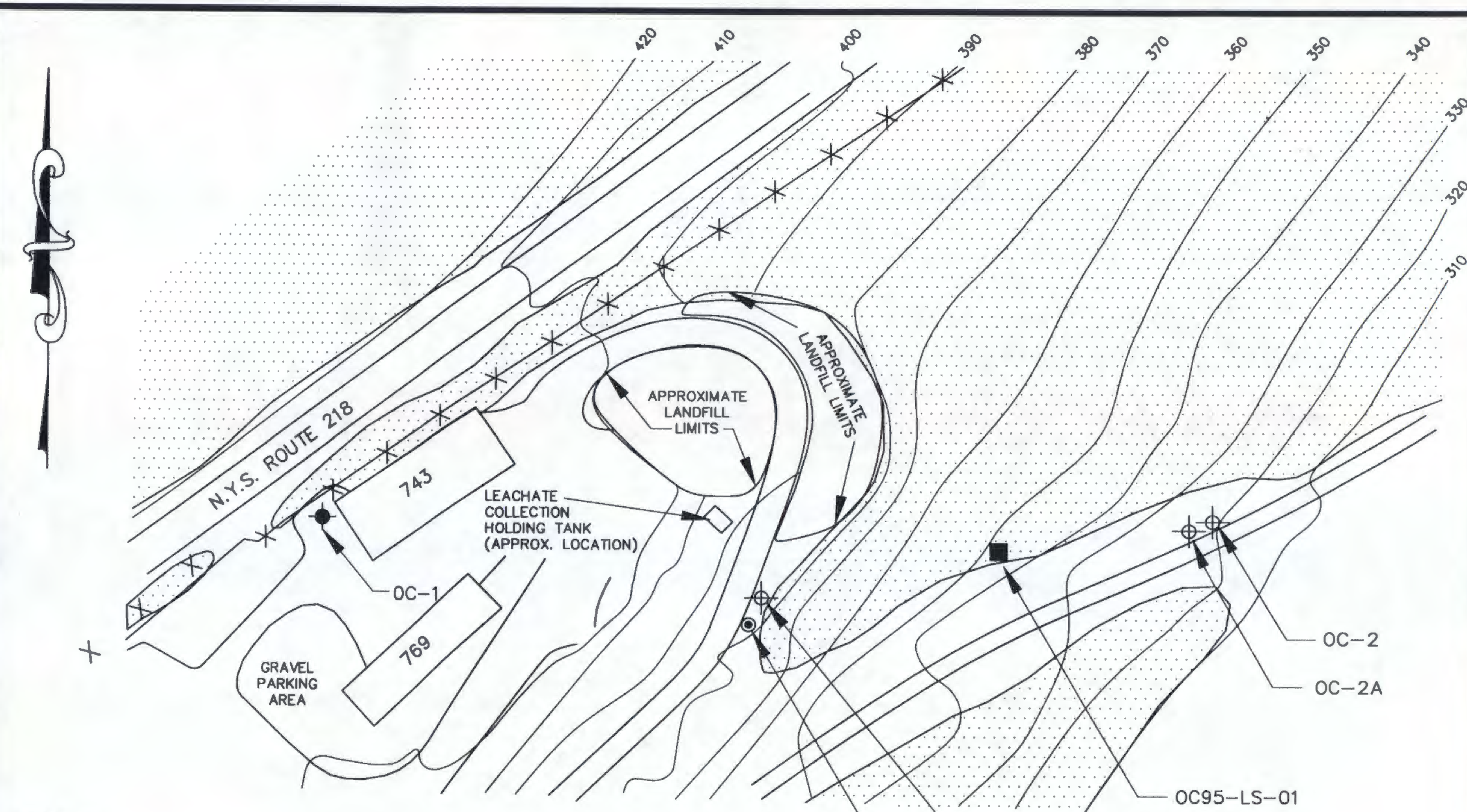
FILE NAME: F:\TEAM\60787\52\LFSMPLOC

EA ENGINEERING, SCIENCE, AND TECHNOLOGY	SIX LANDFILLS U.S. MILITARY ACADEMY WEST POINT, NEW YORK	FIGURE 3-3 SAMPLE LOCATIONS PARKING LOT F LANDFILL	DESIGNED BY JCH	DRAWN BY SY	DATE 25 JUL 1995	PROJECT NO. 60787.52
			CHECKED BY SMD	PROJECT MGR. JHS	SCALE N.T.S.	FILE NO. LFSMPLOC



EA ENGINEERING, SCIENCE, AND TECHNOLOGY	SIX LANDFILLS U.S. MILITARY ACADEMY WEST POINT, NEW YORK	FIGURE 3-4 LEACHATE COLLECTION TANK

PROJECT MGR	DESIGNED BY	DRAWN BY	CHECKED BY	SCALE	DATE	PROJECT NO	FILE NO.
JHS		PJW	BDA	N.T.S.	15 DEC 1994	60787.52	015



LEGEND:

DOWNGRADIENT MONITORING WELL LOCATION

UPGRADIENT MONITORING WELL LOCATION

DEEP MONITORING WELL LOCATION

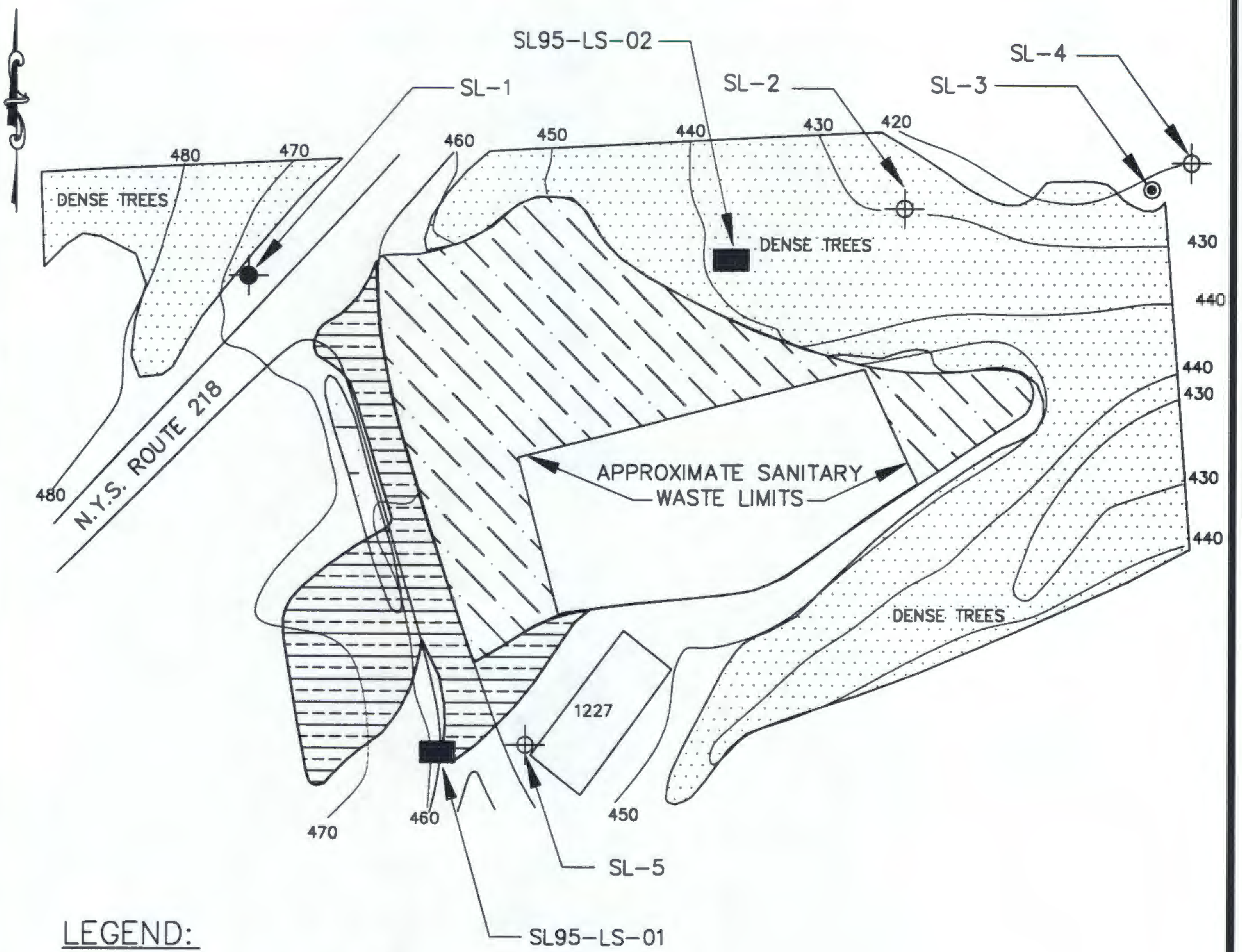
SEEP SAMPLING LOCATION

DENSE TREE AREA

FENCE LINE

DWG. FILE No. F:\CAD\60787\52\OCSMPLOC.DWG

EA ENGINEERING, SCIENCE, AND TECHNOLOGY	SIX LANDFILLS U.S. MILITARY ACADEMY WEST POINT, NEW YORK	FIGURE 3-5 SAMPLE LOCATIONS ORGANIC COMPOST LANDFILL	DESIGNED BY	DRAWN BY SY	DATE 09 OCT 1995	PROJECT NO. 60787.52
			CHECKED BY	PROJECT MGR. JHS	SCALE N.T.S.	FILE NO. OCSMPLOC



LEGEND:

- DOWNGRADIENT MONITORING WELL LOCATION
- UPGRADIENT MONITORING WELL LOCATION
- DEEP MONITORING WELL LOCATION
- SEEP SAMPLING LOCATION
- APPROXIMATE CONSTRUCTION DEBRIS LIMITS
- INFERRED GEOPHYSICAL BOUNDARY OF LANDFILL
- DENSE TREE AREA

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EA ENGINEERING, SCIENCE, AND TECHNOLOGY	SIX LANDFILLS U.S. MILITARY ACADEMY WEST POINT, NEW YORK	FIGURE 3-6 SAMPLE LOCATIONS SKI LOT LANDFILL

PROJECT MGR	DESIGNED BY	DRAWN BY	CHECKED BY	SCALE	DATE	PROJECT NO	FILE NO.
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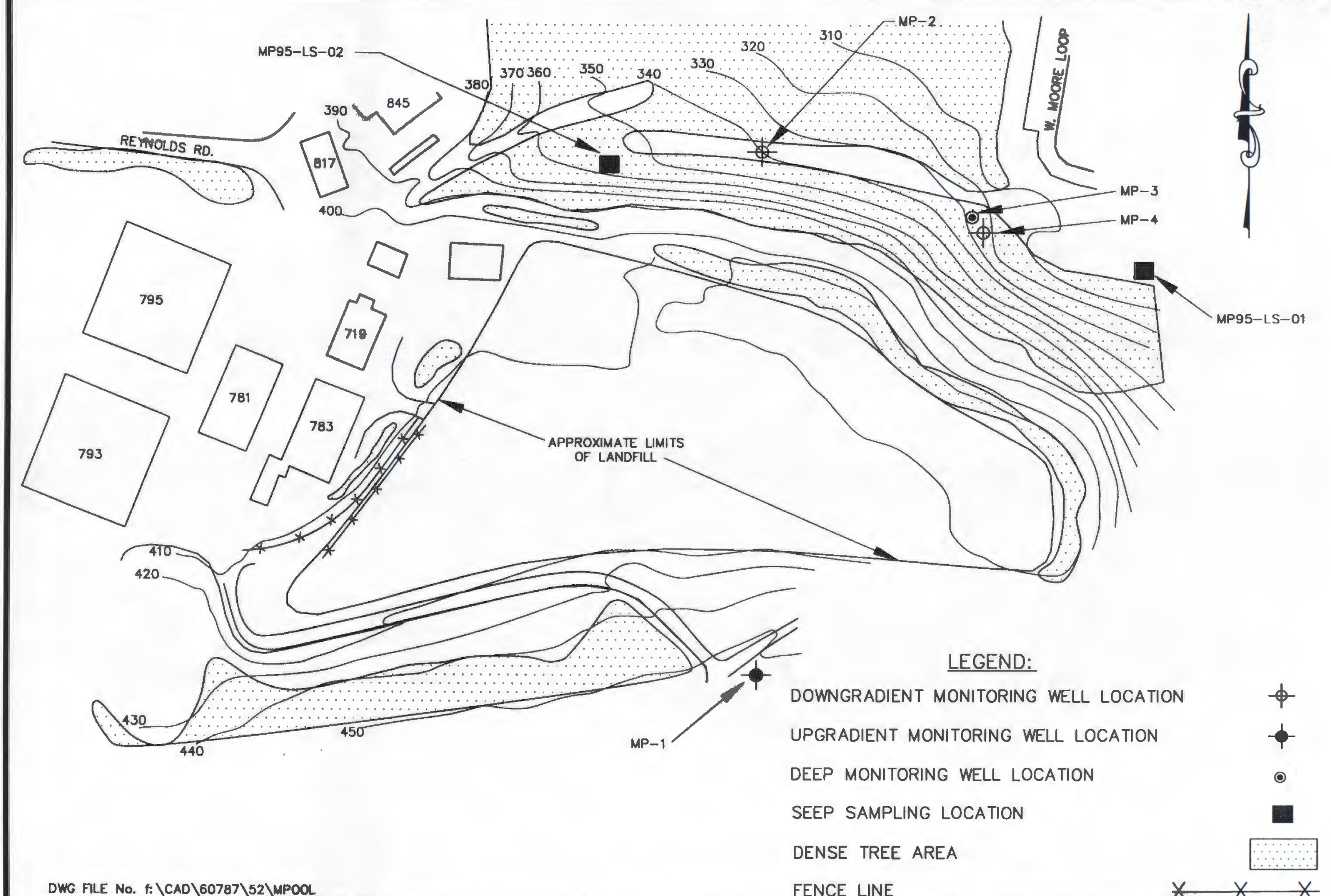
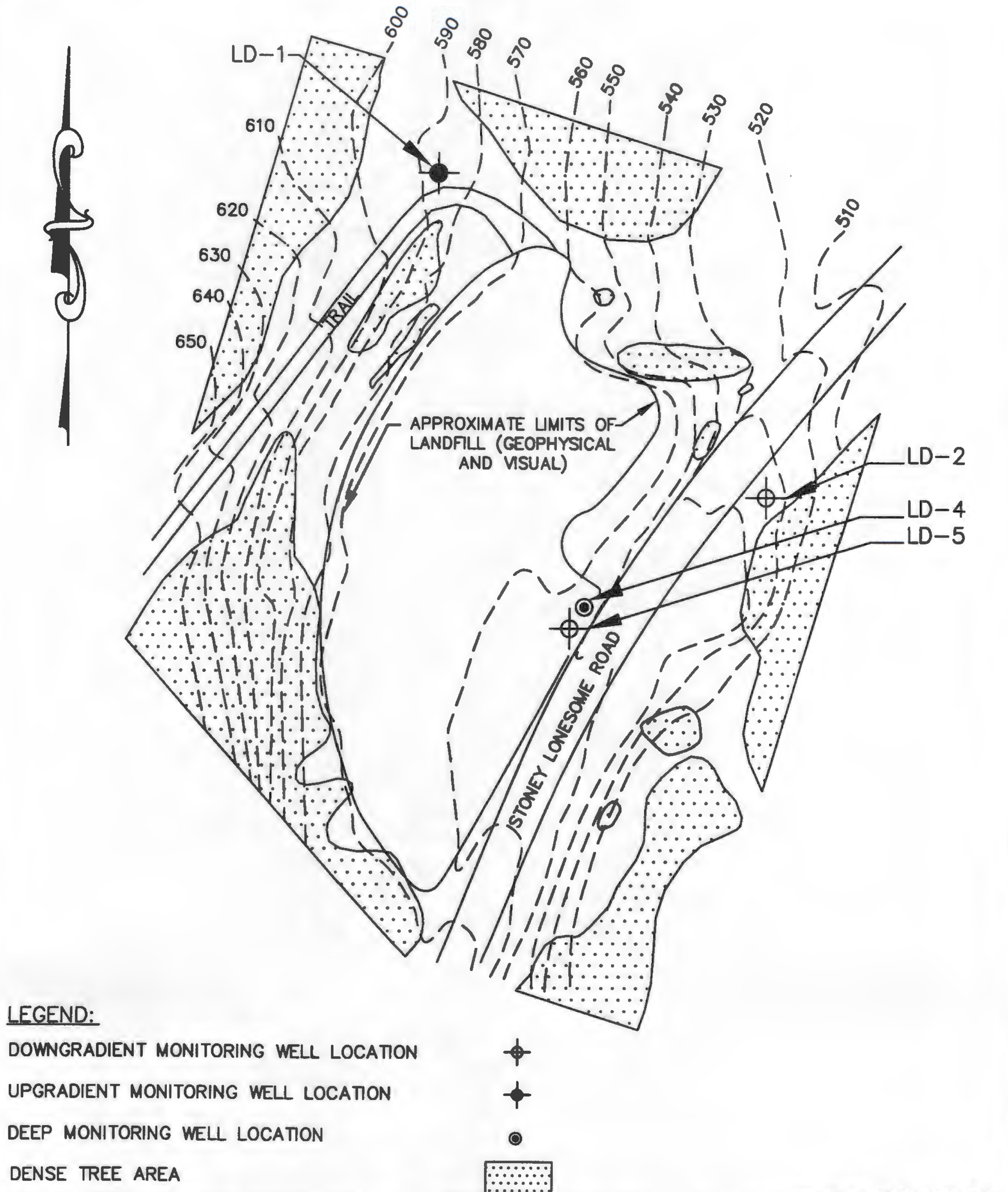


EA ENGINEERING, SCIENCE, AND TECHNOLOGY	SIX LANDFILLS U.S. MILITARY ACADEMY WEST POINT, NEW YORK	FIGURE 3-7 SAMPLE LOCATIONS MOTOR POOL LANDFILL	DESIGNED BY	DRAWN BY SY	DATE 25 JUL 1995	PROJECT NO. 60787.52
			CHECKED BY	PROJECT MGR. JHS	SCALE N.T.S.	FILE NO. MPOOL



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EA ENGINEERING, SCIENCE, AND TECHNOLOGY	SIX LANDFILLS U.S. MILITARY ACADEMY WEST POINT, NEW YORK	FIGURE 3-8 SAMPLE LOCATIONS PARKING LOT D LANDFILL

PROJECT MGR	DESIGNED BY	DRAWN BY	CHECKED BY	SCALE	DATE	PROJECT NO	FILE NO.
JHS	JCH	SY	SMD	N.T.S.	25 JUL 1995	60787.52	LDSMPLOC

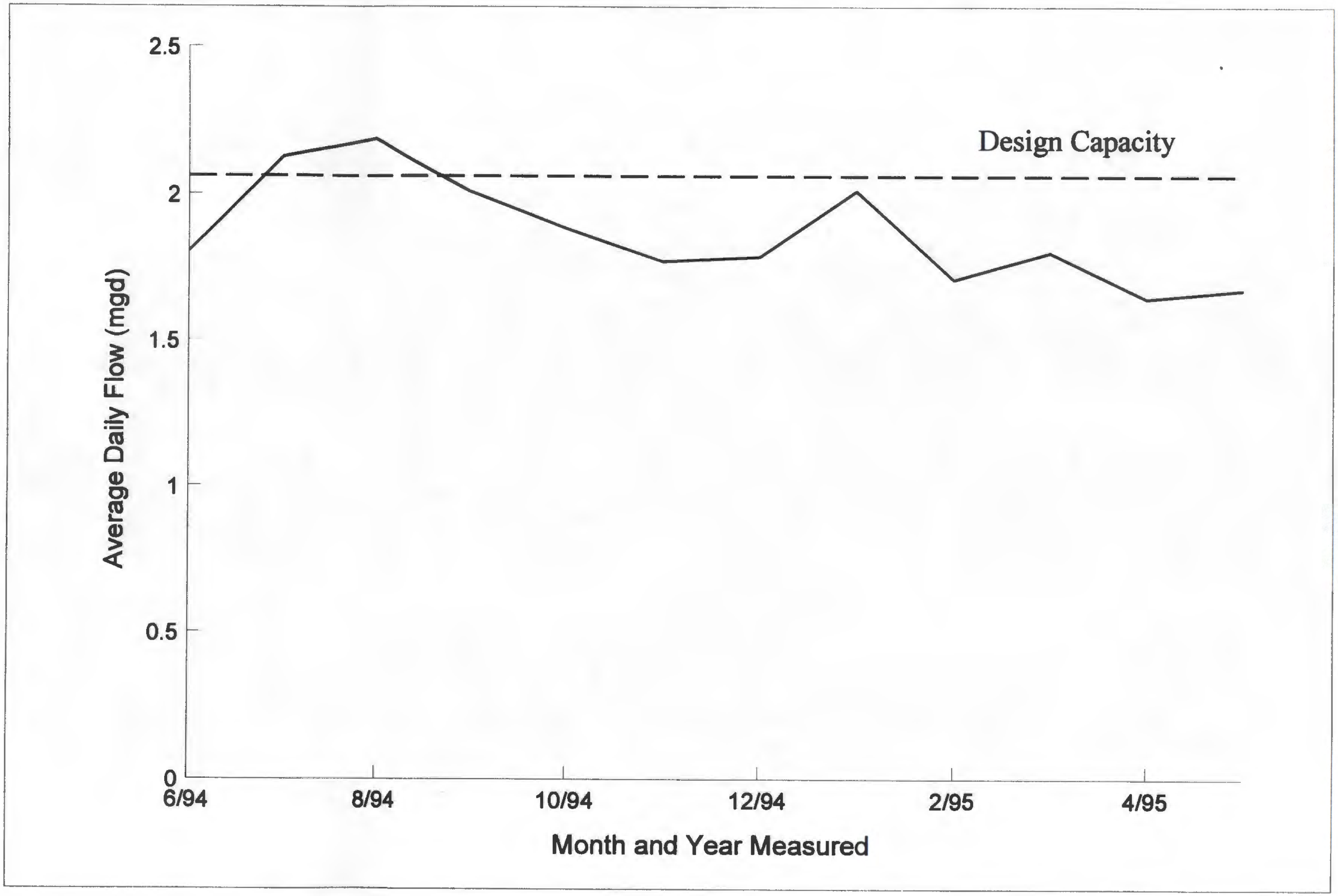


Figure 3-9 Summary of average daily flows at the U.S. Military Academy wastewater treatment plant.

TABLE 3-1 PROJECTED LEACHATE FLOW AMOUNTS

Month/Year	Average Flow (gpd)	%Cap	%D	Additional Flow[a]	%Cap	%D
JUN 1994	1,805,000	87.6	-12.4	1,808,500	87.8	0.19
JUL 1994	2,146,000	104.2	4.2	2,149,500	104.3	0.16
AUG 1994	2,186,000	106.1	6.1	2,189,500	106.3	0.16
SEP 1994	2,009,000	97.5	-2.5	2,012,500	97.7	0.17
OCT 1994	1,883,000	91.4	-8.6	1,886,500	91.6	0.19
NOV 1994	1,771,000	86.0	-14.0	1,774,500	86.1	0.20
DEC 1994	1,786,000	86.7	-13.3	1,789,500	86.9	0.20
JAN 1995	2,011,000	97.6	-2.4	2,014,500	97.8	0.17
FEB 1995	1,709,000	83.0	-17.0	1,712,500	83.1	0.20
MAR 1995	1,801,000	87.4	-12.6	1,804,500	87.6	0.19
APR 1995	1,644,000	79.8	-20.2	1,647,500	80.0	0.21
MAY 1995	1,674,000	81.3	-18.7	1,677,500	81.4	0.21
				Mean	90.9	0.19

Seeps	Landfill	Seep flow (gpd)
PS95-LS-01	Post School	587
LF95-LS-01	Parking Lot E	2,244
LF95-LS-03	Parking Lot F	544
SL95-LS-02	Ski Lot	12
MP95-LS-01	Motor Pool	113
TOTAL		3,500

(a) Corresponds to all seeps adding to existing flow.

4. ALTERNATIVES FOR DISPOSAL OF LEACHATE

The alternatives discussed in this chapter are for the disposal of leachate being generated at established outbreaks at each landfill. The following criteria were considered prior to the development of each alternative:

- Based upon interpretation of the results from the Phase II Site Investigation, it does not appear that these Six Landfills represent a source of a human health or environmental risk through surface water or ground-water pathways. Therefore, from the perspective of environmental protection, no further action appears necessary for surface water and ground water at these sites.

  However, at several of these landfills in high visibility public areas, the iron flocculation from the landfill leachate seeps creates unsightly conditions. These can be interpreted as "contamination" despite the fact that the analytical data indicate otherwise. Accordingly, response actions to improve leachate collection, conveyance, and treatment systems at one or more of these sites and minimize aesthetic impacts to high visibility public areas may be warranted.

- Leachate collection systems, although not entirely effective, currently exist at the Post School, Parking Lot F, and Organic Compost landfills. USMA currently pumps collection tanks and transports the leachate to the treatment plant via tanker truck.

- Six out of 10 of the seep locations are located several hundred feet from an existing sanitary sewer line.

- The amount of leachate being generated at each seep location varies greatly by both location and time of year (ranging from 10 to 2,244 gpd).

- It is preferred that any new collection systems be low maintenance.

- Where feasible, any new system should be designed and built to allow for future expansion to account for possible additional seep outbreaks.

Onsite pretreatment may be necessary at locations where connection to an existing sanitary sewer line is not practical or cost effective. One method of pretreatment is the addition of chemicals to the leachate to enhance flocculation. This method utilizes a chemical feed system to add predetermined amounts of chemicals to collected leachate in order to remove suspended solids and metals through precipitation. The precipitated solids and metals are retained within the collection tank for subsequent removal by a tanker truck equipped with vacuum lines.

A chemical feed system is most effective in situations where the leachate generation amounts remain constant. In situations where the flow amounts vary greatly at different times of the year, such as at USMA, the system would require frequent adjustments to maintain the proper precipitation rate.

Another method of pretreatment is the use of filters to capture suspended solids and metal flocculent in the leachate. Leachate would be collected in a holding tank, which would be connected to a processing tank and ultimately the filtration system itself. The filtration system utilizes porous filter membranes to remove solids and metals, which are retained for disposal. This method requires no chemicals and maintenance would be limited to periodic disposal of collected solids and changing of the filter media.

Regardless of the method of pretreatment, periodic testing and monitoring of the treated water would be required to ensure that the system is functioning properly.

A summary of the considerations for the development of the disposal alternatives for each landfill are presented in Table 4-1.

4.1 POST SCHOOL LANDFILL

4.1.1 Alternative No. 1 (PS-ALT L1): No Action

The major components are as follows:

- Periodically clean out existing catch basin, connection lines, and collection tank.

- Monitor ground-water, surface water, and leachate quality.

The "No Action" alternative consists of periodic inspection and maintenance of the existing leachate collection system. Periodic monitoring of the ground-water, surface water, and leachate is also a component of this alternative. This alternative does not limit access to the site.

4.1.2 Alternative No. 2 (PS-ALT L2): Collection and Discharge to U.S. Military Academy Treatment Plant

This alternative is conceptually similar to the existing system, but consists of upgrades in several areas. The major components are as follows (Appendix B, Figure B-1):

- Abandon existing leachate collection tank in place.

- Replace the existing catch basin and storm drain and install covered collection box and drainage line at seep PS95-LS-01 (Figures B-2 through B-5).

- Connect drainage line directly to sanitary sewer line.

- Monitor ground-water, surface water, and leachate quality.

The intent of this alternative is to provide a new, more effective collection box that is covered to limit access and improve aesthetics. Since the new collection box would be connected directly to the sanitary sewer, the existing collection tank would be unnecessary and would be abandoned. Monitoring of the ground water, surface water, and leachate would continue to evaluate if offsite impacts exist relative to ground-water and surface water quality.

4.1.3 Alternative No. 3 (PS-ALT L3): Collection and Discharge to Stormwater System

This alternative is similar to Alternative No. 2, but involves pretreatment of the leachate and discharge to the stormwater system. The major components are as follows:

- Abandon existing leachate collection tank in place.

- Replace the existing catch basin and storm drain and install covered collection box and drainage line.

- Connect drainage line to a pretreatment unit.

- Provide a pretreatment unit for metals and suspended solids removal by filtration/sedimentation.

- Install piping to connect the pretreatment unit to existing stormwater system.

- Monitor treated leachate for compliance with pretreatment standards.

- Monitor ground-water and surface water quality.

The intent of this alternative is to provide a new, more effective collection box that is covered to limit access and improve aesthetics. Since the new collection box would be connected directly to a pretreatment unit and stormwater system, the existing collection tank would be unnecessary and would be abandoned. Pretreatment would be required to reduce the amounts of suspended metals and solids in the leachate, and to avoid simply relocating the iron staining to another area away from the existing seep location. Monitoring of the ground water, surface water, and leachate would continue to evaluate if offsite impacts exist relative to ground-water and surface water quality.

4.1.4 Alternative No. 4 (PS-ALT L4): Uptake by Vegetation

The major components are as follows:

- Leave existing collection system in place.
- Establish new vegetation along and atop seep location.
- Monitor ground-water, surface water, and leachate quality.

The intent of establishing vegetation is to conceal the outbreak and serve as an aesthetic buffer. This would be accomplished through the uptake, conversion, or capture of suspended solids and metals in the leachate. "Uptake" refers to the consumption of water (i.e., leachate), the removal of any contaminants which may be present, and the storage of those contaminants in the plant tissue. "Conversion" refers to the digestion and breakdown of any contaminants by the plant. "Capture" refers to the root structure of the plant intercepting sediment, solids, and debris that may be present in the leachate.

The selection of the vegetation to be used would need to consider the existing characteristics of the soil, leachate, hydrology, and climate.

This alternative does not limit access to the site.

4.2 PARKING LOT F LANDFILL

4.2.1 Alternative No. 1 (LF-ALT L1): No Action

The major components are as follows:

- Periodically remove debris from swale along access road to improve flow.
- Monitor ground-water, surface water, and leachate quality.

The "No Action" alternative consists of periodic inspection and maintenance of the existing leachate collection system. Periodic monitoring of the ground water, surface water, and leachate is also a component of this alternative. This alternative does not limit access to the site.

4.2.2 Alternative No. 2 (LF-ALT L2): Collection and Transport to U.S. Military Academy Treatment Plant

This alternative is conceptually similar to the existing system, but consists of upgrades in several areas. The major components are as follows:

- Remove existing gutter along access road.
- Remove existing catch basin next to existing leachate collection tank.
- Install lateral collection lines below seep areas LF95-LS-01 (Figures B-5 through B-7) and LF95-LS-03 (Figure B-8).
- Install new collection tank in the vicinity of seep LF95-LS-01.
- Connect lateral collection lines to collection tanks (Figure B-9).
- Periodically gauge volume of each collection tank; pump and transport as required via tanker truck to USMA treatment plant as described in Section 7.1.2.2, Item A.12.
- Monitor ground-water, surface water, and leachate quality.

The intent of this alternative is to provide a new, more effective means to collect leachate and to improve aesthetics. The existing collection tank only receives leachate from the seep location along the access road (LF95-LS-03) during peak storm events, since a storm drain is located in the gutter next to the inlet of the tank. This drain would be abandoned, and the gutter would be reconfigured to properly direct flow to the tank. The new gutter would be designed to collect leachate and storm water separately, and to divert storm water from entering the collection tank. Leachate generation estimates from August 1995 for the seep along the access road would probably require that the existing tank be pumped on a daily basis.

No leachate collection system exists for the seep area located between Parking Lot E and Parking Lot F (LF95-LS-01). This location would also require the installation of lateral collection lines to intercept seepage, which would be directed to a new collection tank. Leachate generation estimates from August 1995 for this seep would probably require that the new tank be pumped on a daily basis.

For both collection systems, each collection tank would be equipped with an outfall and pad at the discharge end to allow for overflow conditions.

Monitoring of the ground water, surface water, and leachate would continue to evaluate if offsite impacts exist relative to ground-water and surface water quality.

This alternative does not limit access to the site.

4.2.3 Alternative No. 3 (LF-ALT L3): Collection and Discharge to Storm Water

This alternative is similar to Alternative No. 2, but involves pretreatment of the leachate and discharge to the stormwater system. The major components are as follows:

- Abandon existing leachate collection tank along access road.
- Remove existing gutter along access road.
- Provide separate pretreatment units for seep areas LF95-LS-01 and LF95-LS-03.
- Install lateral collection lines below the seep area between Parking Lot E and Parking Lot F, as well as along the access road.
- Connect each set of lateral collection lines to pretreatment units.
- Install outfall for discharge of treated leachate from seep LF95-LS-01 to swale along west side of lot.
- Connect pretreatment unit for seep LF95-LS-03 to existing storm drain next to access road.
- Monitor treated leachate from both pretreatment units for compliance with pretreatment standards.

The intent of this alternative is to provide a new, more effective means to collect leachate and to improve aesthetics. The existing collection tank would be abandoned. The gutter along the access road would be reconfigured to properly direct flow to the pretreatment unit. The new gutter would be designed to collect leachate and storm water separately, and to divert storm water from entering the pretreatment unit. The pretreatment unit along the access road would be connected to the existing storm drain, located in the gutter next to the inlet of the existing collection tank.

No leachate collection system exists for the seep area located between Parking Lot E and Parking Lot F (LF95-LS-01). This location would also require the installation of lateral collection lines to intercept seepage, which would be directed to a pretreatment unit. The pretreatment unit would be equipped with an outfall and pad to permit discharge to the swale located along the west edge of the lot.

Monitoring of the ground water, surface water, and leachate would continue to evaluate if offsite impacts exist relative to ground-water and surface water quality.

This alternative does not limit access to the site.

4.2.4 Alternative No. 4 (LF-ALT L4): Collection and Discharge to Sanitary Sewer

The major components are as follows:

- Abandon existing leachate collection tank along access road.
- Remove existing gutter along access road.
- Install lateral collection lines below seeps LF95-LS-01 and LF95-LS-03.
- Install sewer lines to connect the collection lines at both seep locations to the existing sanitary sewer system.

This alternative is a possibility although the nearest connection to an existing sanitary sewer line is at least 700-800 ft from the landfill. The installation of a new sanitary sewer line to convey leachate from the seep area between Parking Lot E and Parking Lot F (LF95-LS-01) to the existing sanitary sewer system would require difficult trenching through terrain that is heavily wooded, steep, and strewn with large boulders. However, this alternative would eliminate the need for transportation of the leachate to the treatment plant, as well as the need for pretreatment prior to discharge to storm water, and would allow for future expansion of the system. Therefore, this may be the best alternative if considered a long-term solution.

4.3 ORGANIC COMPOST LANDFILL

4.3.1 Alternative No. 1 (OC-ALT L1): No Action

The major components are as follows:

- Leave existing collection line and tank in place.
- Periodically pump the collection tank and transport the leachate to USMA treatment plant.
- Monitor ground-water, surface water, and leachate quality.

The "No Action" alternative consists of periodic inspection and maintenance of the existing leachate collection system. Periodic monitoring of the ground water, surface water, and leachate is also a component of this alternative. This alternative does not limit access to the site, although most of the landfill is already surrounded by a fence.

Well established vegetation currently exists along the perimeter of the landfill. The vegetative cover acts as a natural barrier, effectively concealing existing seep locations.

4.3.2 Alternative No. 2 (OC-ALT L2): Collection and Discharge to Storm Water

The major components are as follows:

- Provide pretreatment unit for the existing collection tank.
- Connect existing collection tank to pretreatment unit.
- Install outfall for discharge of treated leachate to ditch along south side of landfill.
- Monitor treated leachate from pretreatment unit for compliance with pretreatment standards.
- Monitor ground-water and surface water quality.

The intent of this alternative is to provide for pretreatment of any generated leachate prior to discharge to nearby storm water. Monitoring of the ground water, surface water, and leachate would continue to evaluate if offsite impacts exist relative to ground-water and surface water quality.

This alternative does not limit access to the site.

4.3.3 Alternative No. 3 (OC-ALT L3): Collection and Discharge to U.S. Military Academy Treatment Plant

The major components are as follows:

- Abandon existing leachate collection tank.
- Install sewer line to connect the existing leachate collection line to the existing sanitary sewer system.

This alternative is a possibility although the nearest connection to an existing sanitary sewer line is at least several hundred feet from the landfill. The installation of a new sanitary sewer line to convey leachate from the landfill to the existing sanitary sewer system would require difficult trenching through terrain that is heavily wooded, steep, and strewn with large boulders. However, this alternative would eliminate the need for transportation of the leachate to the treatment plant, as well as the need for pretreatment prior to discharge to storm water. Therefore, this may be the best alternative if considered a long-term solution.

4.4 SKI LOT LANDFILL

4.4.1 Alternative No. 1 (SL-ALT L1): No Action

The major components are as follows:

- Periodically remove debris from swale near Building 1227 to improve drainage.
- Monitor ground-water, surface water, and leachate quality

The "No Action" alternative consists of periodic removal of debris from the swale near Building 1227. Periodic monitoring of the ground water, surface water, and leachate is also a component of this alternative. This alternative does not limit access to the site.

Well established vegetation currently exists along the swale next to Building 1227, as well as the wooded area at the northeast corner of the landfill. The vegetative cover acts as a natural barrier, effectively concealing the seep outbreaks, particularly in the wooded area northeast of the landfill.

4.4.2 Alternative No. 2 (SL-ALT L2): Collection and Transport to U.S. Military Academy Treatment Plant

The major components are as follows:

- Install lateral collection lines below seeps SL95-LS-01 (Figure B-10) and SL95-LS-02 (Figure B-11).
- Install collection tanks in the vicinity of both seep locations.
- Connect lateral collection lines to collection tanks.
- Periodically pump each collection tank and transport via tanker truck to USMA treatment plant.
- Monitor ground-water, surface water, and leachate quality.

The intent of this alternative is to provide a new and effective means to collect leachate and to improve aesthetics. No leachate collection system exists for either of the seep areas. These locations would require the installation of lateral collection lines to intercept seepage, which would be directed to a new collection tank. Leachate generation estimates from August 1995 for the seep located in the woods northeast of the landfill (SL95-LS-02) would probably require that the new tank be pumped on a monthly basis. A leachate generation estimate for the seep near Building 1227 (SL95-LS-01) could not be made during August 1995 since the seep location was dry.

For both collection systems, each collection tank would be equipped with an outfall and pad at the discharge end to allow for overflow conditions.

Monitoring of the ground water, surface water, and leachate would continue to evaluate if offsite impacts exist relative to ground-water and surface water quality.

This alternative does not limit access to the site.

4.4.3 Alternative No. 3 (SL-ALT L3): Pretreatment and Discharge to Surface Water

This alternative is similar to Alternative No. 2, but involves pretreatment of the leachate and discharge to surface water. The major components are as follows:

- Provide separate pretreatment units for Seeps SL95-LS-01 and SL95-LS-02.
- Install lateral collection lines below both seep areas.
- Connect each set of lateral collection lines to pretreatment units.
- Install outfalls for discharge of treated leachate to the intermittent stream on the southwest side of lot, as well as to the swale east of the wooded area.
- Monitor treated leachate from both pretreatment units for compliance with pretreatment standards.
- Monitor ground-water and surface water quality

The intent of this alternative is to provide a new and effective means to collect leachate and to improve aesthetics. The pretreatment units for both seep locations would discharge to nearby surface water.

No leachate collection system exists for either seep area. Both locations would require the installation of lateral collection lines to intercept seepage, which would be directed to pretreatment units. Each pretreatment unit would be equipped with an outfall and pad to permit discharge to surface water.

Monitoring of the ground water, surface water, and leachate would continue to evaluate if offsite impacts exist relative to ground-water and surface water quality.

This alternative does not limit access to the site.

4.4.4 Alternative No. 4 (SL-ALT L4): Collection and Discharge to U.S. Military Academy Treatment Plant

The major components are as follows:

- Install lateral collection lines at both seep areas.
- Install sewer lines to connect the collection lines at both seep locations to the existing sanitary sewer system.
- Monitor ground-water, surface water, and leachate quality.

The intent of this alternative is to provide a new and effective means to collect leachate from the seep areas and to improve aesthetics. Monitoring of the ground water, surface water, and leachate would continue to evaluate if offsite impacts exist relative to ground-water and surface water quality.

This alternative is a possibility for the seep located in the wooded area northeast of the landfill (SL95-LS-02) although the nearest connection to an existing sanitary sewer line is at least several hundred feet from the landfill. The installation of a new sanitary sewer line to convey leachate from this seep location to the existing sanitary sewer system would require difficult trenching through terrain that is heavily wooded, steep, and strewn with large boulders. However, this alternative would eliminate the need for transportation of the leachate to the treatment plant, as well as the need for pretreatment prior to discharge to storm water. Therefore, this may be the best alternative if considered a long-term solution.

4.5 MOTOR POOL LANDFILL

4.5.1 Alternative No. 1 (MP-ALT L1): No Action

The "No Action" alternative consists of periodic monitoring of the ground water, surface water, and leachate. This alternative does not limit access to the site.

Well established vegetation currently exists in the vicinity of both seep locations. The vegetative cover acts as a natural barrier, effectively concealing the seep outbreaks, particularly in the wooded area west of monitoring well MP-02. Placement of additional shrubs or small trees in the vicinity of the seep located along the stream (MP95-LS-01) would help to conceal the outbreak.

4.5.2 Alternative No. 2 (MP-ALT L2): Collection and Discharge to U.S. Military Academy Treatment Plant

The major components are as follows:

- Install lateral collection lines at seeps MP95-LS-01 (Figure B-12) and MP95-LS-02 (Figure B-13).
- Install holding tank for the seep area along the stream (MP95-LS-01).
- Connect collection line for seep MP95-LS-01 to the holding tank.
- Install sewer line to connect holding tank to existing sanitary sewer system.
- Connect lateral from seep area MP95-LS-02 directly to existing sanitary sewer line that follows along the southwest side of South Moore Loop, at the rear of the housing units.
- Monitor ground-water, surface water, and leachate quality.

The intent of this alternative is to provide a new and effective means to collect leachate from the seep areas and to improve aesthetics. Monitoring of the ground water, surface water, and leachate would continue to evaluate if offsite impacts exist relative to ground-water and surface water quality.

This alternative is a possibility for the seep located along the stream (MP95-LS-01) although the nearest connection to an existing sanitary sewer line is located across the stream. A scavenger tank equipped with a pumping system would be required for this seep location to move leachate from the source area to a more suitable sewer connection location (i.e., midway between seep locations MP95-LS-01 and MP95-LS-02). However, this alternative would eliminate the need for transportation of the leachate to the treatment plant, as well as the need for pretreatment prior to discharge to surface water. Therefore, this may be the best alternative if considered a long-term solution.

4.5.3 Alternative No. 3 (MP-ALT L3): Collection and Discharge to Surface Water

The major components are as follows:

- Provide one pretreatment unit for seep areas MP95-LS-01 and MP95-LS-02.
- Install lateral collection lines below seep areas MP95-LS-01 and MP95-LS-02.
- Connect lateral collection lines to pretreatment unit.

- Install outfall for discharge of treated leachate to stream along east side of landfill.

- Monitor treated leachate from pretreatment unit for compliance with pretreatment standards.

- Monitor ground-water and surface water quality.

The intent of this alternative is to provide a new and effective means to collect leachate and to improve aesthetics. The pretreatment unit would discharge to nearby surface water.

These locations would require the installation of lateral collection lines to intercept seepage, which would be directed to the pretreatment unit. The pretreatment unit would be equipped with an outfall and pad to permit discharge to surface water.

Monitoring of the ground water, surface water, and leachate would continue to evaluate if offsite impacts exist relative to ground-water and surface water quality.

This alternative does not limit access to the site.

TABLE 4-1 CONSIDERATIONS FOR DEVELOPMENT OF DISPOSAL ALTERNATIVES AT THE SIX LANDFILLS

Criteria	Post School	Parking Lot F	Organic Compost	Ski Lot	Motor Pool	Parking Lot D
1. Existing Conditions - Seepage estimates - Analytical results	- 587 gpd at PS95-LS-01 Elevated levels of metals and suspended solids found in leachate.	- 2,244 gpd at LF95-LS-01 - 544 gpd at LF95-LS-03 Elevated levels of metals and suspended solids found in leachate.	Seep outbreaks could not be located during field investigation.	- 12 gpd at SL95-LS-02 Elevated levels of metals and suspended solids found in leachate.	- 113 gpd at MP95-LS-01 Elevated levels of metals and suspended solids found in leachate.	Seep outbreaks could not be located during field investigation.
2. Existing Collection System	Modified catch basin connected to tank and sanitary sewer. System is partially effective.	Swale/gutter along access road near LF95-LS-03. Swale drains to storm sewer. System is partially effective.	Perforated collection line connected to tank. System collects primarily storm water.	No existing collection system.	No existing collection system.	No existing collection system.
3. Design Considerations - Availability of sanitary sewer - Available space - Potential for environmental impact - Potential for human impact	Sewer located along Barnard Loop service road. Space is limited due to existing utilities and housing. Elementary school located nearby.	Sewer located 700-800 ft from landfill. Space along access road is limited due to terrain.	Sewer located several hundred feet from landfill. Space is limited along sides of landfill.	Sewer located 150-200 ft from seep SL95-LS-01. Seep SL95-LS-02 is located several hundred feet from sewer. Space is limited in vicinity of SL95-LS-01.	Sewer located 50-100 ft from seep MP95-LS-02. Seep MP95-LS-01 is located next to stream and is lower in elevation than sewer line. Space is limited along stream. Seep MP95-LS-01 is discharging to stream.	Not applicable.
4. Future Use of Landfill	Continued use as play area. May include construction of new softball fields.	Continued use as parking lot for cadets and visitors.	Continued use as storage area.	Continued use as a parking lot.	Continued use as equipment storage area.	Continued use as a parking lot.
5. Construction Considerations - Terrain - Vegetation - Other	Terrain is steep in vicinity of PS95-LS-01. Shallow bedrock and large boulders are common to area.	Terrain is steep near seep locations. Shallow bedrock, large boulders, and trees are common to area. Vegetation currently acts to conceal seep at LF95-LS-01.	Terrain is steep near sides of landfill. Vegetation currently acts to conceal possible seep location.	Large boulders and trees are common to area. Vegetation currently acts to conceal seeps. Access road may be required near seep SL95-LS-02.	Vegetation currently acts to conceal seep locations.	Not applicable.

Criteria	Post School	Parking Lot F	Organic Compost	Ski Lot	Motor Pool	Parking Lot D
6. Alternatives Considered and Rationale	"Connection to sanitary sewer" would be relatively easy to implement since system is located nearby. Collection box would limit access by humans. "Pretreatment" would be necessary prior to discharge to storm water to meet SPDES requirements. "Uptake by vegetation" could be effective since seep area is small, but this would not limit access.	"Collection and transport" was considered since sanitary sewer is 700-800 ft from landfill. "Pretreatment" would be necessary prior to discharge to storm water to meet SPDES requirements. "Connection to sanitary sewer" is possible although existing sewer system is 700-800 ft from landfill, and trenching could be very difficult due to terrain and vegetation.	"Pretreatment" would be necessary prior to discharge to surface water to meet SPDES requirements. "Connection to sanitary sewer" is possible although existing sewer system is several hundred feet from landfill, and trenching could be very difficult due to terrain and vegetation.	"Collection and transport" was considered since sanitary sewer is at least 150-200 ft from landfill. "Pretreatment" would be necessary prior to discharge to surface water to meet SPDES requirements. "Connection to sanitary sewer" is possible for both seep locations although existing sewer system is 700-800 ft from seep, and trenching could be very difficult due to terrain and vegetation.	"Connection to sanitary sewer" would be relatively easy for seep MP95-LS-02 since system is located nearby. This may be possible for seep MP95-LS-01 although a scavenger tank and pump system would be required. "Pretreatment" would be necessary prior to discharge to surface water to meet SPDES requirements.	Disposal alternatives were not considered for Parking Lot D Landfill since leachate generation appears to be negligible and there is no evidence of current or past seep outbreaks.

5. ALTERNATIVES FOR SOURCE REDUCTION OF LEACHATE

The alternatives discussed in this chapter are for the source reductions of leachate being generated at established outbreaks at each landfill. A summary of the containment methods and considerations for each landfill, including the retained alternatives, is presented in Table 5-1.

5.1 GENERAL CONTAINMENT METHODS

5.1.1 Capping

Capping is designed to minimize contact and infiltration of rainwater into the fill mass, thereby reducing the potential for leachate generation from buried wastes. It would also help to reduce surface soil erosion and potential stormwater transport of any exposed waste materials. The capping process incorporates a low permeability barrier overlying the contents of the disposal area and a suitable cover soil to protect the barrier and support the growth of vegetation. The effectiveness of a cap in reducing the potential for leachate generation is dependent on ground-water levels. Ground water coming in contact with buried wastes, which is more likely when the local water table is elevated, may produce leachate despite the existence of a well-designed cap.

Several capping materials may be considered, including:

- Clay
- Synthetic membranes
- Asphalt or concrete.

Clay has historically been the most extensively used capping material. It can be highly effective in a compatible climate and chemical environment. Clay caps are effective at reducing the percolation of precipitation due to its lower hydraulic conductivity relative to other soil types.

Synthetic membranes may also be used as cap construction material, since they are also capable of reducing the vertical migration of precipitation. The factors influencing the appropriate use of synthetic membranes include chemical compatibility, prevention of tears and punctures, and proper overlapping of seams.

Both asphalt and concrete caps are more susceptible than clay to shrinkage and/or cracking, thus increasing the risk of infiltration and necessitating periodic maintenance. These materials should only be considered for situations where current or future use of the area at the surface of the landfill require them to be used.

5.1.1.1 Post School Landfill

The Post School Landfill, like many of the landfills at West Point, was constructed in an area characterized by very steep terrain, especially on the upgradient and downgradient sides. A seep is located on the downgradient side of the landfill, and it is suspected that leachate generation at this seep location is primarily due to ground water flowing through the waste-bearing layers of the landfill. Based on site topography and the proximity of the lateral ground-water flow gradient to the waste-bearing layer, precipitation infiltrating through the fill mass likely contributes to a lesser degree. The contribution of precipitation infiltrating through the existing cap relative to the amount of ground water passing through the waste-bearing portion of the landfill was examined to assess the potential effectiveness of the installation of a new landfill cap as a leachate reduction alternative.

The ground-water flow estimate for the landfill is based on use of Darcy's Law, assuming a homogeneous rectangular aquifer underlying the landfill. Ground-water flow across the landfill was estimated using the following equation:

$$Q = K * b * I * w$$

where

Q = Flow (ft^3/day)
K = Hydraulic conductivity (ft/day)
b = Saturated aquifer thickness (ft)
I = Hydraulic gradient (ft/ft)
w = Width of aquifer (ft).

Hydraulic conductivity was estimated based on slug tests performed on wells PS-1 and PS-2. These wells were screened within the overburden. Based upon the slug tests, the arithmetic average for the value of hydraulic conductivity was determined to be 14.08 ft/day. It was assumed that the results of the slug tests were representative of the entire layer of overburden found within the saturated aquifer. Although the wells are located beyond the perimeter of the landfill, it was assumed that the results of the slug tests were representative of the soil within the limits of the inferred geophysical boundary. The estimated value for saturated aquifer thickness was based on the average value of data from overburden wells PS-1 and PS-2, as well as data from soil borings PSSB-6 and PSSB-7 (Table 5-2). These borings were selected because each is located within the inferred geophysical boundary of the landfill (LAW 1994). The average value for saturated aquifer thickness was calculated as 10.1 ft. The value for hydraulic gradient was determined across the midpoint of the waste-bearing portion of the landfill. The value for the width of the aquifer was assumed to be the approximate distance between the northern and southern ends of the inferred geophysical boundary (555 ft). Using these data, the cross-sectional area of the aquifer can be determined, and the flow through this area can be estimated using Darcy's Law:

$$\begin{aligned} Q &= 14.08 \text{ ft/day} * 10.1 \text{ ft} * 0.102 * 555 \text{ ft} \\ &= 8{,}050 \text{ ft}^3\text{/day} \\ &= 60{,}214 \text{ gal/day.} \end{aligned}$$

The leachate volume contribution attributable to infiltration through the existing cap was estimated using the Hydrologic Evaluation of Landfill Performance (HELP) model. Default climate data for the nearest meteorological station (New York City) was used to predict the amount of precipitation over a 5-year period. The HELP model also estimated components of the overall water budget, such as surface storage (snow), snowmelt, runoff, infiltration, surface evaporation, subsurface evapotranspiration, stored soil moisture, and percolation. The amount of surface area, assumed to be the portion of the landfill within the inferred geophysical boundary, was approximated at 100,000 ft^2.

The value for hydraulic conductivity of the existing cover (from 1 to 3 ft bgs) was based on the hydraulic conductivity test of remolded sample GTS95-PS-01 (Appendix Table C-1). In addition, for the soil present in the existing cover at 1-3 ft bgs, the HELP model provided default values for porosity, field capacity, wilting point, and initial soil water content which correspond with the value provided for hydraulic conductivity. The HELP model also provided default values for hydraulic conductivity, porosity, field capacity, wilting point, and initial soil water content for soil encountered at 0-1 ft bgs. The characteristics of the soil in the 0- to 1-ft bgs interval were based upon visual observations made during the drilling of soil boring PSSB-6. Based upon the input provided to the HELP model for soil types and climate, it was estimated that approximately 32 percent of the annual precipitation volume infiltrated the existing cap. This is equivalent to an annual percolation rate of 119,806 ft^3/ year, or approximately 2,453 gal per day (gpd).

Thus, the relative contribution of precipitation infiltrating the cap to the amount of ground-water flow beneath the existing cap was calculated as:

$$\begin{aligned}\text{Relative contribution} &= \text{Infiltration / (Infiltration + Ground-Water Flow) * 100\%} \\ &= \text{2,453 gpd / (2,453 gpd + 60,214 gpd) * 100\%} \\ &= 3.9\ \%.\end{aligned}$$

Based on this estimate, the relative contribution of precipitation infiltrating the cap is relatively insignificant compared to the overall volume of ground-water flow beneath the site. These data suggest that the installation of a new capping system at the landfill may not have a significant effect on the reduction of leachate volume observed at the seep location. It is assumed that the preponderance of ground-water flow beneath the site (96.1 percent) is attributable to sources other than surface infiltration. The capping system alternative is retained for further assessment.

5.1.2 Vertical Barriers

Vertical ground-water barriers can be used to reduce contaminant mobility by preventing the lateral migration of contaminants from disposal areas or to divert ground water from contacting waste materials. Many of these have been effective and reliable for both solid and hazardous waste applications.

Various technologies and materials can be employed in constructing ground-water barriers, including:

- Slurry walls
  — Soil/bentonite clay
  — Cement/bentonite clay

- Sheet piling.

A vertical barrier wall option would require a thorough hydrogeologic and geotechnical evaluation prior to design. Variables affecting the long-term effectiveness of these technologies include the following:

- Depth to bedrock and/or confining layer
- Hydraulic gradient
- Compatibility with contaminants
- Permeability and uniformity of confining layer.

Vertical barriers can reduce the lateral migration of ground water through unconsolidated (i.e., overburden) deposits but are less effective in consolidated formations (i.e., bedrock) where fractures may exist as transport channels.

Vertical barriers will not be retained for further consideration due to the nature of soil/bedrock conditions at USMA.

5.1.3 Horizontal Barriers

Horizontal ground-water barriers can be broadly categorized as a bottom-sealing technique. The purpose of bottom sealing is to place an impermeable barrier beneath waste disposal areas to prevent vertical movement of contaminants.

Horizontal barriers are easily installed for areas identified for new landfills. At an existing landfill where access to the bottom of the mass is restricted, bottom sealing is accomplished through grout injection. A series of holes are drilled through the waste disposal area and grout is injected at the base of the hole. The grout forms a horizontal barrier underlying the waste. At present, though potentially promising, no detailed analysis as to its effectiveness and cost is available. Therefore, horizontal barriers are eliminated from further discussion.

5.1.4 Surface Water Diversion/Collection

Surface water diversion would be required for each landfill to control the erosional effects of localized stormwater runoff and to prevent surface water runoff from serving as a source of water to the fill mass. By restricting the source water, the amount of leachate generated is reduced, thereby reducing the mobility and volume of the waste leachate. Drainage ditches and culverts can be constructed at locations to intercept surface water runoff or source areas and direct the water away from the landfill area.

The location of each landfill and the presence of ground water moving through each fill mass makes surface water diversion a viable alternative for leachate reduction. The source of ground water within the fill areas appears to arise from two areas, including surface percolation and entry of water from surrounding slopes. By installing interceptor ditches and culverts, or improving those already in place, these sources of water can be controlled. By reducing the volume of source water, a reduction in leachate water volume and migration will result. The water flow within the ditches and culverts can be directed around the upper edge of each landfill. Increases in peak rates and volumes of surface water runoff will occur downstream of each landfill if each is capped and open channels are constructed around the landfill perimeters. Pre-design drainage calculations will have to be performed to evaluate if construction of detention basins is necessary to mitigate impacts on downstream channels.

Surface water diversion will be retained for further consideration.

5.1.5 Leachate Water Collection

Leachate water extraction can be used to prevent migration of leachate water from the fill to offsite areas. It is not intended to be a means of remediating source area contamination. Two approaches to leachate water collection are discussed in this section: leachate water pumping and subsurface drains.

5.1.5.1 Leachate Water Pumping

Leachate water pumping systems can be an effective means of controlling and reducing leachate migration offsite. Pumping techniques involve pumping through a series of strategically placed interceptor wells to capture leachate in the fill mass. The extraction of leachate water induces a flow toward the pumping wells for subsequent removal and treatment.

Implementing a pumping system requires installation of extraction wells, pumping equipment, and a suitable means of treating and/or disposing of the liquid. The effectiveness of the pumping system is related to site hydrology, aquifer yield, and other hydrogeologic factors. A series of long-term pump tests would be necessary to establish aquifer characteristics for pump design and final well placement.

However, leachate water pumping could also result in the extraction of large amounts of ground water. If elevated levels of contaminants such as iron or manganese were present in the ground water, it would require onsite treatment or would need to be sent to a nearby wastewater treatment plant. This would be undesirable since onsite treatment would require additional costs, and the treatment plant might not have the capacity to handle the large amounts of water.

Pumping and treatment of leachate water will not be retained for further consideration.

5.1.5.2 Subsurface Drains

Subsurface drains include any type of buried conduit used to convey and collect aqueous discharges by gravity flow. Subsurface drains essentially function like an infinite line of extraction wells. They create a continuous zone of influence in which ground water within this zone flows toward the drain. They can also perform many of the same functions as wells and can be used to contain or remove a plume, or to lower the ground-water table to prevent contact of water with the waste material.

For shallow contamination problems, drains can be more cost-effective than pumping, particularly in strata with low or variable hydraulic conductivity where it would be difficult to design as well as cost-prohibitive to operate a pumping system to maintain a continuous hydraulic boundary. Subsurface drains may also be preferred over pumping where ground-water removal is required over a period of several years, because the operation and maintenance costs associated with pumping are substantially higher.

Subsurface drains could be effective for control of shallow aquifer ground water at these landfills, and is retained for further consideration.

5.2 SITE-SPECIFIC CONTAINMENT ACTIONS

5.2.1 Post School Landfill

Although the Post School Landfill receives some ground-water and surface flow from the south side of the landfill, the majority of flow is from the west side. To intercept most of this flow and attempt to divert it around the landfill would not be technically feasible. However, several actions could be taken to reduce the amount of infiltration by ground-water and surface water flow, as well as infiltration from precipitation.

First, improving the existing swale along the west side of the landfill would increase its ability to intercept ground-water and surface water flow from upgradient areas and divert it to the existing stream along the north side. The swale would require prepatory clearing and grubbing to remove small trees and shrubs, which are currently acting to restrict flow in the channel of the swale. The dimensions and characteristics of the new swale would depend on the amount of anticipated volume to be diverted away from the landfill. The placement of an impermeable material along the swale, such as a geomembrane, would act as a barrier for inhibiting flow through the edge of the landfill and would provide a means of containing flow within the swale. Rip-rap stone could be employed within the swale to reduce erosion and enhance the aesthetics of the channel.

Second, according to USMA representatives, future plans at the Post School Landfill call for the improvement of the surface of the landfill to include construction of new softball fields. Prior to construction of the new fields, a capping system could be installed to reduce generation of leachate resulting from precipitation. A suitable cap would be multi-layered and would include the following:

- Upper vegetative layer (grass)
- Drainage layer
- Low-permeability layer.

The upper vegetative layer would be supported by loam or select fill and underlain by the drainage layer, which would be composed of sand or a geosynthetic drainage net. This would be underlain by the low-permeability layer which would consist of a geomembrane or layer of clay. The layers would be graded so that any flow would be directed to swales along the perimeter of the landfill. An additional layer of select fill would be placed below the low-permeability layer to provide structural backfill to support the cap. Prior to capping, the fill would require grading and compacting in order to enhance the stability of the cap and reduce settlement.

Since methane gas is currently being generated in relatively small amounts by the landfill, the cap would need to be designed to allow for the escape of gas. A geonet or layer of sand could be used as the venting layer, which would be placed directly underneath the low-permeability layer, with vent pipes to allow methane to escape to the surface.

A collection line would be placed along the south and east side of the landfill to intercept ground water/leachate and convey it to the existing sanitary sewer system. The collection line would consist of a perforated PVC pipe, placed in a trench beneath the cap, and partially backfilled with stone. In addition, geomembrane and geotextile would be placed along the side slopes of the trench; the geotextile would act as a filter medium to prevent clogging of the stone by fines, and the geomembrane would act to intercept ground-water flow and contain it within the trench.

5.2.1.1 Alternative No. 1 (PS-ALT S1): Capping (Geocomposite) with Surface Water and Gas Vent Controls

This alternative assumes that there will be no future use of the landfill surface area, although this alternative would be more acceptable than Alternative No. 2 for any future use since the final elevation of the surface will be lower. The major components are as follows (Figures 5-1 and 5-2):

- Install security fencing around the perimeter of the landfill to restrict access.

- Remove the top 6 in. of topsoil to lower the final surface elevation of the completed cap.

- Install a cap consisting of select backfill, geonet layers, a layer of geomembrane, select fill, and topsoil. Approximate thickness of the cap will be 3 ft.

- Install vent pipes to allow for the release of generated methane from below the geomembrane layer.
- Improve the existing swale along the west side of the landfill to intercept surface and ground-water flow and to collect runoff from the surface of the proposed cap.
- Install a swale along the east side of the landfill to collect runoff from the surface of the proposed cap.
- Install a leachate collection trench/line below the cap to intercept leachate flow and convey it to the existing sanitary sewer system.

The intent of this alternative is to reduce the amount of leachate being generated by percolation of precipitation through the waste-bearing layers. The proposed cap is to cover the inferred geophysical area of the landfill only, since an existing gas line crosses the southeast portion of the landfill and this type of cap would not allow easy access to the line for maintenance reasons. Monitoring of the ground water, surface water, and leachate would continue to evaluate if offsite impacts exist relative to ground-water and surface water quality.

5.2.1.2 Alternative No. 2 (PS-ALT S2): Capping (Clay) with Surface Water and Gas Vent Controls

This alternative is similar to Alternative No. 1, but involves capping using clay as a barrier layer. The major components are as follows (Figures 5-3 and 5-4):

- Install security fencing around the perimeter of the landfill to restrict access.
- Remove the top 6 in. of topsoil to lower the final surface elevation of the completed cap.
- Install a cap consisting of sand, clay, select backfill, and topsoil. Approximate thickness of the cap will be 5-6 ft.
- Install vent pipes to allow for the release of generated methane from below the surface.
- Improve the existing swale along the west side of the landfill to intercept surface and ground-water flow and to collect runoff from the surface of the proposed cap.
- Install a swale along the east side of the landfill to collect runoff from the surface of the proposed cap.

- Install a leachate collection trench/line below the cap to intercept leachate flow and convey it to the existing sanitary sewer system.

The intent of this alternative is to reduce the amount of leachate being generated by percolation of precipitation through the waste-bearing layers. The proposed cap would cover the entire visual boundary of the landfill. This type of cap would also allow easier access to the existing gas line for maintenance reasons. Monitoring of the ground water, surface water, and leachate would continue to evaluate if offsite impacts exist relative to ground-water and surface water quality.

5.2.2 Parking Lot F Landfill

The majority of ground-water and surface flow is from the west side of the Parking Lot F Landfill. To intercept most of this flow and attempt to divert it around the landfill would not be technically feasible. However, several actions could be taken to reduce the amount of infiltration by ground-water and surface water flow, as well as infiltration from precipitation.

According to USMA representatives, future plans at Parking Lot F call for the repaving of the entire surface of the landfill. This would be similar to a capping system and would reduce the amount of leachate generated by the percolation of precipitation. In addition, the existing swale along the west side of the landfill would be improved and paved to increase its ability to collect surface and ground-water flow from upgradient areas, as well as increased runoff amounts from the surface of the landfill due to repaving.

Repaving of Parking Lot F would be most effective for reducing the generation of leachate if it was performed in conjunction with repaving of Parking Lot E, which is located upgradient of Parking Lot F.

An alternative to this would be the installation of a capping system to reduce generation of leachate resulting from precipitation. A suitable cap would be multi-layered and would include the following:

- Upper vegetative layer (grass)
- Drainage layer
- Low-permeability layer.

The upper vegetative layer would be supported by loam or select fill and underlain by the drainage layer, which would be composed of sand. This would be underlain by the low-permeability layer which would consist of a layer of clay. The layers would be graded so that any flow would be directed to swales along the perimeter of the landfill. An additional layer of select fill would be placed below the low-permeability layer to provide structural backfill to support the cap. Prior to capping, the fill would require grading and compacting in order to enhance the stability of the cap and reduce settlement.

Improving the existing swale along the west side of the landfill would increase its ability to intercept ground-water and surface water flow from upgradient areas and divert it to the existing stream along the north side. The swale would require prepatory clearing and grubbing to remove small trees and shrubs, which are currently acting to restrict flow in the channel of the swale. The dimensions and characteristics of the new swale would depend on the amount of anticipated volume to be diverted away from the landfill. The placement of an impermeable material along the swale, such as a geomembrane, would act as a barrier for inhibiting flow through the edge of the landfill and would provide a means of containing flow within the swale. Rip-rap stone could be employed within the swale to reduce erosion and enhance the aesthetics of the channel.

5.2.2.1 Alternative No. 1 (LF-ALT S1): Repave Surface of Lot

The major components are as follows:

- Repave surface of lot with asphalt.
- Improve swale along west side of landfill and pave swale with asphalt.

5.2.2.2 Alternative No. 2 (LF-ALT S2): Capping (Clay) with Surface Water Controls

This alternative involves capping using clay as a barrier layer. The major components are as follows (Figures 5-5 and 5-6):

- Install security fencing around the perimeter of the landfill to restrict access.
- Remove the top 6 in. of the existing surface to lower the final surface elevation of the completed cap.
- Install a cap consisting of sand, clay, select backfill, and topsoil. Approximate thickness of the cap will be 5-6 ft.
- Improve the existing swale along the west side of the landfill to intercept surface and ground-water flow and to collect runoff from the surface of the proposed cap.
- Install a swale along the east side of the landfill to collect runoff from the surface of the proposed cap.

The intent of this alternative is to reduce the amount of leachate being generated by percolation of precipitation through the waste-bearing layers. Monitoring of the ground water, surface water, and leachate would continue to evaluate if offsite impacts exist relative to ground-water and surface water quality.

5.2.3 Organic Compost Landfill

5.2.3.1 Alternative No. 1 (OC-ALT S1): Repave Surface of Lot

According to USMA representatives, the Organic Compost Landfill will continue to be used as a storage and parking area. This alternative would be similar to a capping system and would reduce the amount of leachate generated by the percolation of precipitation. The current surface consists of a tar and chip-type paving. Repaving would consist of installing a 6-in. thick layer of asphalt to cover the existing surface of the landfill.

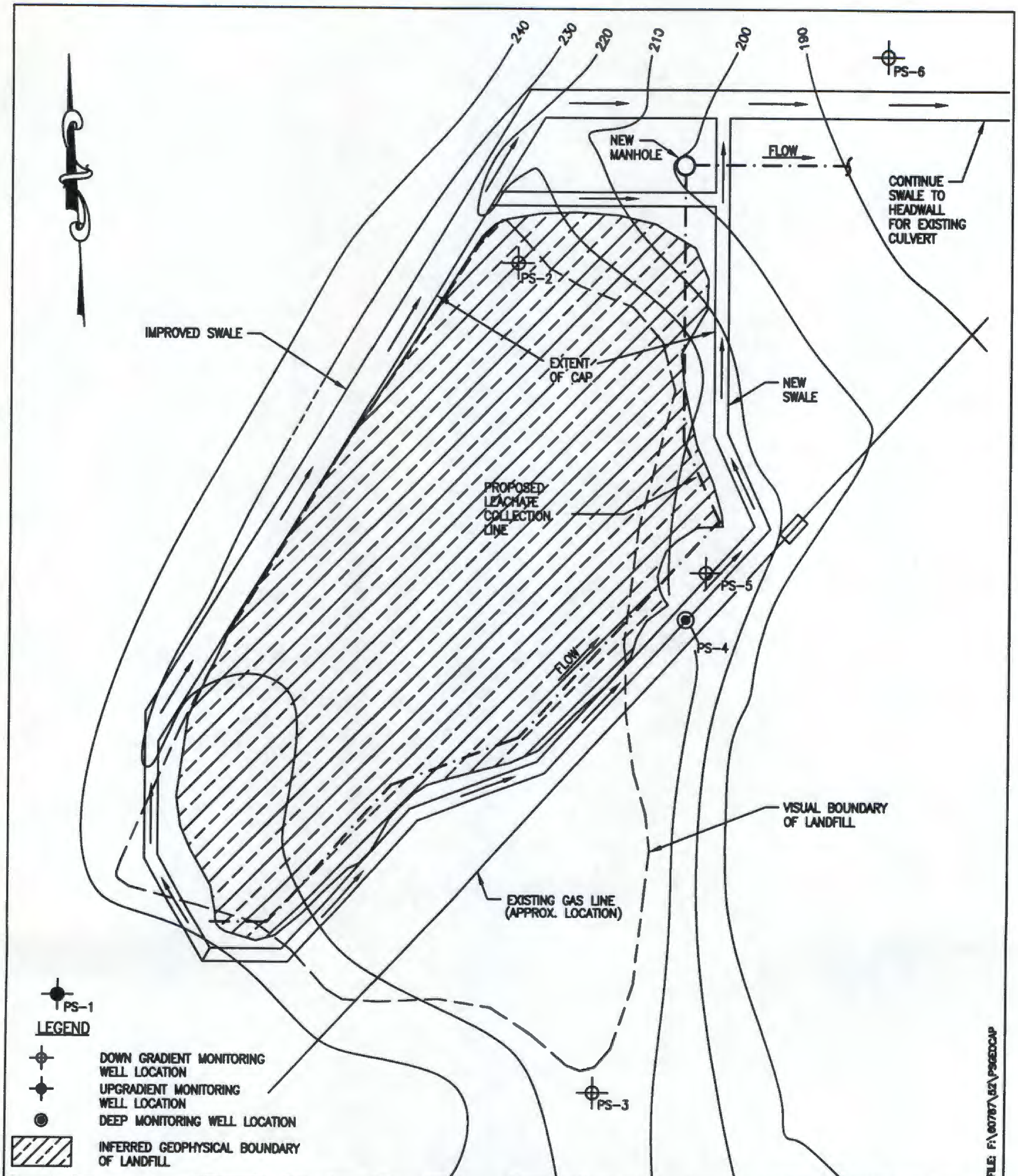
5.2.4 Ski Lot Landfill

5.2.4.1 Alternative No. 1 (SL-ALT S1): Repave Surface of Lot

According to USMA representatives, the Ski Lot will continue to be used as a parking area. This alternative would be similar to a capping system and would reduce the amount of leachate generated by the percolation of precipitation. The current surface consists of a tar and chip type paving. Repaving would consist of installing a 6-in. thick layer of asphalt to cover the existing surface of the landfill.

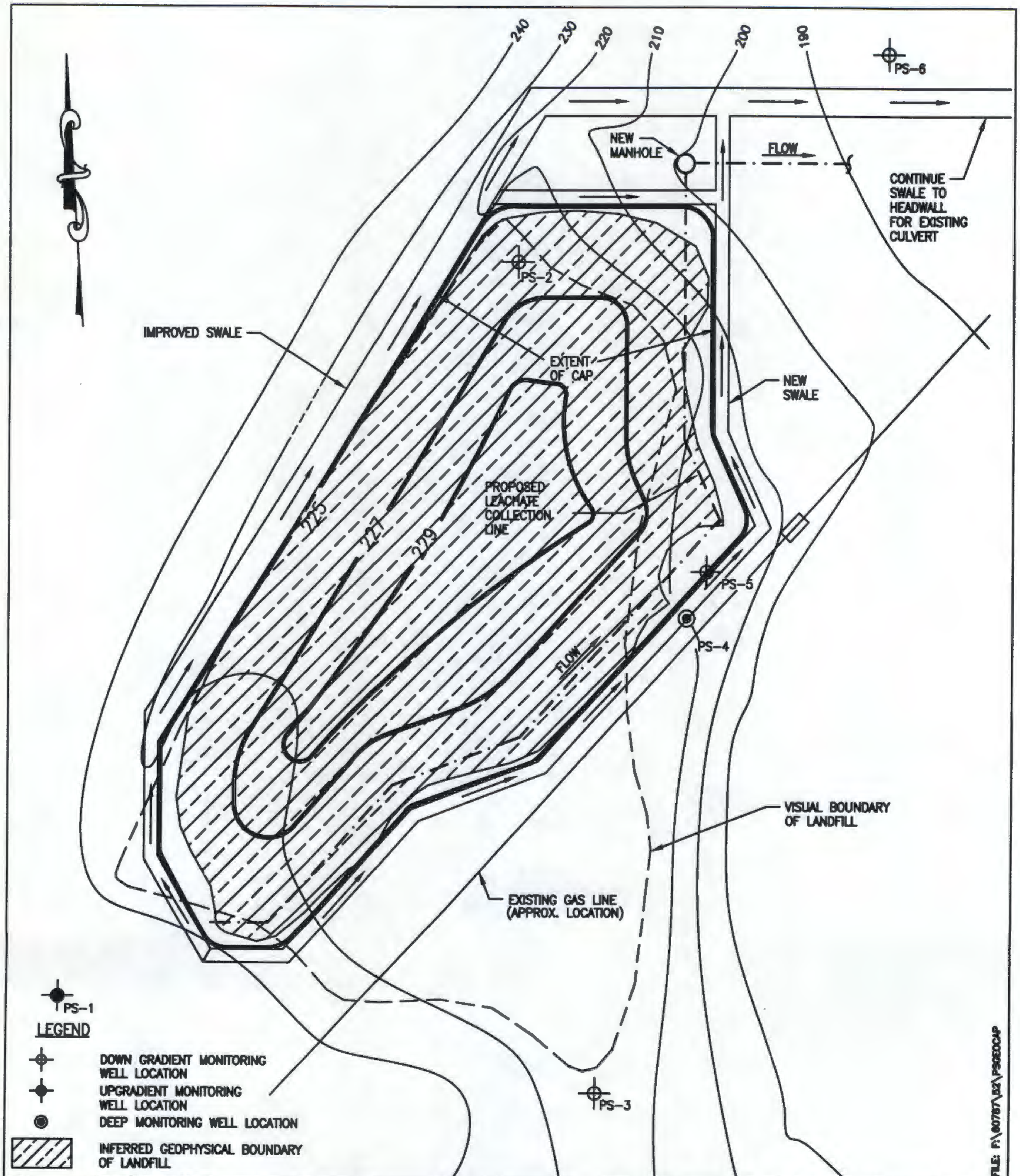
5.2.5 Motor Pool Landfill

The alternatives for the reduction of leachate at the Motor Pool are addressed in Section 6.3.2 under alternatives for managing methane generation.



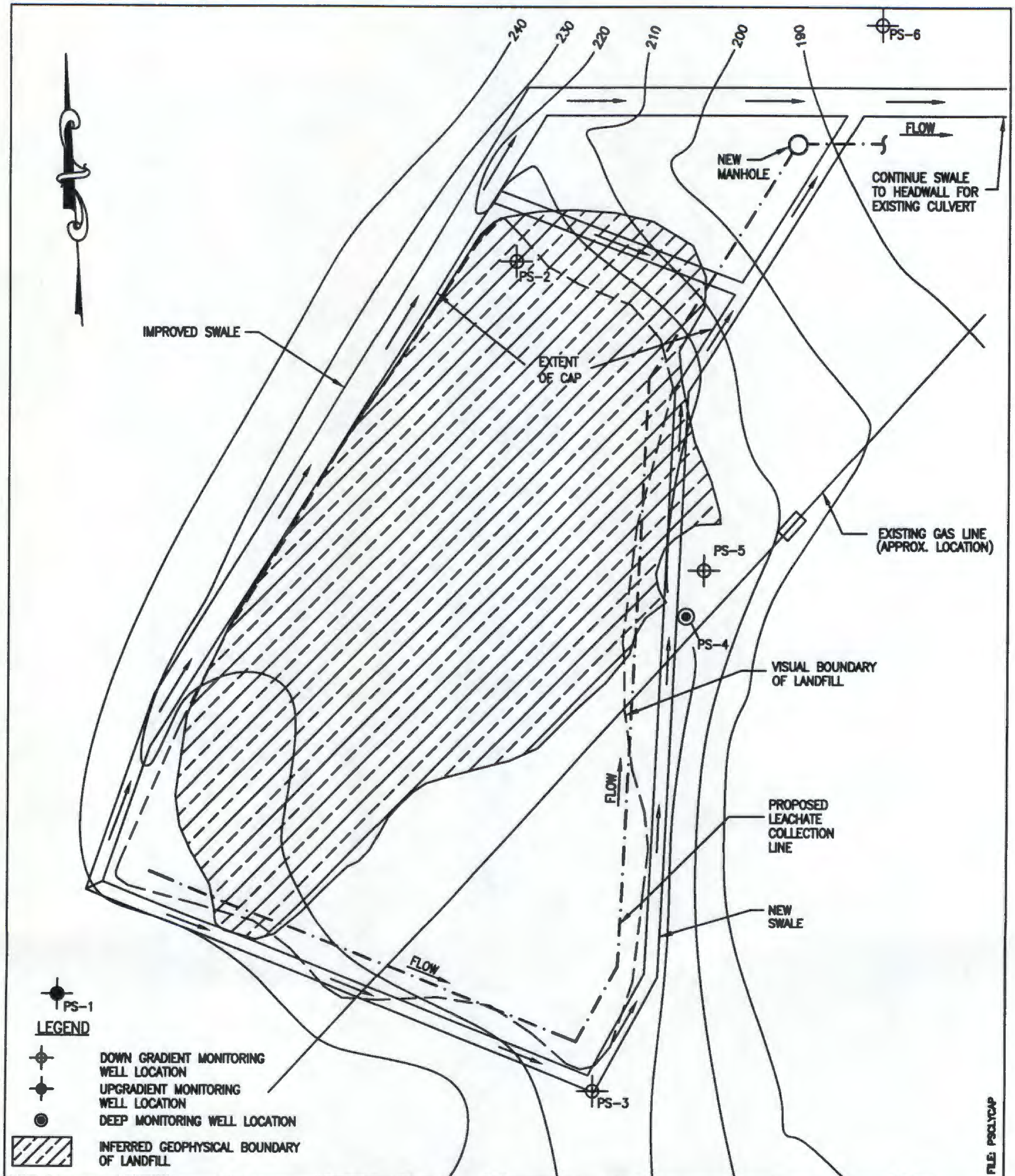
EA ENGINEERING, SCIENCE, AND TECHNOLOGY	SIX LANDFILLS U.S. MILITARY ACADEMY WEST POINT, NEW YORK	FIGURE 5-1 POST SCHOOL LANDFILL SITE DRAINAGE PLAN SCENARIO ONE

PROJECT MGR	DESIGNED BY	DRAWN BY	CHECKED BY	SCALE	DATE	PROJECT NO	FIGURE NO.
JHS	JCH	CC	SMD	N.T.S.	9-13-95	60787.52	-



EA ENGINEERING, SCIENCE, AND TECHNOLOGY	SIX LANDFILLS U.S. MILITARY ACADEMY WEST POINT, NEW YORK	FIGURE 5-2 POST SCHOOL LANDFILL CONTOUR MAP SCENARIO ONE

PROJECT MGR	DESIGNED BY	DRAWN BY	CHECKED BY	SCALE	DATE	PROJECT NO	FIGURE NO.
JHS	JCH	CC	SMD	N.T.S.	9-13-95	60787.52	-



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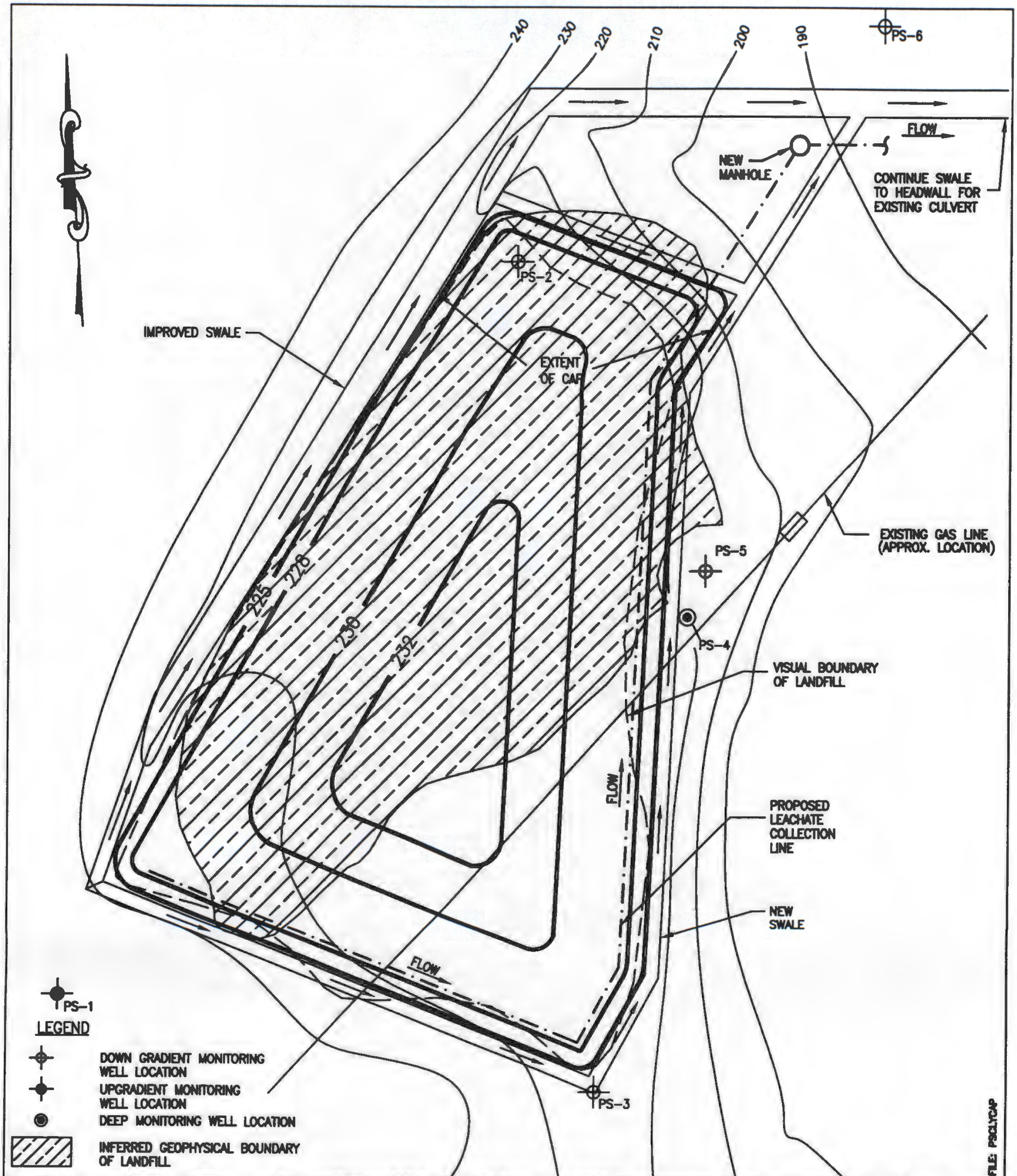
WEST POINT, NEW YORK

FIGURE 5-3
POST SCHOOL LANDFILL
SITE DRAINAGE MAP
SCENARIO TWO

PROJECT MGR	DESIGNED BY	DRAWN BY	CHECKED BY	SCALE	DATE	PROJECT NO	FIGURE NO.
JHS	JCH	CC	SMD	N.T.S.	9-13-95	60787.52	-



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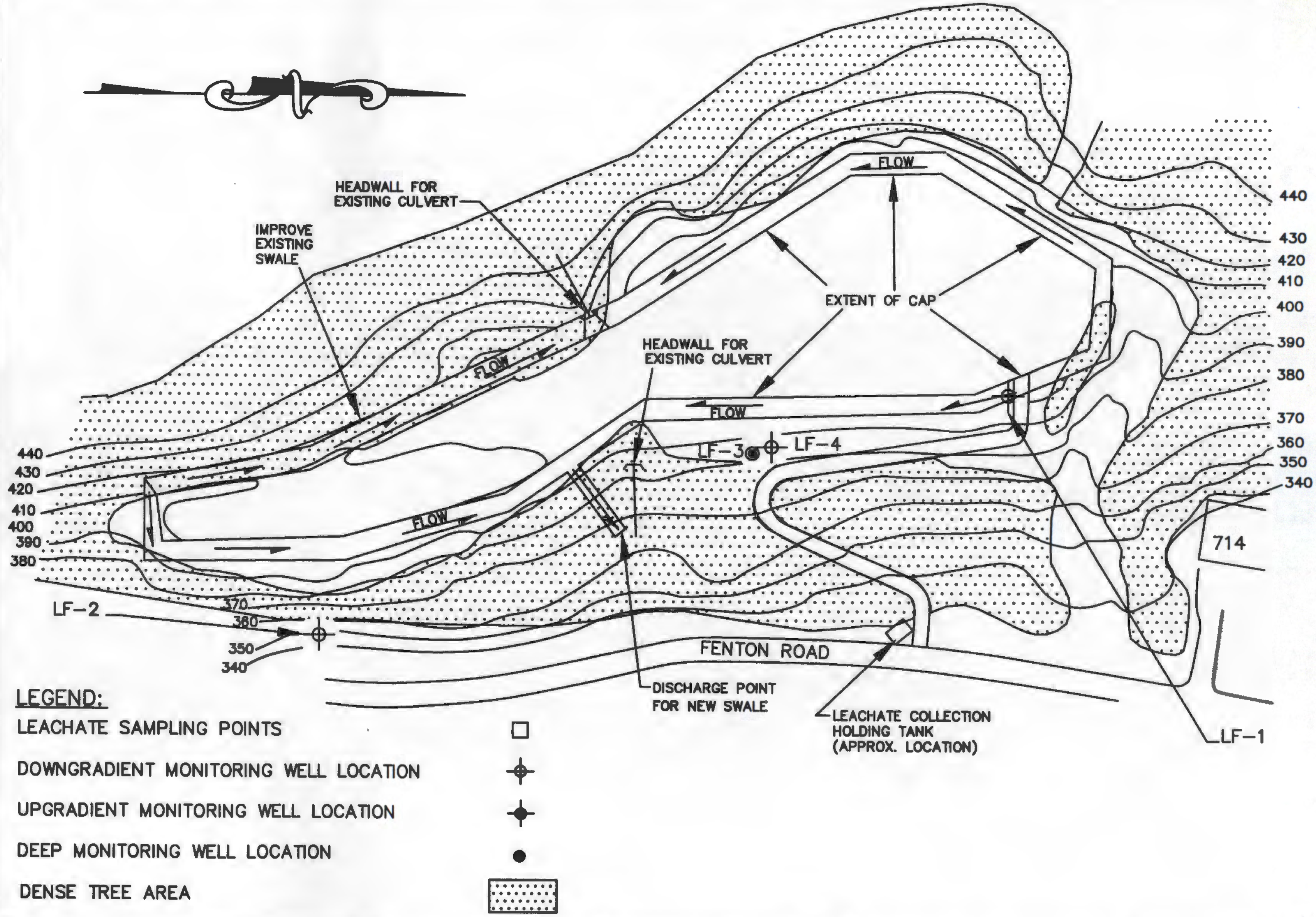
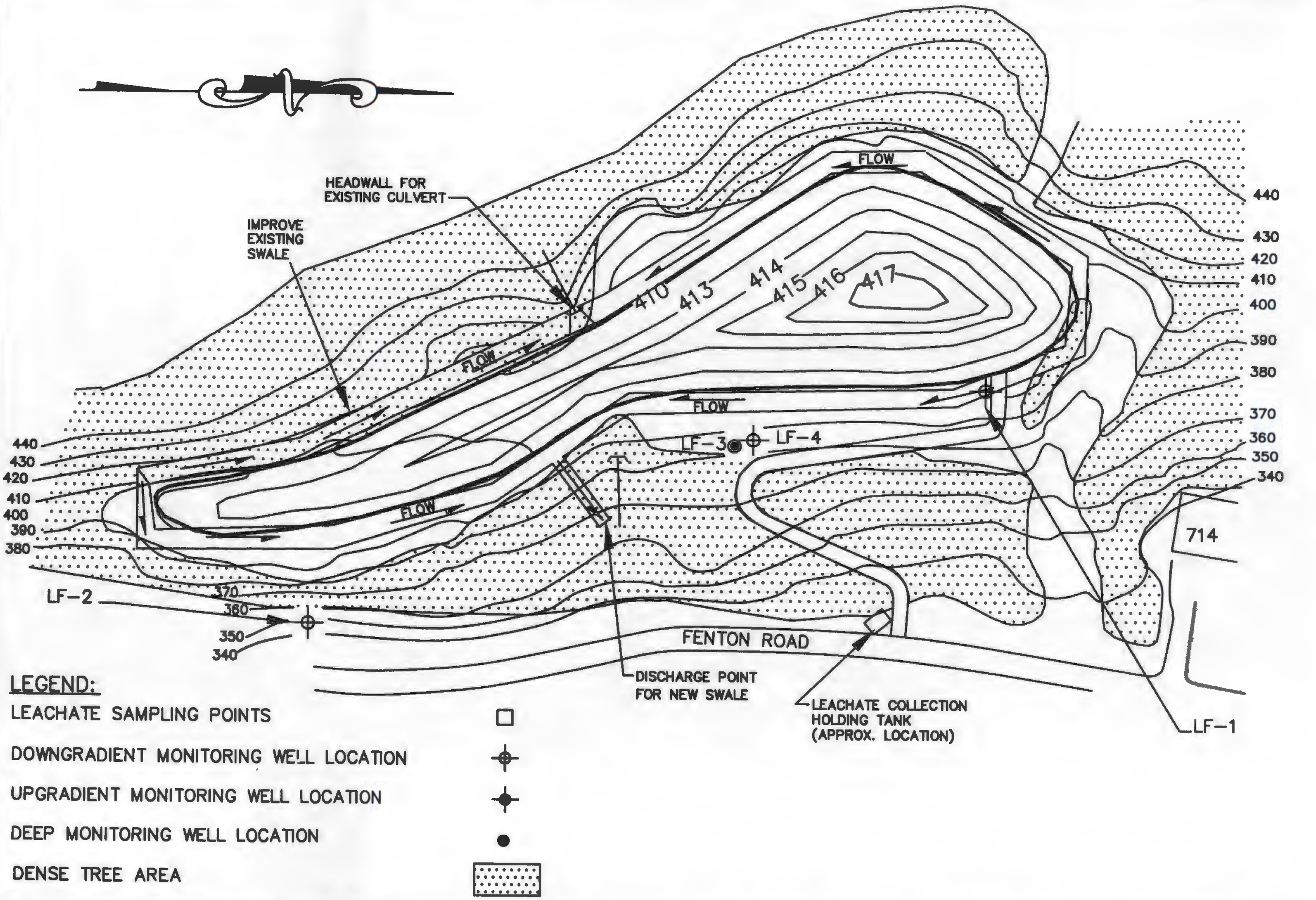
SIX LANDFILLS
U.S. MILITARY ACADEMY
WEST POINT, NEW YORK

FIGURE 5-4
POST SCHOOL LANDFILL
CONOUR MAP
SCENARIO TWO

PROJECT MGR	DESIGNED BY	DRAWN BY	CHECKED BY	SCALE	DATE	PROJECT NO	FIGURE NO.
JHS	JCH	CC	SMD	N.T.S.	9-13-95	60787.52	-



EA ENGINEERING, SCIENCE, AND TECHNOLOGY	SIX LANDFILLS U.S. MILITARY ACADEMY WEST POINT, NEW YORK	FIGURE 5-5 PARKING LOT F LANDFILL SITE DRAINAGE PLAN FOR PROPOSED CAP	DESIGNED BY JCH	DRAWN BY JFW	DATE OCT. 5, 1995	PROJECT NO. 60787.52
			CHECKED BY SMD	PROJECT MGR. JHS	SCALE N.T.S.	FILE NO. LFCAPCON



EA ENGINEERING, SCIENCE, AND TECHNOLOGY	SIX LANDFILLS U.S. MILITARY ACADEMY WEST POINT, NEW YORK	FIGURE 5-6 PARKING LOT F LANDFILL CONTOUR MAP FOR PROPOSED CAP	DESIGNED BY JCH	DRAWN BY JFW	DATE OCT. 5, 1995	PROJECT NO. 60787.52
			CHECKED BY SMD	PROJECT MGR. JHS	SCALE N.T.S.	FILE NO. FIG56

TABLE 5-1 SUMMARY OF CONTAINMENT METHODS AND CONSIDERATIONS
SIX LANDFILLS, U.S. MILITARY ACADEMY, WEST POINT, NEW YORK

Remedial Technology	Landfill Site				
	Post School	Parking Lot F	Organic Compost	Ski Lot	Motor Pool
1. Multi-media cap	**Retained: Would provide minimization of surface infiltration while allowing for methane collection**	Not Retained: Incompatible with future use, which calls for continued use as parking area	Not Retained: Incompatible with future use, which calls for continued use as parking area	Not Retained: Incompatible with future use, which calls for continued use as parking area	Not Retained: Incompatible with future use, which calls for continued use as parking area
2. Clay cap	**Retained: Would provide minimization of surface infiltration while allowing for methane collection**	Not Retained: Incompatible with future use, which calls for continued use as parking area	Not Retained: Incompatible with future use, which calls for continued use as parking area	Not Retained: Incompatible with future use, which calls for continued use as parking area	Not Retained: Incompatible with future use, which calls for continued use as parking area
3. Asphalt/concrete cap	Not Retained: Incompatible with future use, which calls for construction of new softball fields	**Retained: Would provide minimization of surface infiltration**	**Retained: Would provide minimization of surface infiltration**	**Retained: Would provide minimization of surface infiltration**	**Retained: Would provide minimization of surface infiltration. May also enhance operation of proposed SVE systems**
4. Vertical barriers	Not Retained: Technically non-feasible due to shallow bedrock	Not Retained: Technically non-feasible due to shallow bedrock	Not Retained: Technically non-feasible due to shallow bedrock	Not Retained: Technically non-feasible due to shallow bedrock	Not Retained: Technically non-feasible due to shallow bedrock
5. Horizontal barriers	Not Retained: Feasibility has not been analytically supported or established in the continental United States at present time	Not Retained: Feasibility has not been analytically supported or established in the continental United States at present time	Not Retained: Feasibility has not been analytically supported or established in the continental United States at present time	Not Retained: Feasibility has not been analytically supported or established in the continental United States at present time	Not Retained: Feasibility has not been analytically supported or established in the continental United States at present time

NOTE: Shaded areas indicate retained remedial technologies.

Remedial Technology	Landfill Site				
	Post School	Parking Lot F	Organic Compost	Ski Lot	Motor Pool
6. Surface water diversion	**Retained: May reduce generation and migration of leachate**	**Retained: May reduce generation and migration of leachate**	**Retained: May reduce generation and migration of leachate**	**Retained: May reduce generation and migration of leachate**	**Retained: May reduce generation and migration of leachate**
7. Leachate pumping	Not Retained: May induce ground-water infiltration as well as leachate. This would result in large amounts of water requiring disposal or treatment which would significantly increase the cost required to implement	Not Retained: May induce ground-water infiltration as well as leachate. This would result in large amounts of water requiring disposal or treatment which would significantly increase the cost required to implement	Not Retained: May induce ground-water infiltration as well as leachate. This would result in large amounts of water requiring disposal or treatment which would significantly increase the cost required to implement	Not Retained: May induce ground-water infiltration as well as leachate. This would result in large amounts of water requiring disposal or treatment which would significantly increase the cost required to implement	Not Retained: May induce ground-water infiltration as well as leachate. This would result in large amounts of water requiring disposal or treatment which would significantly increase the cost required to implement
8. Subsurface drains	**Retained: May be effective if combined with capping system**	Not Retained: Would not be combined with a capping system	Not Retained: Would not be combined with a capping system	Not Retained: Would not be combined with a capping system	Not Retained: Would not be combined with a capping system

TABLE 5-2 SOIL BORING/MONITORING WELL LOCATIONS USED TO APPROXIMATE AQUIFER THICKNESS AT POST SCHOOL LANDFILL, SIX LANDFILLS, U.S. MILITARY ACADEMY, WEST POINT, NEW YORK

Soil Boring/ Monitoring Well Location	Date	Depth to Bedrock (ft bgs)[a]	Depth to Ground Water (ft bgs)	Assumed Saturated Aquifer Thickness (ft)
PS-1	11 May 1995	Unknown (assume as 18.0)	9.07	8.93
PS-2	11 May 1995	Unknown (assume as 18.0)	10.26	7.74
PSSB-6	3 May 1995	15.0	4.00	11.00
PSSB-7	3 May 1995	18.9	6.00	12.90

(a) Drilling logs indicate that refusal was not encountered during installation of wells PS-1 and PS-2 (LAW 1994). Overburden thickness at PS-1 was recorded as "greater than 16 ft," while overburden thickness at PS-2 was recorded as "greater than 17 ft." Refusal was encountered at well PS-3 at a depth of 18 ft bgs. Therefore, the depth to bedrock at PS-1 and PS-2 was assumed to be 18 ft bgs.

NOTE: bgs = Below ground surface.

6. METHANE GENERATION AND PROPOSED ACTIONS

Methane and soil vapor surveys were performed at the Post School, Ski Lot, and Motor Pool landfills. The procedures outlined in Section 2.3.5 of the Field Sampling and Analysis Plan (EA 1995d) were followed.

6.1 POST SCHOOL LANDFILL

The methane and soil vapor survey was conducted on 14-17 June 1995 at this landfill. A 50-ft × 50-ft grid was established along the eastern and southeastern perimeter of the landfill, with a 100-ft × 100-ft grid established at the remainder of the site. A total of 35 soil vapor samples (plus 4 duplicates) were planned for this landfill.

6.1.1 Survey Results

Methane was reported in 21 of the 33 samples collected, with mean and maximum concentrations of 9.3 and 54.4 percent, respectively. Seven of the results exceeded the lower explosive limit for methane (15 percent), and 6 of the results exceeded the upper explosive limit (25 percent) for methane. The highest methane concentration was reported on the northeast corner of the landfill, with elevated methane concentrations also observed on the southwest corner of the landfill. The output from the kriged results, which yields statistically weighted concentrations, showed concentration isopleths increasing towards the southwest corner, decreasing near the center of the landfill, and increasing towards the northeast corner (Figure 6-1). A discussion of "kriging" is presented in Appendix H of the Phase II Investigation Report (EA 1995a).

The southeast corner of the landfill was generally free of detectable methane, and there was no methane reported in the samples collected off the landfill footprint and adjacent to the Barnard Loop Service Road. The New York Landfill regulations (6 NYCRR Part 360, Section 2.17[f]) requires that landfill gases be below the lower explosive limit along the perimeter. Therefore, although exceedances of the lower explosive limit were reported in 7 of 33 samples, and since none of these were along the landfill perimeter, the Post School Landfill is in compliance with this regulatory requirement.

Soil vapor samples collected onsite were also analyzed for chlorinated and non-chlorinated VOC using a field gas chromatograph. These compounds were reported in at least 1 of the samples. Elevated concentrations for all of these analytes were observed on the eastern side of the landfill. However, samples collected adjacent to this area but off the landfill footprint were free of detectable chlorinated and non-chlorinated VOC. All of the concentrations were below the lower explosive limit for these compounds.

6.1.2 Proposed Actions

At this time, no actions are proposed for handling methane generation at the Post School Landfill since it is in compliance with 6 NYCRR Part 360, Section 2.17(f). However, if a capping system is to be installed for purposes of leachate source reduction, the inclusion of a gas venting layer within the cap may be warranted to prevent the buildup of methane below the cap and to allow the gas to vent to the atmosphere.

6.2 SKI LOT LANDFILL

The methane and soil vapor survey was conducted on 17-18 June 1995 at this landfill. A 50-ft × 50-ft grid was established along perimeter of the golf course and around Building 1227, with a 100-ft x 100-ft grid established at the remainder of the site. A total of 26 soil vapor samples (plus 3 duplicates) were planned for this landfill.

6.2.1 Survey Results

Methane was reported in 25 of the 26 samples collected, with mean and maximum concentrations of 7.9 and 49.0 percent, respectively. Five of the results exceeded the lower explosive limit for methane (15 percent), and 4 of the results exceeded the upper explosive limit (25 percent) for methane. The highest methane concentration was reported on the southeast side of the landfill. Samples collected along the edge of the golf course or near Building 1227 showed methane at low concentrations (less than 0.5 percent). The output from the kriged results, which yields statistically weighted concentrations, showed concentration isopleths increasing from the southeastern corner of the landfill towards the center of the landfill (Figure 6-2). A discussion of "kriging" is presented in Appendix H of the Phase II Investigation Report (EA 1995a).

Soil vapor samples collected onsite were also analyzed for chlorinated and non-chlorinated VOC using a field gas chromatograph. Benzene, toluene, m/p-xylene, o-xylene, trichloroethene, and tetrachloroethene were detected in these samples. All of these VOC were noted in conjunction with the elevated methane concentrations observed on the east-southeast side of the landfill.

6.2.2 Proposed Actions

At this time, no actions are proposed for handling methane generation at the Ski Lot Landfill since it is in compliance with 6 NYCRR Part 360, Section 2.17(f).

6.3 MOTOR POOL LANDFILL

The methane and soil vapor survey was conducted on 19-22 June 1995 at this landfill. A 50-ft × 50-ft grid was established along the northern and northwest perimeter of the landfill, with a 100-ft ×100-ft grid established at the remainder of the site. A total of 49 soil vapor samples (plus

4 duplicates) were planned for this landfill. During the field effort, 31 samples were actually collected. The remaining samples could not be collected due to tightly-packed soil encountered at some locations.

6.3.1 Survey Results

Methane was reported in 26 of the 31 samples collected, with mean and maximum concentrations of 33.4 percent and 85.6 percent, respectively. Nineteen of the results exceeded the lower explosive limit (15 percent) and 17 of the results exceeded the upper explosive limit (25 percent) for methane. The highest methane concentrations were reported on the northeastern perimeter of the landfill. The output from the kriged results, which yields statistically weighted concentrations, showed concentration isopleths increasing from the approximate center of the landfill towards the northeast corner of the landfill (Figure 6-3). A discussion of "kriging" is presented in Appendix H of the Phase II Investigation Report (EA 1995a).

Soil vapor samples collected onsite were also analyzed for chlorinated and non-chlorinated VOC using a field gas chromatograph. All of the concentrations were below the lower explosive limit for these compounds.

6.3.2 Proposed Actions

The following actions are proposed for the handling of methane generation at the Motor Pool Landfill. These actions are being proposed in response to the results obtained from the methane and soil vapor survey conducted at this landfill in June 1995. It should be noted that prior to any recommendation of one of these alternatives, additional surveying should be performed to further assess the presence of methane and soil vapor at the landfill.

6.3.2.1 Alternative No. 1 (MP-ALT S3): Active Treatment System (Soil Vapor Extraction)

The major components are as follows (Figure 6-4):

- Install collection pipes in trenches within the limits of the landfill. Each collection trench is assumed to have a radius of influence of approximately 50 ft.

- Install one steel manhole per collection trench to allow access for maintenance and repairs (i.e., vacuum gauge reading, silt/water removal).

- Install an autodialer to allow for alarm notification and remote troubleshooting of the system.

- Install carbon vessels to remove any VOC or SVOC from the condensate that is to be discharged to the sanitary sewer system.

- Provide a building to enclose the condensate tank, blower, and electrical panels associated with the collection system.

- Provide explosion-proof equipment to reduce the hazards associated with the buildup of methane gas inside the building.

- Install passive venting wells along the north side of the landfill to permit air flow through the northern slope and to enhance the effectiveness of the northern soil vapor extraction trenches.

The intent of the system is to actively remove methane gas and soil vapor from the landfill using collection trenches that are connected to a blower system. The system would require periodic inspection and maintenance to ensure proper operation.

6.3.2.2 Alternative No. 2 (MP-ALT S4): Passive Venting System

The major components are as follows (Figure 6-5):

- Install passive venting wells within the landfill at locations where the highest levels of methane and/or soil vapor concentrations were observed.

- Periodically inspect and maintain each well to ensure proper operation.

The intent of the system is to allow methane gas and soil vapor to vent to the atmosphere, without the assistance of a blower system. Each venting well would be installed to a depth which would be 1 ft above the maximum ground-water elevation for each location. This represents a simpler, less expensive alternative to the active treatment system discussed in Section 6.3.2.1.

6.3.3 Cost Estimates and Assumptions

6.3.3.1 Alternative No. 1 (MP-ALT S3): Active Treatment System

The cost estimate for the proposed active treatment system at the Motor Pool Landfill is shown in Appendix D, Table D-3. The following assumptions were made for purposes of developing the cost estimate.

Collection Pipes (MP-ALT S3; Items A.4 through A.22)—It is assumed that the collection trenches will require these items for proper installation and operation of the system. It is also assumed that the radius of influence for each collection trench will be approximately 50 ft.

Steel Manholes (MP-ALT S3; Item A.25)—It is assumed that the collection system will require 18 stainless steel manholes to enable access to the well points for maintenance and inspection.

Autodialer (MP-ALT S3; Item A.26)—It is assumed that the collection system will require an autodialer to allow for remote troubleshooting of the system. The autodialer may be programmed to recognize problems with the operation of the system, and automatically contacts personnel in charge of maintaining the system.

Carbon Vessels (MP-ALT S3; Item A.27)—It is assumed that the system will require 2 carbon vessels to remove any VOC or SVOC from the condensate that is to be discharged to the sewer system.

Condensate Appurtenances (MP-ALT S3; Item A.28)—It is assumed that the system will require appurtenances such as sampling ports, flow gauges, etc. for the collection and discharge of condensate.

Explosion-Proof (XP) Features (MP-ALT S3; Items A.29 and A.30)—It is assumed that the building used to enclose the condensate tank, blower, and electrical panels will require explosion-proof equipment (i.e., Class I, Division I, Group D) to reduce the hazards associated with the possible buildup of methane gas inside of the structure.

Trenches (MP-ALT S3; Items A.31 and A.32)—It is assumed that the dimensions of the soil vapor extraction trenches will be approximately 4 ft deep and 3 ft wide.

Install Passive Venting Well (MP-ALT S3; Item A.33)—It is assumed that the system will require passive venting points along the north side of the landfill to permit air flow through the northern slope and to enhance the effectiveness of the northern soil vapor extraction trenches.

Quarterly Maintenance/Repairs (MP-ALT S3; Item B.2)—It is assumed that the system will require a 4-hour monthly inspection and maintenance to ensure proper operation.

6.3.3.2 Alternative No. 2 (MP-ALT S4): Passive Treatment System

The cost estimate for the proposed passive venting system at the Motor Pool Landfill is shown in Table D-4. The following assumptions were made for purposes of developing the cost estimate.

Passive Venting Points (MP-ALT S4; Item A.1)—Each venting point will require a steel manhole to allow access, and the associated pipes and fittings will be constructed of PVC. The venting point will require sand and pea stone as backfill to enhance air movement through the area immediately next to the riser pipe. Cement grout will be required to provide stability and to seal off the venting point at the surface.

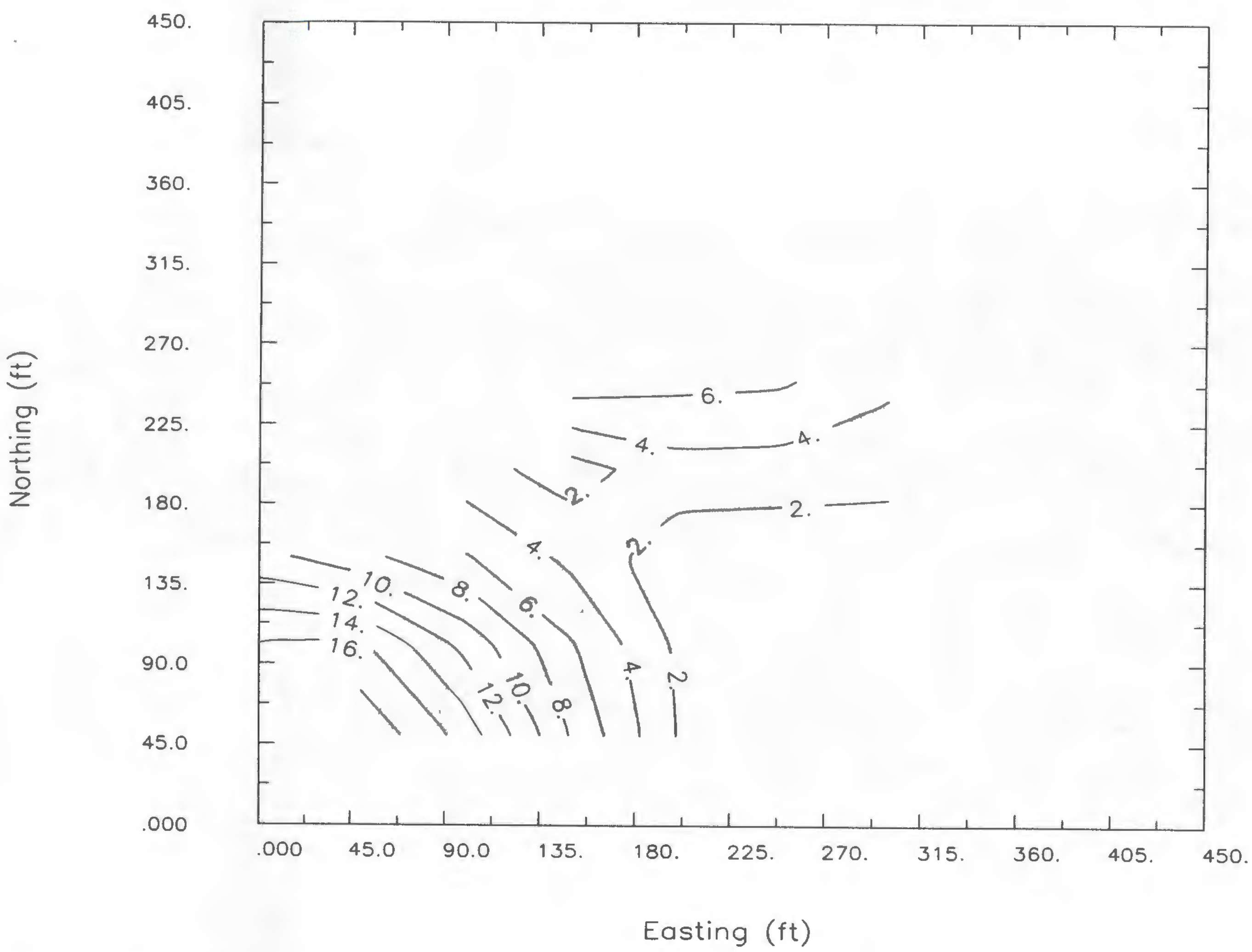


Figure 6-1. Methane concentration isopleths for the Post School Landfill.

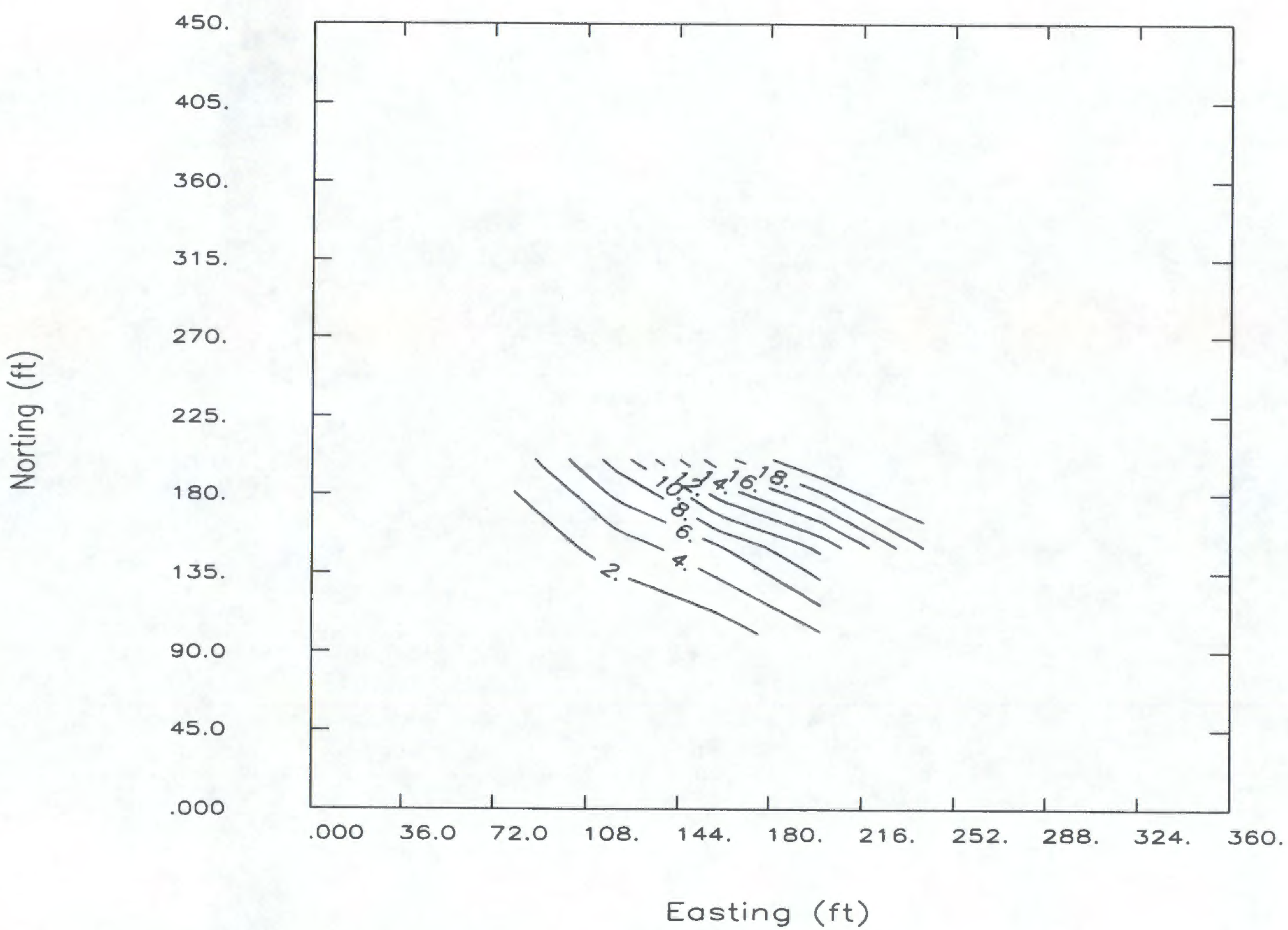


Figure 6-2. Methane concentration isopleths for the Ski Lot Landfill.

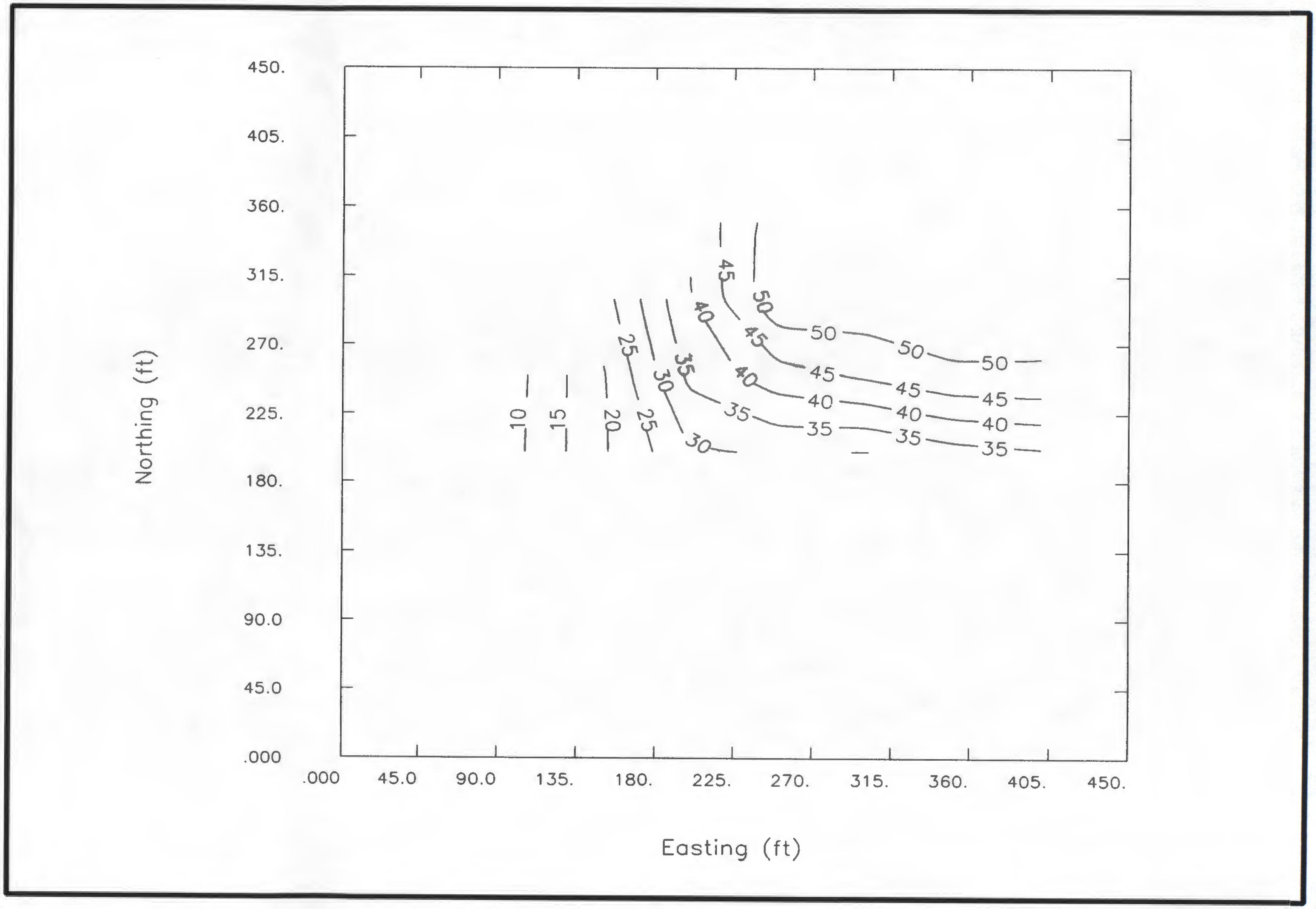
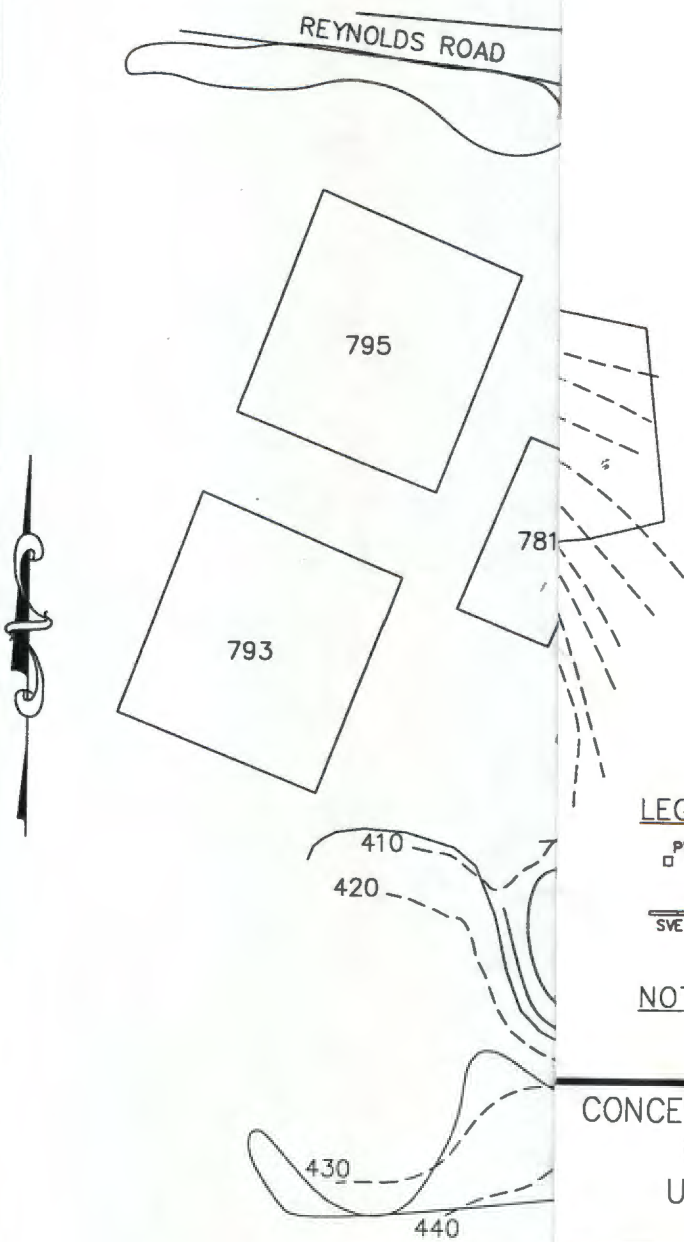


Figure 6-3. Methane concentration isopleths for the Motor Pool Landfill.



LEGEND:

PVP 1 PASSIVE VENTING POINT

SVE 1 SOIL VAPOR EXTRACTION TRENCH

NOTE: NEW ASPHALT PAVING TO BE COMPLETED IN SVE TRENCH AREA.

DWG. FILE No. F:\CAD\60787\SVE

CONCEPTUAL SVE SYSTEM LAYOUT
MOTOR POOL LANDFILL
U.S. MILITARY ACADEMY
WEST POINT, NEW YORK

FIGURE 6–4

EA ENGINEERING, SCIENCE, AND TECHNOLOGY

3 WASHINGTON CENTER
THE MAPLE BUILDING
NEWBURGH, NEW YORK 12550
(914) 565–8100

PROJECT NUMBER	60787\52
SCALE	N.T.S.
FILE NAME	F:\CAD\60787\SVE
DRAWING NUMBER	60787\026
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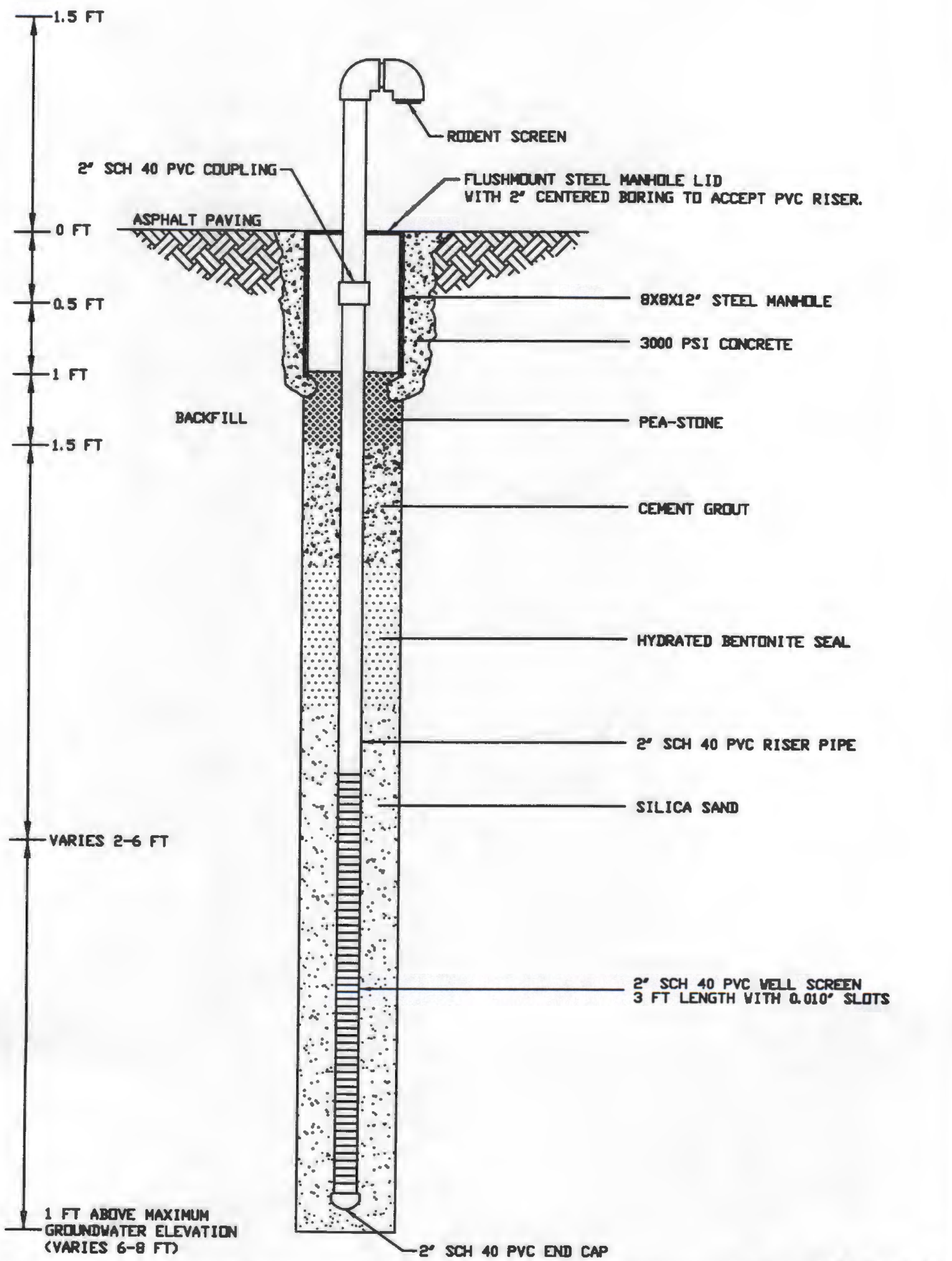

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EA ENGINEERING, SCIENCE, AND TECHNOLOGY	SIX LANDFILLS U.S. MILITARY ACADEMY WEST POINT, NEW YORK	FIGURE 6-5 PASSIVE VENTING POINT CONSTRUCTION DIAGRAM MOTOR POOL LANDFILL

PROJECT MGR	DESIGNED BY	DRAWN BY	CHECKED BY	SCALE	DATE	PROJECT NO	FILE NO.
JHS	CJV	CJV	JCH	N.T.S.	27 OCT 1995	60787.52	BORD

7. ENGINEERING ECONOMIC ANALYSIS

7.1 ALTERNATIVES FOR DISPOSAL OF LEACHATE

Table 7-1 summarizes the capital costs and operating and maintenance costs for each of the alternatives for the disposal of leachate as presented in Chapter 4. Appendix E Tables E-1 through E-18 provide the detailed cost estimates for each of these alternatives. The following susbsections discuss the pertinent assumptions used to develop these estimates.

7.1.1 Post School Landfill

7.1.1.1 Alternative No. 1: No Action

Clean Out Existing System (PS-ALT L1; Item A.1)—It is assumed that the existing system will require the removal of debris and flocculation from the catch basin and inlet, connection line to the collection tank, and collection tank.

Laboratory Analysis (PS-ALT L1; Items B.3 and C.3)—Analytical costs for operating and maintenance were based upon the cost to perform Target Analyte List (TAL) metals, total phenolics, and 11 water quality parameters (Table 7-2).

7.1.1.2 Alternative No. 2: Collection and Discharge to U.S. Military Academy Treatment Plant

Tank Abandonment (PS-ALT L2; Item A.1)—It is assumed that the existing collection tank will be kept in place, disconnected from the existing conveyance system, and "closed" by filling with concrete.

Collection System (PS-ALT L2; Item A.2)—It is assumed that the collection system for seep PS95-LS-01 will consist of a cast-in-place concrete retention box. The exact location of the box will need to be determined in the field. The intent of the retention box is to conceal and fully enclose the seep area for both aesthetic reasons and to prevent future access by humans or wildlife. Dimensions will be approximately 3 × 4 × 6 ft, and the box will be connected to existing features using dowels. Access to the box will be through a removable steel grating at the top, which will consist of galvanized steel. The grating will require a locking device to prevent unauthorized access.

Remove Existing Catch Basin and Drain (PS-ALT L2; Item A.4)—The line connecting the two existing catch basins near seep PS95-LS-01 will need to be capped at each end to divert stormwater flow back to the existing storm drain.

Connection Line to Sanitary Manhole (PS-ALT L2; Items A.5 and A.6)—A 6-in. PVC pipe will be installed to convey collected leachate from the retention box directly to the 6-in. sanitary sewer line located next to Barnard Loop Housing Unit 235/236. Connection to sanitary sewer will be accomplished by the installation of a new manhole.

New Macadam Paving (PS ALT L2; Item A.7)—It is assumed that the installation of the connection line from the retention box to the sanitary sewer will require the removal of approximately 50 ft^2 of macadam pavement which will be replaced under this item.

Seed and Erosion Control (PS ALT L2; Item A.8)—It is assumed that the installation of the connection line from the retention box to the sanitary sewer will require the removal of approximately 200 ft^2 of grass which will be replaced under this item.

Excavate Trench (PS ALT L2; Item A.10)—It is assumed that the installation of the connection line from the retention box to the sanitary sewer will require excavation of a 4 ft × 2 ft trench for placement of the line.

Backfill Trench (PS ALT L2; Item A.11)—It is assumed that the installation of the connection line from the retention box to the sanitary sewer will require approximately 15 yd^3 of backfill.

Laboratory Analysis (PS-ALT L2; Items B.3 and C.3)—Analytical costs for operating and maintenance were based upon the cost to perform TAL metals, total phenolics, and 11 water quality parameters (Table 7-2).

7.1.1.3 Alternative No. 3: Collection and Discharge to Stormwater System

Tank Abandonment (PS-ALT L3; Item A.1)—It is assumed that the existing collection tank will be kept in place, disconnected from the existing conveyance system, and "closed" by filling with concrete.

Collection System (PS-ALT L3; Item A.2)—It is assumed that the collection system for seep PS95-LS-01 will consist of a cast-in-place concrete retention box. The exact location of the box will need to be determined in the field. The intent of the retention box is to conceal and fully enclose the seep area for both aesthetic reasons and to prevent future access by humans or wildlife. Dimensions will be approximately 3 × 4 × 6 ft, and the box will be connected to existing features using dowels. Access to the box will be through a removable steel grating at the top, which will consist of galvanized steel. The grating will require a locking device to prevent unauthorized access.

Remove Existing Catch Basin and Drain (PS-ALT L3; Item A.4)—The line connecting the two existing catch basins near seep PS95-LS-01 will be capped at each end to divert stormwater flow back to the existing storm drain.

Pretreatment Filtration Vessel (PS ALT L3; Items A.5, A.6, A.9, and A.10)—It is assumed that the leachate will require pretreatment through filtration of suspended solids and metals prior to discharge to the existing stormwater system. The new collection box will be connected to the pretreatment vessel with a 6-in. diameter PVC line, and the pretreatment vessel will be connected to the existing stormwater system using a 6-in. diameter PVC line as well. The pretreatment vessel will be installed on a concrete slab foundation and enclosed within a new building to prevent unauthorized access.

New Macadam Paving (PS ALT L3; Item A.12)—It is assumed that the installation of the connection line from the pretreatment vessel to the stormwater system will require the removal of approximately 50 ft^2 of macadam pavement, which will be replaced under this item.

Seed and Erosion Control (PS ALT L3; Item A.13)—It is assumed that the installation of the connection line from the pretreatment vessel to the stormwater system will require the removal of approximately 200 ft^2 of grass, which will be replaced under this item.

Excavate Trenches (PS ALT L3; Item A.15)—It is assumed that the installation of the connection line from the collection box to the pretreatment vessel, and from the pretreatment vessel to the stormwater system, will require excavation of a trench that is approximately 100 ft long, with dimensions of 4 ft × 2 ft, for placement of the line.

Backfill Trenches (PS ALT L3; Item A.16)—It is assumed that the installation of the connection lines will require approximately 30 yd^3 of backfill.

Laboratory Analysis (PS-ALT L3; Items B.3 and C.3)—Analytical costs for operating and maintenance were based upon the cost to perform TAL metals, total phenolics, and 11 water quality parameters (Table 7-2).

7.1.1.4 Alternative No. 4: Uptake of Leachate by Vegetation

Regrading (PS-ALT L4; Item A.1)—It is assumed that the site will require a small amount of regrading prior to placement of vegetation to optimize uptake and concealment of the seepage.

Clean Out Existing System (PS-ALT L4; Item A.2)—It is assumed that the existing system will require the removal of debris and flocculation from the catch basin and inlet, connection line to the collection tank, and collection tank.

Laboratory Analysis (PS-ALT L4; Items B.3 and C.3)—Analytical costs for operating and maintenance were based upon the cost to perform TAL metals, total phenolics, and 11 water quality parameters (Table 7-2).

7.1.2 Parking Lot F Landfill

7.1.2.1 Alternative No. 1: No Action

Remove Debris from Swale (LF-ALT L1; Item A.1)—It is assumed that the existing swale will require the removal of debris and flocculation to enhance the drainage of seep LF95-LS-03.

Laboratory Analysis (LF-ALT L1; Items B.2 and C.2)—Analytical costs for operating and maintenance were based upon the cost to perform TAL metals, total phenolics, and 11 water quality parameters (Table 7-2).

7.1.2.2 Alternative No. 2: Collection and Transport to U.S. Military Academy Treatment Plant

Remove Existing Gutter Along Access Road (LF-ALT L2; Item A.1)—It is assumed that the existing swale will require the removal of the existing gutter along the access road prior to installation of the new collection line.

Remove Existing Storm Drain (LF-ALT L2; Item A.2)—It is assumed the existing storm drain next to the existing leachate collection tank will need to be removed to allow placement of a new collection line to the tank.

Lateral Collection Lines (LF-ALT L2; Item A.3)—It is assumed that approximately 50 ft of 6-in. diameter perforated PVC pipe will be required to collect seepage from location LF95-LS-03, and that two 50 ft-lines will be required for seep LF95-LS-01.

HDPE 40-mil (LF-ALT L2; Item A.4)—It is assumed that approximately 800 ft^2 of 40-mil HDPE will be required to line the new swale along the access road, and that 600 ft^2 will be required for the collection trench at seep LF95-LS-01.

Geotextile (LF-ALT L2: Item A.5)—It is assumed that approximately 300 ft^2 of geotextile will be required to enclose the collection trench below the new swale along the access road, and that 600 ft^2 would be required for the collection trench at seep LF95-LS-01.

Collection Box (LF-ALT L2; Item A.6)—The collection box will be used to join the two new lateral collection lines near seep LF95-LS-01 and allow future cleanout and maintenance of the laterals.

Vault (LF-ALT L2; Item A.7)—The vault will be used to enclose the collection box and allow for future access for maintenance.

Excavate Trenches (LF-ALT L2; Item A.8)— It is assumed that the installation of the connection lines from the collection trenches to the tanks will require approximately 325 ft of trenching, with dimensions of 4 ft × 2 ft, for placement of the lines. The estimated cost accounts for excavating the trenches in an area that is approximately 50 percent rock and 50 percent common soil. It is also assumed that the new swale along the access road will require excavation for placement of the rip-rap and collection trench, and that excavation will be required for the collection trench at seep LF95-LS-01.

Backfill Trenches (LF-ALT L2; Item A.9)—It is assumed that the installation of the connection lines from the collection trenches to the tanks will require approximately 100 yd^3 of backfill. It is also assumed that the new collection trench along the access road will require approximately 11 yd^3 of crushed stone for backfilling, and that 19 yd^3 will be required for the collection trench at seep LF95-LS-01.

Rip-Rap Stone (LF-ALT L2; Item A.10)—It is assumed that the new swale along the access road will require approximately 20 yd^3 of rip-rap stone to reduce erosion and protect the 40-mil HDPE trench liner.

New Collection Tank (LF-ALT L2; Item A.12)—Based on leachate generation estimates from August 1995, it is assumed that a 4,000-gal capacity collection tank will be required for seep LF95-LS-01. It is assumed that the tank will need to be pumped on a daily basis. It is also assumed that the existing collection tank will be utilized to collect seepage from location LF95-LS-03, and that this tank will need to pumped on a daily basis.

Prefabricated Concrete Outfalls with Pads (LF-ALT L2; Item A.13)—It is assumed that both collection tanks will be equipped with concrete outfalls (with pads) at the discharge ends to allow for possible tank overflow conditions.

Laboratory Analysis (LF-ALT L2; Items B.2 and C.2)—Analytical costs for operating and maintenance were based upon the cost to perform TAL metals, total phenolics, and 11 water quality parameters (Table 7-2).

Pump New Collection Tank (LF-ALT L2; Items B.3 and C.3)—Based on leachate generation estimates from August 1995, it is assumed that the new collection tank (4,000-gal capacity) will need to be pumped on a daily basis, and that the pumping activity will take 1 hour to complete.

Pump Existing Collection Tank (LF-ALT L2; Items B.4 and C.4)—Based on leachate generation estimates from August 1995, it is assumed that the existing collection tank (1,000-gal capacity) will need to be pumped on a daily basis, and that the pumping activity will take 0.5 hours to complete.

Transport to Treatment Plant (LF-ALT L2; Items B.5 and C.5)—It is assumed that a round trip from the Target Hill treatment plant to Parking Lot F will take approximately 0.5 hours to complete, and that the round trip will be performed on a daily basis using a pumper truck with sufficient storage capacity to completely drain both collection tanks.

7.1.2.3 Alternative No. 3: Collection and Discharge to Stormwater System

Tank Abandonment (LF-ALT L3; Item A.1)—It is assumed that the tank will be kept in place, disconnected from the existing conveyance system, and "closed" by filling with concrete.

Lateral Collection Lines (LF-ALT L3; Item A.2)—It is assumed that approximately 50 ft of 6-in. diameter perforated PVC pipe will be required to collect seepage along the access road, and that two 50-ft lines will be required for seep LF95-LS-01.

HDPE 40-mil (LF-ALT L3; Item A.3)—It is assumed that approximately 800 ft^2 of 40-mil HDPE will be required to line the new swale along the access road, and that 600 ft^2 will be required for seep LF95-LS-01.

Geotextile (LF-ALT L3; Item A.4)—It is assumed that approximately 250 ft^2 of geotextile will be required to enclose the collection trench below the new swale along the access road, and that 600 ft^2 will be required for seep LF95-LS-01.

Collection Box (LF-ALT L3; Item A.5)—The collection box will be used to join the two new lateral collection lines near seep LF95-LS-01 and allow future cleanout and maintenance of the laterals.

Vault (LF-ALT L3; Item A.6)—The vault will be used to enclose the collection box and allow for future access for maintenance.

Excavate Trenches (LF-ALT L3; Item A.7)— It is assumed that the installation of the connection lines from the collection trenches to the pretreatment units will require approximately 275 ft of trenching, with dimensions of 4 ft × 2 ft, for placement of the lines. The estimated cost accounts for excavating the trenches in an area that is approximately 50 percent rock and 50 percent common soil. It is also assumed that the new swale along the access road will require excavation for placement of the rip-rap and collection trench, and that excavation will be required for the collection trench at seep LF95-LS-01.

Backfill Trenches (LF-ALT L3; Item A.8)—It is assumed that the installation of the connection lines from the collection trenches to the pretreatment units will require approximately 100 yd^3 of backfill. It is also assumed that the new collection trench along the access road will require approximately 11 yd^3 of crushed stone for backfilling, and that 19 yd^3 will be required for the collection trench at seep LF95-LS-01.

Rip-Rap Stone (LF-ALT L3; Item A.9)—It is assumed that the new swale along the access road will require approximately 20 yd^3 of rip-rap stone to reduce erosion and protect the 40-mil HDPE trench liner.

Pretreatment Filtration Vessel (LF-ALT L3; Items A.11, A.10, A.12, A.15, and A.16)—It is assumed that the leachate will require pretreatment through filtration of suspended solids and metals prior to discharge to the existing surface water/stormwater system.

For seep LS-95-LF-01, it is assumed that the collection box will be connected to the pretreatment vessel with a 6-in. diameter PVC line, and the pretreatment vessel will discharge to storm water using a prefabricated concrete outfall with a pad.

For seep LS-95-LF-03, it is assumed that the lateral collection line will be connected to the pretreatment unit with a solid 6-in. diameter PVC line. The pretreatment vessel will be connected to the existing storm drain next to the existing collection tank along the access road.

Both pretreatment vessels will be installed on a concrete slab foundation and enclosed within a new building to prevent unauthorized access.

New Macadam Paving (LF-ALT L3; Item A.18)—It is assumed that the installation of the connection line along and across the access road will require the removal of a small amount of macadam pavement, which will be replaced under this item.

Laboratory Analysis (LF-ALT L3; Items B.2 and C.2)—Analytical costs for operating and maintenance were based upon the cost to perform TAL metals, total phenolics, and 11 water quality parameters (Table 7-2).

7.1.2.4 Alternative No. 4: Collection and Discharge to U.S. Military Academy Treatment Plant

Remove Existing Gutter Along Access Road (LF-ALT L4; Item A.1)—It is assumed that the existing swale will require the removal of the existing gutter along the access road prior to installation of the new collection line.

Remove Existing Storm Drain (LF-ALT L4; Item A.2)—It is assumed the existing storm drain next to the existing leachate collection tank will need to be removed to allow placement of a new collection line to the tank.

Lateral Collection Lines (LF-ALT L4; Item A.3)—It is assumed that approximately 50 ft of 6-in. diameter perforated PVC pipe will be required to collect seepage from location LF95-LS-03, and that two 50-ft lines will be required for seep LF95-LS-01.

Connection Lines to Sanitary Sewer (LF-ALT L4; Item A.4)—It is assumed that the lateral collection lines will be connected to the existing sewer line located south of the intersection of Fenton Road and Howze Place, which will require approximately 2,000 ft of 8-in. diameter pipe.

HDPE 40-mil (LF-ALT L4; Item A.5)—It is assumed that approximately 800 ft^2 of 40-mil HDPE will be required to line the new swale along the access road, and that 600 ft^2 will be required for the collection trench at seep LF95-LS-01.

Geotextile (LF-ALT L4; Item A.6)—It is assumed that approximately 300 ft^2 of geotextile will be required to enclose the collection trench below the new swale along the access road, and that 600 ft^2 would be required for the collection trench at seep LF95-LS-01.

Collection Box (LF-ALT L4; Item A.7)—The collection box will be used to join the two new lateral collection lines near seep LF95-LS-01 and allow future cleanout and maintenance of the laterals.

Vault (LF-ALT L4; Item A.8)—The vault will be used to enclose the collection box and allow for future access for maintenance.

Excavate Trenches (LF-ALT L4; Item A.9)— It is assumed that the installation of the connection lines from the collection trenches to existing sanitary sewer will require approximately 2,000-ft of trenching, with dimensions of 4 ft × 2 ft, for placement of the lines. The estimated cost accounts for excavating the trenches in an area that is approximately 50 percent rock and 50 percent common soil. It is also assumed that the new swale along the access road will require excavation for placement of the rip-rap and collection trench, and that excavation will be required for the collection trench at seep LF95-LS-01.

Backfill Trenches (LF-ALT L4; Item A.10)—It is assumed that the installation of the connection lines from the collection trenches to the existing sanitary sewer will require approximately 600 yd^3 of backfill. It is also assumed that the new collection trench along the access road will require approximately 11 yd^3 of crushed stone for backfilling, and that 19 yd^3 will be required for the collection trench at seep LF95-LS-01.

Rip-Rap Stone (LF-ALT L4; Item A.11)—It is assumed that the new swale along the access road will require approximately 20 yd^3 of rip-rap stone to reduce erosion and protect the 40-mil HDPE trench liner.

Laboratory Analysis (LF-ALT L4; Items B.2 and C.2)—Analytical costs for operating and maintenance were based upon the cost to perform TAL metals, total phenolics, and 11 water quality parameters (Table 7-2).

7.1.3 Organic Compost Landfill

7.1.3.1 Alternative No. 1: No Action

Clean Out Existing System (OC-ALT L1; Item A.1)—It is assumed that the existing system will require the removal of debris from the connection line and collection tank.

Laboratory Analysis (OC-ALT L1; Items B.2 and C.2)—Analytical costs for operating and maintenance were based upon the cost to perform TAL metals, total phenolics, and 11 water quality parameters (Table 7-2).

Pump Existing Collection Tank (OC-ALT L1; Items B.3 and C.3)—It is assumed that the existing collection tank (750-gal capacity) will need to be pumped on a monthly basis, and that the pumping activity will take 0.5 hours to complete.

Transport to Treatment Plant (OC-ALT L1; Items B.4 and C.4)—It is assumed that a round trip from the Target Hill treatment plant to the Organic Compost Landfill will take approximately 0.5 hours to complete, and that the round trip will be performed on a monthly basis using a pumper truck with sufficient storage capacity to completely drain the collection tank.

7.1.3.2 Alternative No. 2: Collection and Discharge to Storm Water

Pretreatment Filtration Vessel (OC-ALT L2; Items A.1, A.2, A.5, A.6, and A.7)—It is assumed that the leachate will require pretreatment through filtration of suspended solids and metals prior to discharge to storm water. It is assumed that the existing collection tank will be used and connected to the pretreatment vessel with a 6-in. diameter PVC line, and the pretreatment vessel will discharge to storm water using a prefabricated concrete outfall with a pad.

The pretreatment vessel will be installed on a concrete slab foundation and enclosed within a new building to prevent unauthorized access.

Excavate Trench (OC-ALT L2; Item A.8)—It is assumed that the installation of the connection line to the pretreatment unit will require approximately 50 ft of trenching, with dimensions of 4 ft × 2 ft, for placement of the line. The estimated cost accounts for excavating the trench in an area that is approximately 100 percent common soil.

Backfill Trench (OC-ALT L2; Item A.9)—It is assumed that the installation of the connection line will require approximately 15 yd^3 of backfill.

Laboratory Analysis (OC-ALT L2; Items B.2 and C.2)—Analytical costs for operating and maintenance were based upon the cost to perform TAL metals, total phenolics, and 11 water quality parameters (Table 7-2).

7.1.3.3 Alternative No. 3: Collection and Discharge to U.S. Military Academy Treatment Plant

Connection Line to Sanitary Sewer (OC-ALT L3; Item A.1)—It is assumed that the lateral collection lines will be connected to the existing sanitary sewer located next to the Keller Army Hospital, which will require approximately 500 ft of 8-in. diameter pipe.

Excavate Trench (OC-ALT L3; Item A.2)— It is assumed that the installation of the connection line from the collection trench to the existing sanitary sewer will require excavation of a 4 ft × 2 ft trench for placement of the line. The estimated cost accounts for excavating the trench in an area that is approximately 50 percent rock and 50 percent common soil.

Backfill Trench (OC-ALT L3; Item A.3)—It is assumed that the installation of the connection line from the collection trench to the existing sanitary sewer location will require approximately 150 yd^3 of backfill.

Laboratory Analysis (OC-ALT L3; Items B.2 and C.2)—Analytical costs for operating and maintenance were based upon the cost to perform TAL metals, total phenolics, and 11 water quality parameters (Table 7-2).

7.1.4 Ski Lot Landfill

7.1.4.1 Alternative No. 1: No Action

Remove Debris from Swale (SL-ALT L1; Item A.1)—It is assumed that the existing swale near Building 1227 will require the removal of debris and flocculation to enhance drainage of the seep location.

Laboratory Analysis (SL-ALT L1; Items B.2 and C.2)—Analytical costs for operating and maintenance were based upon the cost to perform TAL metals, total phenolics, and 11 water quality parameters (Table 7-2).

7.1.4.2 Alternative No. 2: Collection and Transport to U.S. Military Academy Treatment Plant

Clearing and Grubbing (SL-ALT L2; Item A.1)—It is assumed that seep area SL95-LS-02 will require the removal of vegetation to allow placement of the new collection line and tank and to allow access for future maintenance.

Lateral Collection Lines (SL-ALT L2; Item A.2)—It is assumed that approximately 50 ft of 6-in. diameter perforated PVC pipe will be required to collect seepage at SL95-LS-01, and that one 100 ft line will be required for seep SL95-LS-02.

HDPE 40-mil (SL-ALT L2; Item A.3)—It is assumed that approximately 200 ft^2 of 40-mil HDPE will be required to line the improved swale near Building 1227, and that 550 ft^2 will be required for the collection trench at seep SL95-LS-02.

Geotextile (SL-ALT L2; Item A.4)— It is assumed that approximately 250 ft^2 of geotextile will be required to enclose the collection trench beneath the improved swale near Building 1227, and that 900 ft^2 will be required for the collection trench at seep SL95-LS-02.

Excavate Trenches (SL-ALT L2; Item A.5)— It is assumed that the installation of the connection lines from the collection trenches to the tanks will require approximately 100 ft of trenching, with dimensions of 4 ft × 2 ft, for placement of the lines. The estimated cost accounts for excavating the trenches in an area that is approximately 50 percent rock and 50 percent common soil. It is also assumed that excavation will be required for the collection trenches at both seep locations.

Backfill Trenches (SL-ALT L2; Item A.6)—It is assumed that the installation of the connection lines from the collection trenches to the tanks will require approximately 30 yd^3 of backfill. It is also assumed that the collection trench beneath the improved swale near Building 1227 will require approximately 5 yd^3 of crushed stone for backfilling, and that 10 yd^3 will be required for the collection trench at seep SL95-LS-02.

Rip-Rap Stone (SL-ALT L2; Item A.7)—It is assumed that the new swale near Building 1227 will require approximately 5 yd^3 of rip-rap stone to reduce erosion and protect the 40-mil HDPE trench liner.

New Collection Tank (SL-ALT L2; Item A.9)—Based on leachate generation estimates from August 1995, it is assumed that a 1,000-gal capacity collection tank will be required for seep SL95-LS-01, as well as for seep SL95-LS-02. It is assumed that each tank will need to be pumped on a monthly basis.

Prefabricated Concrete Outfalls with Pads (SL-ALT L2; Item A.10)—It is assumed that both collection tanks will be equipped with concrete outfalls (with pads) at the discharge ends to allow for possible tank overflow conditions.

Laboratory Analysis (SL-ALT L2; Items B.2 and C.2)—Analytical costs for operating and maintenance were based upon the cost to perform TAL metals, total phenolics, and 11 water quality parameters (Table 7-2).

Pump New Collection Tanks (SL-ALT L2; Items B.3 and C.3)—Based on leachate generation estimates from August 1995, it is assumed that the new collection tanks (1,000-gal capacity each) will need to be pumped on a monthly basis, and that the pumping activity for each tank will take 0.5 hours to complete.

Transport to Treatment Plant (SL-ALT L2; Items B.5 and C.5)—It is assumed that a round trip from the Target Hill treatment plant to the Ski Lot landfill will take approximately 0.5 hours to complete, and that the round trip will be performed on a monthly basis using a pumper truck with sufficient storage capacity to completely drain both collection tanks.

7.1.4.3 Alternative No. 3: Collection and Discharge to Surface Water

Clearing and Grubbing (SL-ALT L3; Item A.1)—It is assumed that seep area SL95-LS-02 will require the removal of a small amount of vegetation to allow placement of the new collection line and tank and to allow access for future maintenance.

Lateral Collection Lines (SL-ALT L3; Item A.2)—It is assumed that approximately 50 ft of 6-in. diameter perforated PVC pipe will be required to collect seepage at SL95-LS-01, and that one 100-ft line will be required for seep SL95-LS-02.

HDPE 40-mil (SL-ALT L3; Item A.3)—It is assumed that approximately 200 ft^2 of 40-mil HDPE will be required to line the improved swale near Building 1227, and that 550 ft^2 will be required for the collection trench at seep SL95-LS-02.

Geotextile (SL-ALT L3; Item A.4)— It is assumed that approximately 250 ft^2 of geotextile will be required to enclose the collection trench below the improved swale near Building 1227, and that 900 ft^2 will be required for the collection trench at seep SL95-LS-02.

Excavate Trenches (SL-ALT L3; Item A.5)— It is assumed that the installation of the connection lines from the collection trenches to the pretreatment units will require approximately 200 ft of trenching, with dimensions of 4 ft × 2 ft, for placement of the lines.

Backfill Trenches (SL-ALT L3; Item A.6)—It is assumed that the installation of the connection lines from the collection trenches to the pretreatment units will require approximately 60 yd^3 of backfill. It is also assumed that the collection trench beneath the improved swale near Building 1227 will require approximately 5 yd^3 of crushed stone for backfilling, and that 10 yd^3 will be required for the collection trench at seep SL95-LS-02.

Rip-Rap Stone (SL-ALT L3; Item A.7)—It is assumed that the new swale near Building 1227 will require approximately 5 yd^3 of rip-rap stone to reduce erosion and protect the 40-mil HDPE trench liner.

Pretreatment Filtration Vessel (SL-ALT L3; Items A.9, A.8, A.10, A.13, and A.14)—It is assumed that the leachate will require pretreatment through filtration of suspended solids and metals prior to discharge to surface water. For both seep locations, it is assumed that the lateral connection lines will be connected to the pretreatment vessels with a 6-in. diameter PVC line, and the pretreatment vessel will discharge to surface water using a prefabricated concrete outfall with a pad.

Both pretreatment vessels will be installed on a concrete slab foundation and enclosed within a new building to prevent unauthorized access.

Laboratory Analysis (SL-ALT L3; Items B.2 and C.2)—Analytical costs for operating and maintenance were based upon the cost to perform TAL metals, total phenolics, and 11 water quality parameters (Table 7-2).

7.1.4.4 Alternative No. 4: Collection and Discharge to U.S. Military Academy Treatment Plant

Lateral Collection Lines (SL-ALT L4; Item A.1)—It is assumed that approximately 50 ft of 6-in. diameter perforated PVC pipe will be required to collect seepage at SL95-LS-01, and that one 100-ft line will be required for seep SL95-LS-02.

Connection Lines to Sanitary Sewer (SL-ALT L4; Item A.2)—It is assumed that one of the lateral collection lines will be connected to the existing manhole inside the gate entrance for the U.S. Mint facility, which will require approximately 200 ft of 8-in. diameter pipe, and that the other collection line will be connected to the existing sewer line in the vicinity of the Motor Pool Landfill, which will require approximately 700 ft of 8-in. diameter pipe.

New Macadam Paving (SL-ALT L4; Item A.3)—It is assumed that the installation of the connection line from the collection line to the sanitary sewer will require the removal of approximately 50 ft^2 of macadam pavement, which will be replaced under this item.

Excavate Trenches (SL-ALT L4; Item A.4)— It is assumed that the installation of the connection line from the collection trench to the existing manhole will require approximately 900 ft of trenching, with dimensions of 4 ft × 2 ft trench for placement of the line. The estimated cost accounts for excavating the trenches in an area that is approximately 50 percent rock and 50 percent common soil. It is also assumed that excavation will be required for the collection trenches at both seep locations.

Backfill Trenches (SL-ALT L4; Item A.5)—It is assumed that the installation of the connection lines from the collection trenches to the existing sewer locations will require approximately 270 yd^3 of backfill. It is also assumed that the collection trench beneath the improved swale near Building 1227 will require approximately 5 yd^3 of crushed stone for backfilling, and that 10 yd^3 will be required for the collection trench at seep SL95-LS-02.

Rip-Rap Stone (SL-ALT L4; Item A.6)—It is assumed that the new swale near Building 1227 will require approximately 5 yd^3 of rip-rap stone to reduce erosion and protect the 40-mil HDPE trench liner.

Laboratory Analysis (SL-ALT L4; Items B.2 and C.2)—Analytical costs for operating and maintenance were based upon the cost to perform TAL metals, total phenolics, and 11 water quality parameters (Table 7-2).

7.1.5 Motor Pool Landfill

7.1.5.1 Alternative No. 1: No Action

Laboratory Analysis (MP-ALT L1; Items B.2 and C.2)—Analytical costs for operating and maintenance were based upon the cost to perform TAL metals, total phenolics, and 11 water quality parameters (Table 7-2).

7.1.5.2 Alternative No. 2: Collection and Discharge to U.S. Military Academy Treatment Plant

Lateral Collection Line (MP-ALT L2; Item A.1)—It is assumed that approximately 50 ft of 6-in. diameter perforated PVC pipe will be required to collect seepage at each location.

HDPE 40-mil (MP-ALT L2; Item A.2)—It is assumed that approximately 550 ft^2 of 40-mil HDPE will be required to enclose the collection trenches at the seep locations.

Geotextile (MP-ALT L2; Item A.3)—It is assumed that approximately 900 ft^2 of geotextile will be required to enclose the collection trenches at the seep locations.

Connection Line to Existing Sewer (MP-ALT L2; Item A.4)—It is assumed that the collection line for seep MP95-LS-02 will be connected to the existing sanitary sewer line, which will require approximately 50 ft of 6-in. diameter solid PVC pipe.

Seed and Erosion Control (MP-ALT L2; Item A.5)—It is assumed that the installation of the lateral collection line and connection line to the sanitary sewer will require the removal of approximately 500 ft^2 of grass, which will be replaced under this item.

Excavate Trenches (MP-ALT L2; Item A.7)— It is assumed that the installation of the connection lines from the seep locations to the existing sanitary sewer will require approximately 100 ft of trenching, with dimensions of 4 ft × 2 ft, for placement of the lines. The estimated cost accounts for excavating the trenches in an area that is approximately 100 percent common soil.

Backfill Trenches (MP-ALT L2; Item A.8)—It is assumed that the installation of the connection lines from the seep locations to the existing sanitary sewer will require approximately 30 yd^3 of backfill. It is also assumed that the collection trenches at each seep location will require approximately 20 yd^3 of crushed stone for backfilling.

Laboratory Analysis (MP-ALT L2; Items B.2 and C.2)—Analytical costs for operating and maintenance were based upon the cost to perform TAL metals, total phenolics, and 11 water quality parameters (Table 7-2).

7.1.5.3 Alternative No. 3: Collection and Discharge to Surface Water

Lateral Collection Lines (MP-ALT L3; Item A.1)—It is assumed that approximately 50 ft of 6-in. diameter perforated PVC pipe will be required to collect seepage at MP95-LS-02, and that 50 ft of line will be required for the collection trench at seep MP95-LS-01.

HDPE 40-mil (MP-ALT L3; Item A.2)—It is assumed that approximately 275 ft^2 of 40-mil HDPE will be required to line the collection trench at seep MP95-LS-02, and that 275 ft^2 will be required for the collection trench at seep MP95-LS-01.

Geotextile (MP-ALT L3; Item A.3)—It is assumed that approximately 450 ft^2 of geotextile will be required to enclose the collection trench at seep MP95-LS-02, and that 450 ft^2 will be required for the collection trench at seep MP95-LS-01.

Excavate Trenches (MP-ALT L3; Item A.4)— It is assumed that the installation of the connection lines from the collection trenches to the pretreatment unit will require approximately 250 ft of trenching, with dimensions of 4 ft × 2 ft, for placement of the lines. The estimated cost accounts for excavating the trench in an area that is approximately 100 percent common soil.

Backfill Trenches (MP-ALT L3; Item A.5)—It is assumed that the installation of the connection lines from the collection trenches to the pretreatment unit will require approximately 75 yd^3 of backfill. It is also assumed that the collection trenches at seeps MP95-LS-01 and MP95-LS-02 will require approximately 10 yd^3 each of crushed stone for backfilling.

Pretreatment Filtration Vessel (MP-ALT L3; Items A.8, A.7, A.9, A.12, and A.13)—It is assumed that the leachate will require pretreatment through filtration of suspended solids and metals prior to discharge to surface water, which will be accomplished using one pretreatment vessel to be located near seep location MP95-LS-01. For both seep locations, it is assumed that the lateral connection lines will be connected to the pretreatment vessel with a 6-in. diameter PVC line, and the pretreatment vessel will discharge to surface water using a prefabricated concrete outfall with a pad.

The pretreatment vessel will be installed on a concrete slab foundation and enclosed within a new building to prevent unauthorized access.

Laboratory Analysis (MP-ALT L3; Items B.2 and C.2)—Analytical costs for operating and maintenance were based upon the cost to perform TAL metals, total phenolics, and 11 water quality parameters (Table 7-2).

7.2 ALTERNATIVES FOR SOURCE REDUCTION OF LEACHATE

Table 7-3 summarizes the capital costs and operating and maintenance costs for each of the alternatives for the reduction of leachate as presented in Chapter 5. Appendix F Tables F-1 through F-6 provide the detailed cost estimates for each of these alternatives. The following susbsections discuss the pertinent assumptions used to develop these estimates.

7.2.1 Post School Landfill

7.2.1.1 Alternative No. 1: Capping (Geocomposite) with Surface Water and Gas Vent Controls

Security Fence/Gate (PS-ALT S1; Item A.1)—It is assumed that the fence will be placed along the entire perimeter of the proposed cap.

Site Regrading (PS-ALT S1; Item A.2)—It is assumed that site regrading will include removing the top 6 in. of the existing topsoil prior to placement of the cap in order to lower the final overall elevation of the constructed cap.

Soil Backfilling for Capping (PS-ALT S1; Item A.4)—It is assumed that soil backfilling will be required along the northern boundary of the cap, as well as beneath a portion of the center of the cap to create the minimum slope required for proper drainage.

Capping System (PS-ALT S1; Item A.5)—It is assumed that select backfill will be required to prevent puncturing of the geomembrane. Geonet will be used above the geomembrane as a drainage layer, and below the geomembrane as a gas venting layer.

Gas Vents (PS-ALT S1; Item A.6)—As per 6 NYCRR Part 360, one gas vent is required per acre of landfill.

Surface Water Diversion - West/North (PS-ALT S1; Item A.7)—It is assumed that the existing swale along the west and north sides of the landfill will be replaced by a swale that is 5 ft deep, 10 ft wide at the bottom, and 20 ft wide at the top (side slopes = 1:1). Rip-rap will be placed within the channel to reduce erosion.

Surface Water Diversion - East/South (PS-ALT S1; Item A.8)—It is assumed that a swale will be placed along the toe of the slope for the proposed cap along the east and south sides, to intercept runoff from the cap. The approximate dimensions of this swale are assumed as 2.5 ft deep, 5 ft wide at the bottom, and 10 ft wide at the top (side slopes = 1:1).

Leachate Collection Line (PS-ALT S1; Item A.9)—It is assumed that a leachate collection line will be placed beneath the cap, along the south and east edges of the proposed cap. Dimensions of the trench are assumed as 20 ft deep, 2 ft wide at the bottom, and 42 ft wide at the top (side slopes = 1:1). The collection line will consist of 6-in. diameter perforated PVC, covered by approximately 7 ft of crushed stone. Geotextile and geomembrane will be placed in the trench along the side slopes to act as a filter medium to prevent clogging of the stone, and to contain ground water/leachate within the trench, respectively. A new manhole will be required beyond the limit of the landfill to connect to the existing sanitary sewer.

Laboratory Analysis (PS-ALT S1; Items B.2 and C.2)—Analytical costs for operating and maintenance were based upon the cost to perform TAL metals, total phenolics, and 11 water quality parameters (Table 7-2).

7.2.1.2 Alternative No. 2: Capping (Clay) with Surface Water and Gas Vent Controls

Security Fence/Gate (PS-ALT S2; Item A.1)—It is assumed that the fence will be placed along the entire perimeter of the proposed cap.

Site Regrading (PS-ALT S2; Item A.2)—It is assumed that site regrading will include removing the top 6 in. of the existing topsoil prior to placement of the cap, in order to lower the final overall elevation of the constructed cap.

Soil Backfilling for Capping (PS-ALT S2; Item A.4)— It is assumed that soil backfilling will be required along the northeast boundary of the cap, as well as beneath a portion of the center of the cap to create the minimum slope required for proper drainage.

Capping System (PS-ALT S2; Item A.5)—It is assumed that the proposed cap will consist of a 2-ft thick layer of clay, underlain by a 1 ft thick gas venting layer comprised of sand. A 2-ft thick layer of select backfill/loam will be placed immediately above the clay to provide protection. A 6-in. layer of topsoil will be placed on top of the cap to support new grass.

Gas Vents (PS-ALT S2; Item A.6)—As per 6 NYCRR Part 360, one gas vent is required per acre of landfill.

Surface Water Diversion—West/North (PS-ALT S2; Item A.7)—It is assumed that the existing swale along the west and north sides of the landfill will be replaced by a swale that is 5 ft deep, 10 ft wide at the bottom, and 20 ft wide at the top (side slopes = 1:1). Rip-rap will be placed within the channel to reduce erosion.

Surface Water Diversion - East/South (PS-ALT S2; Item A.8)—It is assumed that a swale will be placed along the toe of the slope for the proposed cap along the east and south sides, to intercept runoff from the cap. The approximate dimensions of this swale are assumed as 2.5 ft deep, 5 ft wide at the bottom, and 10 ft wide at the top (side slopes = 1:1).

U.S. Military Academy —It is assumed that a leachate collection line will be placed beneath the cap, along the south and east edges. Dimensions of the trench are assumed as 20 ft deep, 2 ft wide at the bottom, and 42 ft wide at the top (side slopes = 1:1). The collection line will consist of 6-in. diameter perforated PVC, covered by approximately 7 ft of crushed stone. Geotextile and geomembrane will be placed in the trench along the side slopes to act as a filter medium to prevent clogging of the stone, and to contain ground water/leachate within the trench, respectively. A new manhole will be required beyond the limit of the landfill to connect to the existing sanitary sewer.

Laboratory Analysis (PS-ALT S2; Items B.2 and C.2)—Analytical costs for operating and maintenance were based upon the cost to perform TAL metals, total phenolics, and 11 water quality parameters (Table 7-2).

7.2.2 Parking Lot F Landfill

7.2.2.1 Alternative No. 1: Repave Surface of Lot

Repave Surface of Parking Area (LF-ALT S1; Item A.1)—It is assumed that the entire surface of the existing parking area will be repaved with a layer of asphalt approximately 6-in. thick.

Surface Water Diversion (LF-ALT S1; Item A.2)—It is assumed that the drainage characteristics of the existing swale on the west side of the landfill will be improved and that the bottom and sides will be paved with a layer of asphalt approximately 3-in. thick.

7.2.2.2 Alternative No. 2: Capping (Clay) with Surface Water Controls

Security Fence/Gate (LF-ALT S2; Item A.1)—It is assumed that the fence will be placed along the entire perimeter of the proposed cap.

Site Regrading (LF-ALT S2; Item A.2)—It is assumed that site regrading will include removing the top 6 in. of the existing surface (macadam) prior to placement of the cap, in order to lower the final overall elevation of the constructed cap.

Soil Backfilling for Capping (LF-ALT S2; Item A.4)—It is assumed that soil backfilling will be required beneath most of the cap to create the minimum slope required for proper drainage.

Capping System (LF-ALT S2; Item A.5)—It is assumed that the proposed cap will consist of a 2-ft thick layer of clay, underlain by a 1 ft thick gas venting layer comprised of sand. A 2-ft thick layer of select backfill/loam will be placed immediately above the clay to provide protection. A 6-in. layer of topsoil will be placed on top of the cap to support new grass.

Surface Water Diversion - West/North (LF-ALT S2; Item A.6)—It is assumed that the existing swale along the west and north sides of the landfill will be replaced by a swale that is 5 ft deep, 10 ft wide at the bottom, and 20 ft wide at the top (side slopes = 1:1). Rip-rap will be placed within the channel to reduce erosion. Flow will be directed towards the existing culvert near the midpoint of the landfill.

Surface Water Diversion - East/South (LF-ALT S2; Item A.7)—It is assumed that a swale will be placed along the toe of the slope for the proposed cap along the east and south sides, to intercept runoff from the cap. The approximate dimensions of this swale are assumed as 2.5 ft deep, 5 ft wide at the bottom, and 10 ft wide at the top (side slopes = 1:1). Flow will be directed to the midpoint of the landfill and discharged to the existing intermittent stream located east of the landfill.

Laboratory Analysis (PS-ALT S2; Items B.2 and C.2)—Analytical costs for operating and maintenance were based upon the cost to perform TAL metals, total phenolics, and 11 water quality parameters (Table 7-2).

7.2.3 Organic Compost Landfill

7.2.3.1 Alternative No. 1: Repave Surface of Lot

Repave Surface of Parking Area (OC-ALT S1; Item A.1)—It is assumed that the entire surface of the existing storage area will be repaved with a layer of asphalt approximately 6-in. thick.

7.2.4 Ski Lot Landfill

7.2.4.1 Alternative No. 1: Repave Surface of Lot

Repave Surface of Parking Area (SL-ALT S1; Item A.1)—It is assumed that the entire surface of the existing parking area will be repaved with a layer of asphalt approximately 6-in. thick.

7.2.5 Motor Pool Landfill

7.2.5.1 Alternative No. 1: Repave Entire Surface of Lot

Repave Surface of Parking Area (MP-ALT S1; Item A.1)—It is assumed that the entire surface of the existing parking area will be repaved with a layer of asphalt approximately 6-in. thick.

7.2.5.2 Alternative No. 2: Repave Lot to Cover Proposed Soil Vapor Extraction System

Repave Surface of Parking Area (MP-ALT S2; Item A.1)—It is assumed that the surface of the existing parking area within the limits of the proposed soil vapor extraction system will be repaved with a layer of asphalt approximately 6-in. thick. The proposed soil vapor extraction system is discussed in Section 6.3.2.

TABLE 7-1 COST SUMMARY FOR DISPOSAL ALTERNATIVES SIX LANDFILLS, U.S. MILITARY ACADEMY, WEST POINT, NEW YORK

Alternative	Capital Cost ($)	Operation and Maintenance Cost ($)[a]
Post School Landfill		
1. No Action	500	60,000
2. Collection and Discharge to U.S. Military Academy Treatment Plant	10,000	60,000
3. Collection and Discharge to Storm-Water System (Pretreatment)	119,000	162,000
4. Uptake by Vegetation	4,000	52,000
Parking Lot F Landfill		
1. No Action	500	49,000
2. Collection and Transport to U.S. Military Academy Treatment Plant	46,000	1,788,000
3. Collection and Discharge to Storm-Water System (Pretreatment)	252,000	253,000
4. Collection and Discharge to U.S. Military Academy Treatment Plant	167,000	55,000
Organic Compost Landfill		
1. No Action	500	78,000
2. Collection and Discharge to Storm Water (Pretreatment)	111,000	143,000
3. Collection and Discharge to U.S. Military Academy Treatment Plant	44,000	55,000
Ski Lot Landfill		
1. No Action	500	49,000
2. Collection and Transport to U.S. Military Academy Treatment Plant	20,000	56,000
3. Collection and Discharge to Surface Water (Pretreatment)	240,000	253,000
4. Collection and Discharge to U.S. Military Academy Treatment Plant	79,000	55,000
Motor Pool Landfill		
1. No Action	0	47,000
2. Collection and Discharge to U.S. Military Academy Treatment Plant	41,000	55,000
3. Collection and Discharge to Surface Water (Pretreatment)	130,000	151,000

(a) Operation and maintenance costs are based upon 30-year present worth analysis.

TABLE 7-2 ANALYTICAL PARAMETERS FOR QUARTERLY MONITORING OF LEACHATE QUALITY

Analytical Parameter	Analytical Method
Target Analyte List metals	EPA SW-846
Total phenolics	EPA Method 420.1
Color	EPA Method 110.2
Chloride	EPA Method 325.1
Fluoride	EPA Method 340.2
Ammonia	EPA Method 350.1
Nitrate	EPA Method 353.2
Nitrite	EPA Method 353.2
Sulfate	EPA Method 375.4
Alkalinity	EPA Method 310.1
Hardness	EPA Method 130.1
Total suspended solids	EPA Method 160.2
Dissolved organic carbon	EPA Method 415.2

TABLE 7-3 COST SUMMARY FOR SOURCE REDUCTION ALTERNATIVES SIX LANDFILLS, U.S. MILITARY ACADEMY, WEST POINT, NEW YORK

Alternative	Capital Cost ($)	Operation and Maintenance Cost ($)[a]
Post School Landfill		
1. Capping (Geocomposite) with Surface Water and Gas Vent Controls	865,000	586,000
2. Capping (Clay) with Surface Water and Gas Vent Controls	1,413,000	586,000
Parking Lot F Landfill		
1. Repave Surface and Improve Swale Drainage Characteristics	307,000	186,000
2. Capping (Clay) with Surface Water Controls	834,000	586,000
Organic Compost Landfill		
1. Repave Surface of Lot	33,000	186,000
Ski Lot Landfill		
1. Repave Surface of Lot	196,000	186,000
Motor Pool Landfill		
1. Repave Surface of Lot	491,000	186,000
2. Repave Surface of Lot Within Limits of Proposed Soil Vapor Extraction System	349,000	186,000
(a) Operation and maintenance costs are based on 30-year present worth analysis.		

8. SUMMARY AND CONCLUSIONS

8.1 SUMMARY

The Leachate Management Analysis included an examination of the existing leachate collection systems at the Post School, Parking Lot F, and Organic Compost landfills. In addition, alternatives for both the disposal and reduction of leachate were evaluated for each landfill. An engineering economic analysis was performed for each of the disposal and reduction alternatives.

In order to provide additional information for the analysis, *in situ* leachate flow estimates were performed at established seep outbreaks located at the Post School, Parking Lot F, Ski Lot, and Motor Pool landfills. Soil samples of the cover material at each landfill were also collected to determine the hydraulic conductivity.

Also, methane and soil vapor surveys were performed at the Post School, Ski Lot, and Motor Pool landfills. A cost estimate was performed for two treatment alternatives for methane currently being generated at the Motor Pool Landfill.

8.1.1 Post School Landfill

8.1.1.1 Leachate Disposal

In August 1995, EA performed an *in situ* flow estimate for seep location PS95-LS-01. The leachate flow at location PS95-LS-01 was estimated to be 587 gpd. A flow estimate could not be performed at that time for PS95-LS-02 since the area was dry. It should be noted that this estimate was performed during what is considered to be the driest time of the year. Prior to any implementation of the discussed alternatives, additional flow estimating may be warranted to obtain data for periods with higher amounts of precipitation.

Four alternatives for the disposal of leachate were developed, which include the following:

1. No action
2. Collection and discharge to USMA treatment plant
3. Collection and discharge to stormwater system
4. Uptake by vegetation.

The results of the economic analysis for the leachate disposal alternatives are summarized below:

Post School Landfill		
Alternative	Capital Cost ($)	O&M Cost ($)
1. No Action	500	60,000
2. Collection and Discharge to USMA Treatment Plant	10,000	60,000
3. Collection and Discharge to Stormwater System (Pretreatment)	119,000	162,000
4. Uptake by Vegetation	4,000	52,000

8.1.1.2 Leachate Source Reduction

According to USMA representatives, future plans at the Post School Landfill call for the improvement of the surface of the landfill to include construction of new softball fields. Therefore, source reduction alternatives for leachate must compliment these plans. Two alternatives for the source reduction of leachate were developed, which include the following:

1. Capping (geocomposite) with surface water and gas vent controls
2. Capping (clay) with surface water and gas vent controls.

The results of the economic analysis for the leachate source reduction alternatives are summarized below:

Post School Landfill		
Alternative	Capital Cost ($)	O&M Cost ($)
1. Capping (Geocomposite) with Surface Water and Gas Vent Controls	865,000	586,00
2. Capping (Clay) with Surface Water and Gas Vent Controls	1,413,000	586,000

8.1.1.3 Methane Survey

Results from the methane survey indicated that the highest methane concentration was reported on the northeast corner of the landfill, with elevated methane concentrations also observed on the southwest corner of the landfill. The southeast corner of the landfill was generally free of detectable methane, and there was no methane reported in the samples collected off the landfill footprint and adjacent to the Barnard Loop Service Road.

Soil vapor samples collected onsite were also analyzed for chlorinated and non-chlorinated VOC using a field gas chromatograph. These compounds were reported in at least 1 of the samples. Elevated concentrations for all of these analytes were observed on the eastern side of the landfill.

However, samples collected adjacent to this area but off the landfill footprint were free of detectable chlorinated and non-chlorinated VOC. All of the concentrations were below the lower explosive limit for these compounds. These data indicate that methane control will not need to be a component of any actions at this site. However, if a capping system is to be installed for purposes of leachate source reduction, a gas venting layer may be warranted to prevent the buildup of methane below the cap.

8.1.2 Parking Lot F Landfill

8.1.2.1 Leachate Disposal

In August 1995, EA performed an *in situ* flow estimate for seep locations LF95-LS-01 and LF95-LS-03. The leachate flow at location LF95-LS-01 was estimated to be 2,244 gpd. The leachate flow at location LF95-LS-03 was estimated to be 544 gpd. Prior to any implementation of the discussed alternatives, additional flow estimating may be warranted to obtain data for periods with higher amounts of precipitation.

Four alternatives for the disposal of leachate were developed, which include the following:

1. No action
2. Collection and transport to USMA treatment plant
3. Collection and discharge to storm water
4. Collection and discharge to USMA treatment plant.

The results of the economic analysis for the leachate disposal alternatives are summarized below.

Parking Lot F Landfill		
Alternative	Capital Cost ($)	O&M Cost ($)
1. No Action	500	49,000
2. Collection and Transport to USMA Treatment Plant	46,000	1,788,000
3. Collection and Discharge to Stormwater System (Pretreatment)	252,000	253,000
4. Collection and Discharge to USMA Treatment Plant	167,000	55,000

8.1.2.2 Leachate Source Reduction

According to USMA representatives, future plans at the Parking Lot F Landfill call for the repaving of the entire surface of the landfill, which could be considered to be a source reduction alternative. In addition, the following alternative was considered:

1. Capping (clay) with surface water controls.

The results of the economic analysis for the leachate source reduction alternatives are summarized below:

Parking Lot F Landfill		
Alternative	Capital Cost ($)	O&M Cost ($)
1. Repave Surface and Improve Swale Drainage Characteristics	307,000	186,000
2. Capping (Clay) with Surface Water Controls	834,000	586,000

8.1.3 Organic Compost Landfill

8.1.3.1 Leachate Disposal

According to the 1994 LAW report, the existing leachate collection system was installed in 1990. It appears that the system was to collect both leachate and surface water runoff, although no seep outbreaks could be located by EA during field sampling activities conducted in May 1995. It also appears that a perforated PVC drainage pipe was installed along the edge of the access road and connected to a 750-gal tank. The intent of the system was to periodically pump the tank and transport its contents to the USMA treatment plant via tanker truck.

Three alternatives for the disposal of leachate were developed, which include the following:

1. No action
2. Collection and discharge to storm water
3. Collection and discharge to USMA treatment plant.

The results of the economic analysis for the leachate disposal alternatives are summarized below.

Organic Compost Landfill		
Alternative	Capital Cost ($)	O&M Cost ($)
1. No Action	500	78,000
2. Collection and Discharge to Storm Water (Pretreatment)	111,000	143,000
3. Collection and Discharge to USMA Treatment Plant	44,000	55,000

8.1.3.2 Leachate Source Reduction

According to USMA representatives, the Organic Compost Landfill will continue to be used as a storage and parking area. Repaving of the lot could be considered to be a source reduction alternative.

The result of the economic analysis for the leachate source reduction alternative is summarized below:

Organic Compost Landfill		
Alternative	Capital Cost ($)	O&M Cost ($)
1. Repave Surface of Lot	33,000	186,000

8.1.4 Ski Lot Landfill

8.1.4.1 Leachate Disposal Alternatives

In August 1995, EA performed an *in situ* flow estimate for seep location SL95-LS-01. The leachate flow at location SL95-LS-01 was estimated to be 12 gpd. A flow estimate could not be performed at that time at location SL95-LS-02 since the area was dry. Prior to any implementation of the discussed alternatives, additional flow estimating may be warranted to obtain data for periods with higher amounts of precipitation.

There is no existing leachate collection system at the Ski Lot Landfill.

Four alternatives for the disposal of leachate were developed, which include the following:

1. No action
2. Collection and transport to USMA treatment plant
3. Pretreatment and discharge to surface water
4. Collection and discharge to USMA treatment plant.

The results of the economic analysis for the leachate disposal alternatives are summarized below:

Ski Lot Landfill		
Alternative	Capital Cost ($)	O&M Cost ($)
1. No Action	500	49,000
2. Collection and Transport to USMA Treatment Plant	20,000	56,000
3. Collection and Discharge to Surface Water (Pretreatment)	240,000	253,000
4. Collection and Discharge to USMA Treatment Plant	79,000	55,000

8.1.4.2 Leachate Source Reduction

According to USMA representatives, the Ski Lot Landfill will continue to be used as a parking area. Repaving of the lot could be considered to be a source reduction alternative.

The result of the economic analysis for the leachate source reduction alternative is summarized below:

Ski Lot Landfill		
Alternative	Capital Cost ($)	O&M Cost ($)
1. Repave Surface of Lot	196,000	186,000

8.1.4.3 Methane Survey

Results from the methane survey indicated that the highest methane concentration was reported on the southeast side of the landfill. Overall, methane was reported in 25 of the 26 samples collected, with 5 of the results exceeding the lower explosive limit for methane (15 percent), and 4 of the results exceeding the upper explosive limit (25 percent) for methane. Samples collected along the edge of the golf course or near Building 1227 showed methane at low concentrations (less than 0.5 percent).

Soil vapor samples collected onsite were also analyzed for chlorinated and non-chlorinated VOC using a field gas chromatograph. Benzene, toluene, m/p-xylene, o-xylene, trichloroethene, and tetrachloroethene were detected in these samples. All of these VOC were noted in conjunction with the elevated methane concentrations observed on the east-southeast side of the landfill. These data indicate that methane control will not need to be a component of any actions at this site.

8.1.5 Motor Pool Landfill

8.1.5.1 Leachate Disposal Alternatives

In August 1995, EA performed an *in situ* flow estimate for seep location MP95-LS-01. The leachate flow at location MP95-LS-01 was estimated to be 113 gpd. A flow estimate could not be performed at that time at location MP95-LS-02 since the area was dry. Prior to any implementation of the discussed alternatives, additional flow estimating may be warranted to obtain data for periods with higher amounts of precipitation.

There is no existing leachate collection system at the Motor Pool Landfill.

Three alternatives for the disposal of leachate were developed, which include the following:

1. No action
2. Collection and discharge to USMA treatment plant
3. Collection and discharge to surface water.

Motor Pool Landfill		
Alternative	Capital Cost ($)	O&M Cost ($)
1. No Action	0	47,000
2. Collection and Discharge to USMA Treatment Plant	41,000	55,000
3. Collection and Discharge to Surface Water (Pretreatment)	130,000	151,000

8.1.5.2 Leachate Source Reduction

According to USMA representatives, the Motor Pool Landfill will continue to be used as a parking area. Repaving of the lot could be considered to be a source reduction alternative.

The results of the economic analysis for the leachate source reduction alternatives are summarized below:

Motor Pool Landfill		
Alternative	Capital Cost ($)	O&M Cost ($)
1. Repave Surface of Lot	491,000	186,000
2. Repave Surface of Lot Within Limits of Proposed Soil Vapor Extraction System	349,000	186,000

The proposed soil vapor extraction system is discussed in Section 6.3.2. Although the intent of repaving the surface of the lot within the limits of the soil vapor extraction system would be to enhance its operation, it may also contribute to the source reduction of leachate. Therefore, the cost analysis was included with the source reduction alternatives for the Motor Pool Landfill.

8.1.5.3 Methane Survey

Results from the methane survey indicated that the highest methane concentration was reported on the northeastern perimeter of the landfill. Overall, methane was reported in 26 of the 31 samples collected, with 19 of the results exceeding the lower explosive limit (15 percent) and 17 of the results exceeding the upper explosive limit (25 percent) for methane. Proposed actions for the handling of methane are discussed in Section 6.3.2.

Soil vapor samples collected onsite were also analyzed for chlorinated and non-chlorinated VOC using a field gas chromatograph. All of the concentrations were below the lower explosive limit for these compounds. The highest total benzene, toluene, ethyl benzene, and xylene concentrations were reported on the western perimeter of the landfill.

8.1.6 Parking Lot D Landfill

According to the Phase I report (LAW 1994), leachate generation was observed at a location in the vicinity of monitoring Wells LD-04 and LD-05. The amount of flow was estimated to be 10 gal/day. However, no supporting calculations or data could be found to support this estimate. During field investigation activities conducted by EA in 1995, no evidence of any seep outbreaks could be found at or in the immediate vicinity of Parking Lot D Landfill. In addition, no leachate collection system has been installed at the Parking Lot D Landfill.

8.2 CONCLUSIONS

Analytical results collected during this investigation were used in conjunction with historical data collected from each of these sites to evaluate whether the landfill waste was contributing to the possible degradation of the ground water or surface water adjacent to the landfills. Results from the sampling conducted at each seep location are presented in the Phase II Investigation Report. All of the seep samples showed elevated levels of metals and water quality results relative to the background spring located west of the USMA Washington Gate entrance. Although NYSDEC Class GA standards were exceeded in some of the cases, the parameters are associated with taste and odor considerations for drinking water quality and are not considered "toxic." The standards which were exceeded were for metals such as iron, magnesium, manganese, and sodium. However, since all of the seeps exhibit iron flocculation, they have aesthetic impacts at their discharge points. Therefore, improvements to the leachate interception and conveyance systems may be warranted.

Existing leachate collection systems at the Post School, Parking Lot F, and Organic Compost landfills were determined to be only partially effective.

Leachate generation at Parking Lot D Landfill was considered negligible and an evaluation of leachate disposal and source reduction alternatives was not performed.

The New York State Landfill regulations (6 NYCRR Part 360, Section 2.17[f]) require that landfill gases be below the lower explosive limit along the perimeter. Therefore, the Post School and Ski Lot landfills are in compliance with this regulatory requirement. At the Motor Pool Landfill, the methane survey showed methane concentrations in excess of the lower explosive limit and upper explosive limit at several sampling locations. The output from the kriged results, which yields statistically weighted concentrations, showed concentration isopleths increasing from the approximate center of the landfill toward the northeast corner of the landfill. It appears that the methane gas is migrating towards this side of the landfill. Therefore, installation of a treatment system, either active or passive, may be necessary at the Motor Pool Landfill.

9. RECOMMENDATIONS FOR FURTHER ACTION

The Leachate Management Analysis has been prepared to examine the potential alternatives to disposing of leachate and reducing the generation of leachate at each of the Six Landfills at West Point, New York. In addition, potential alternatives for the handling of methane generation at the Motor Pool Landfill have been prepared and are included in this report. The alternatives were compared based upon implementability, cost, and compliance with regulations. Based upon analysis of data presented in the Phase II Investigation Report and Leachate Management Analysis, the following alternatives are proposed and discussed below for each landfill.

9.1 POST SCHOOL LANDFILL

9.1.1 Leachate Disposal

Recommendation: Alternative PS-ALT L2 (Collection and Discharge to USMA Treatment Plant)

A leachate collection system should be installed at seep location PS95-LS-01 to upgrade the existing collection system. The new system should be connected directly to the existing sanitary sewer system located in the vicinity of the seep location. The existing leachate collection tank should also be abandoned in place or removed.

It should be noted that at the time of this report, a 30 percent design has been completed for this alternative and construction work is underway.

Criteria

This alternative was selected due to the following criteria:

- Implementation of the alternative would limit future access to the seep location.
- The amount of space required to implement this alternative would be minimal.
- The overall costs associated with the alternative would be significantly less than those for pretreatment.

9.1.2 Leachate Source Reduction

Recommendation: Alternative PS-ALT S1 (Capping with Surface Water and Gas Vent Controls)

Capping of the site may be warranted to effectively close the site in compliance with 6 NYCRR Part 360 regulations. This would include a site cap (geocomposite), gas collection system, surface water diversion system, and site contour plans.

It should be noted that at the time of this report, construction work has begun to improve the existing surface water diversion system (swale) along the west side of the landfill.

Criteria

This alternative was selected due to the following criteria:

- It would effectively close the site.
- It would be compatible with future use plans for the site.

9.1.3 Methane Handling

At this time, methane generation does not appear to be significant enough to warrant installation of either a passive or active collection system. Thus, **"No Action"** is recommended for methane handling at this landfill. However, if a capping system is to be installed for purposes of leachate source reduction, a gas venting layer may be warranted to prevent the buildup of methane below the cap and allow the gas to vent to the atmosphere.

9.2 PARKING LOT F LANDFILL

9.2.1 Leachate Disposal

Recommendation: Alternative LF-ALT L4 (Collection and Discharge to USMA Treatment Plant)

A leachate collection system should be installed at seep locations LF95-LS-01 and LF95-LS-03. The new system should be connected directly to the existing sanitary sewer system located in the vicinity of the intersection of Howze Place and Fenton Road. The existing leachate collection tank should also be abandoned in place or removed.

It should be noted that at the time of this report, a 30 percent design has been completed for seep location LF95-LS-01, and construction work is underway to install collection lines at both seep locations. As an interim measure, the collection systems at both seep locations are to be connected to the stormwater system.

Criteria

This alternative was selected due to the following criteria:

- The amount of space required to implement this alternative would be minimal.
- The overall costs associated with the alternative would be significantly less than those for pretreatment and for transporting leachate to the USMA treatment plant.

9.2.2 Leachate Source Reduction

Recommendation: Alternative LF-ALT S1 (Repave Surface and Improve Swale Characteristics)

The surface of the landfill should be repaved with asphalt to help reduce the infiltration of precipitation through the waste-bearing layers of the landfill.

Criteria

Repaving of the surface of the landfill was recommended since it would be compatible with the future use plans for the site.

9.3 ORGANIC COMPOST LANDFILL

9.3.1 Leachate Disposal

Recommendation: Alternative OC-ALT L1 (No Action with Continued Monitoring)

At this time, leachate generation does not appear to be significant enough to warrant an upgrade of the existing collection system. Thus, **"No Action with Continued Monitoring"** is recommended for this location.

Criteria

This alternative was recommended since leachate generation does not appear to be significant enough to warrant an upgrade of the existing collection system. In addition, no seep outbreaks could be located by EA during field activities conducted in May 1995.

9.3.2 Leachate Source Reduction

At this time, leachate generation does not appear to be significant enough to warrant repaving of the surface of the landfill. Thus, **"No Action"** is recommended for leachate source reduction at this landfill.

9.4 SKI LOT LANDFILL

9.4.1 Leachate Disposal

Recommendation: Alternative SL-ALT L4 (Collection and Discharge to USMA Treatment Plant)

A leachate collection system should be installed at seep locations SL95-LS-01 and SL95-LS-02. The new collection system at Seep SL95-LS-01 should be connected directly to the existing sanitary sewer system located to the west of the U.S. Treasury Depository. The new collection system at Seep SL95-LS-02 should be connected directly to the existing sanitary sewer system located in the vicinity of the Motor Pool Landfill.

Criteria

This alternative was selected due to the following criteria:

- The amount of space required to implement this alternative would be minimal.
- The overall costs associated with the alternative would be significantly less than those for pretreatment.
- The alternative would not require the use of owned or leased equipment to transport the leachate to the USMA treatment plant.
- Although the overall costs associated with transporting the leachate to the treatment plant are lower than those for connecting to the sewer, the costs were based on flow estimates performed during drier months. If flow amounts were found to be significantly higher at other times of the year, collection and transportation may become significantly more expensive and may not be as practical as connecting to the sewer.

9.4.2 Leachate Source Reduction

Recommendation: Alternative SL-ALT S1 (Repave Surface of Lot and Improve Swale Drainage Characteristics)

The surface of the landfill should be repaved with asphalt to help reduce the infiltration of precipitation through the waste-bearing layers of the landfill.

Criteria

Repaving of the surface of the landfill was recommended since it would be compatible with the future use plans for the site.

9.4.3 Methane Handling

At this time, methane generation does not appear to be significant enough to warrant installation of either a passive or active collection system. Thus, **"No Action"** is recommended for methane handling at this landfill.

9.5 MOTOR POOL LANDFILL

9.5.1 Leachate Disposal

Recommendation: Alternative MP-ALT L2 (Collection and Discharge to USMA Treatment Plant)

A leachate collection system should be installed at seep locations MP95-LS-01 and MP95-LS-02. The new system should be connected directly to the existing sanitary sewer system that follows along the southwest side South Moore Loop, at the rear of the housing units. Seep location MP95-LS-01 would require a scavenger tank equipped with a pumping system to move leachate from the source area to a suitable sewer connection location.

Criteria

This alternative was selected due to the following criteria:

- The amount of space required to implement this alternative would be minimal.
- The overall costs associated with the alternative would be significantly less than those for pretreatment.

9.5.2 Leachate Source Reduction

Recommendation: Alternative MP-ALT S1 (Repave Surface of Lot)

The surface of the landfill should be repaved with asphalt to help reduce the infiltration of precipitation through the waste-bearing layers of the landfill.

Criteria

The amount of repaving would depend upon whether an active or passive collection system for methane was selected. However, in either case, repaving would contribute to the reduction of leachate generation.

Repaving of the surface of the landfill was recommended since it would be compatible with the future use plans for the site.

9.5.3 Methane Handling

At this time, a recommendation for the type of collection system to be installed at the Motor Pool Landfill will not be made. Prior to any recommendation, additional surveying should be performed to further assess the presence of methane and soil vapor at the landfill.

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Appendix A

Calculations for Leachate Flow Estimates (Current Conditions)

APPENDIX A

CALCULATIONS FOR LEACHATE FLOW ESTIMATES (CURRENT CONDITIONS) SIX LANDFILLS, U.S. MILITARY ACADEMY, WEST POINT, NEW YORK

SKI LOT LANDFILL (SL95-LS-02)			
Dimensions (ft^3): 0.83 (12 in. x 12 in. x 10 in.; L x W x D)			
Time	Diff (hr)	Volume (ft^3)	gpd
1100		0	
1400	3	0.208	12
To convert from ft^3 to gallons, multiply by 7.4805195			

MOTOR POOL LANDFILL (MP95-LS-01)			
Dimensions (ft^3): 1.59 (14 in. x 14 in. x 14 in.; L x W x D)			
Time	Diff (hr)	Volume (ft^3)	gpd
1145		0	
1220	0.58	0.624	192
1330	1.75	0.907	93
1445	3.00	0.907	54
Mean			113

POST SCHOOL LANDFILL (PS95-LS-01)			
Time (sec)	Volume (mL)	L/min	gpd
20	500	1.50	570.6
22	570	1.55	591.4
21	550	1.57	597.8
Mean			587

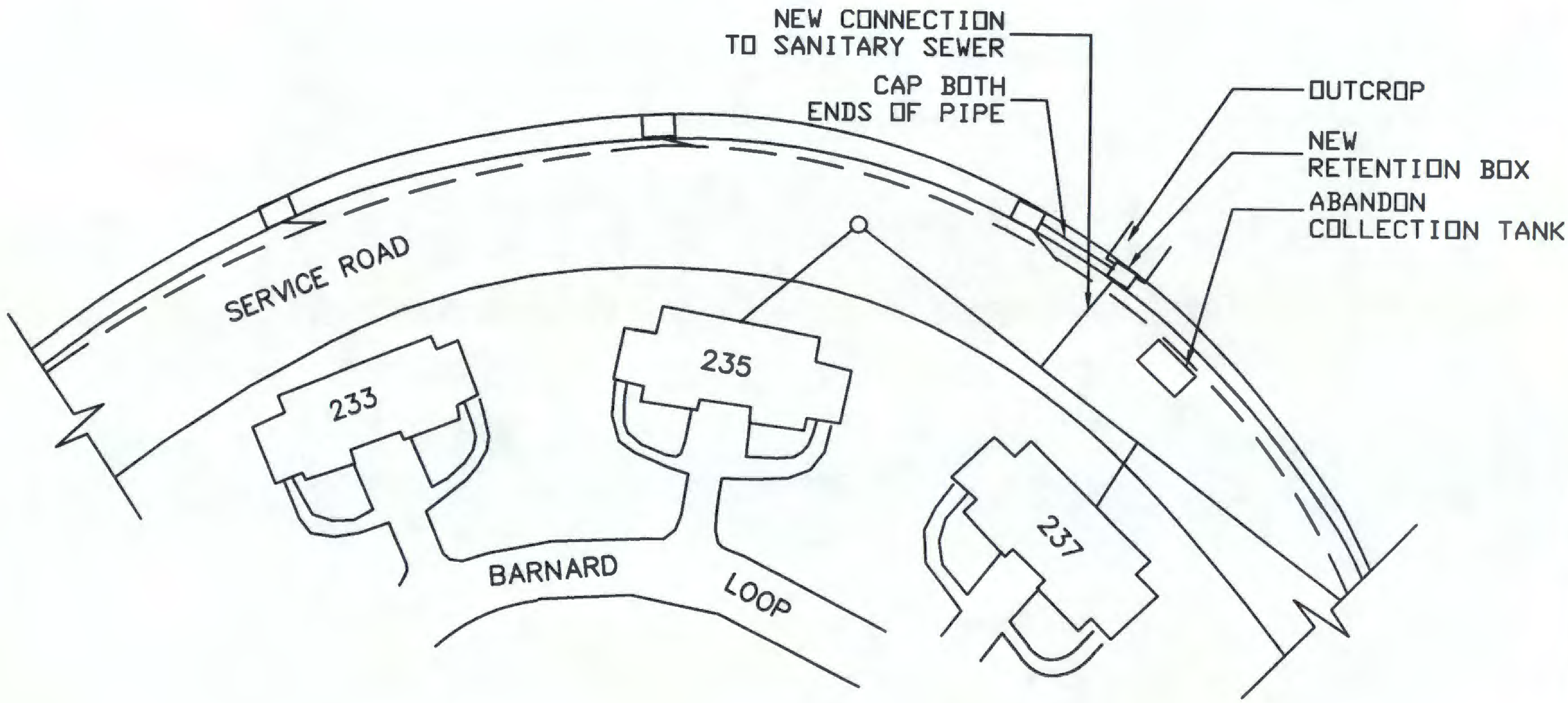
PARKING LOT F LANDFILL (LF95-LS-01)			
Dimensions (ft^3): 1.00 (12 in. x 12 in. x 12 in.; L x W x D)			
Time	Diff (hr)	Volume (ft^3)	gpd
1537		0	
1539	0.03	0.500	2,693
1543	0.10	1.000	1,795
Mean			2,244

PARKING LOT F LANDFILL (LF95-LS-03)			
Dimensions (ft^3): 1.00 (12 in. x 12 in. x 12 in.; L x W x D)			
Time	Diff (hr)	Volume (ft^3)	gpd
1244		0	
1304	0.33	1.000	544

Appendix B

Figures and Details for Leachate Disposal Alternatives

APPENDIX B - LIST OF FIGURES



LEGEND
- ■ SEEP LOCATION
- ▭ CATCH BASIN
- O MANHOLE
- - - STORM DRAIN
- —— SANITARY SEWER LINE

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EA ENGINEERING, SCIENCE, AND TECHNOLOGY	SIX LANDFILLS U.S. MILITARY ACADEMY WEST POINT, NEW YORK	FIGURE B-1 PROPOSED COLLECTION SYSTEM POST SCHOOL LANDFILL

PROJECT MGR	DESIGNED BY	DRAWN BY	CHECKED BY	SCALE	DATE	PROJECT NO	FILE No.
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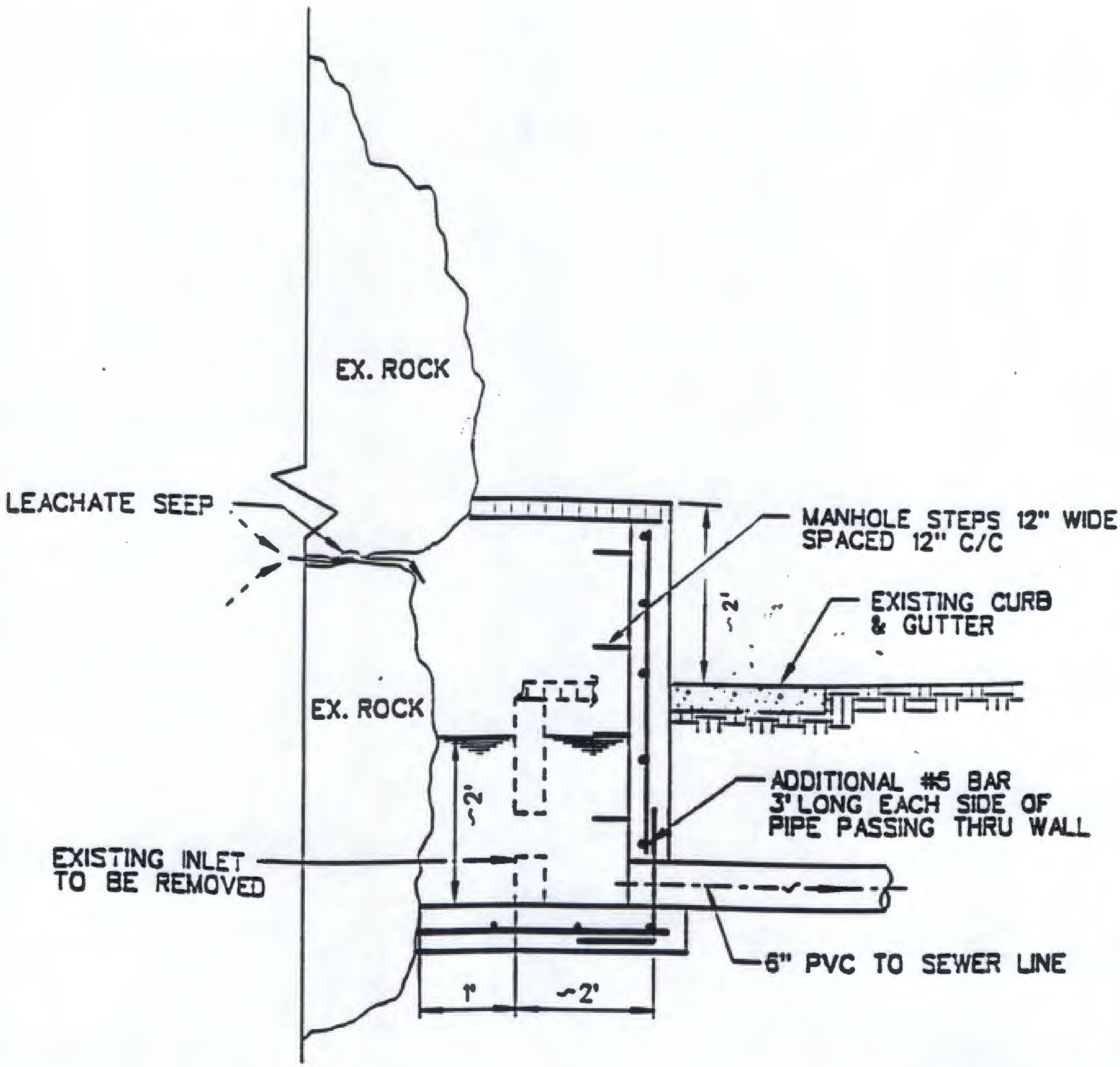

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EA ENGINEERING, SCIENCE, AND TECHNOLOGY

SIX LANDFILLS
U.S. MILITARY ACADEMY
WEST POINT, NEW YORK

FIGURE B-2
SECTION 1-1
LEACHATE COLLECTION BOX
POST SCHOOL LANDFILL

PROJECT MGR	DESIGNED BY	DRAWN BY	CHECKED BY	SCALE	DATE	PROJECT NO	FILE No.
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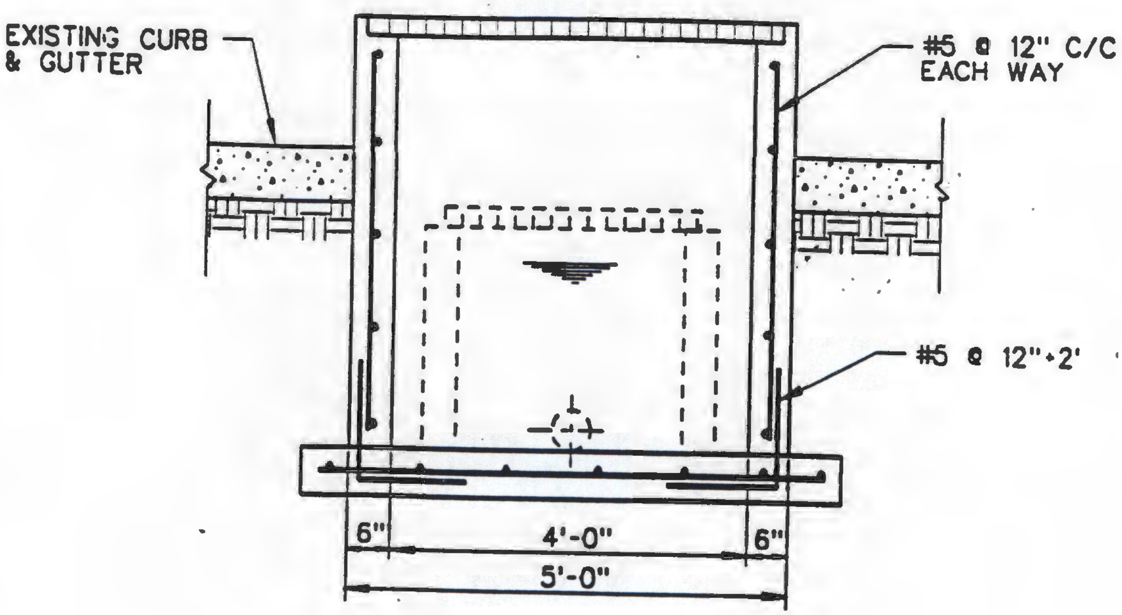

DWG. FILE No. F:\CAD\60787\52\SEC2-2

EA ENGINEERING, SCIENCE, AND TECHNOLOGY	SIX LANDFILLS U.S. MILITARY ACADEMY WEST POINT, NEW YORK	FIGURE B-3 SECTION 2-2 LEACHATE COLLECTION BOX POST SCHOOL LANDFILL

PROJECT MGR	DESIGNED BY	DRAWN BY	CHECKED BY	SCALE	DATE	PROJECT NO	FILE No.
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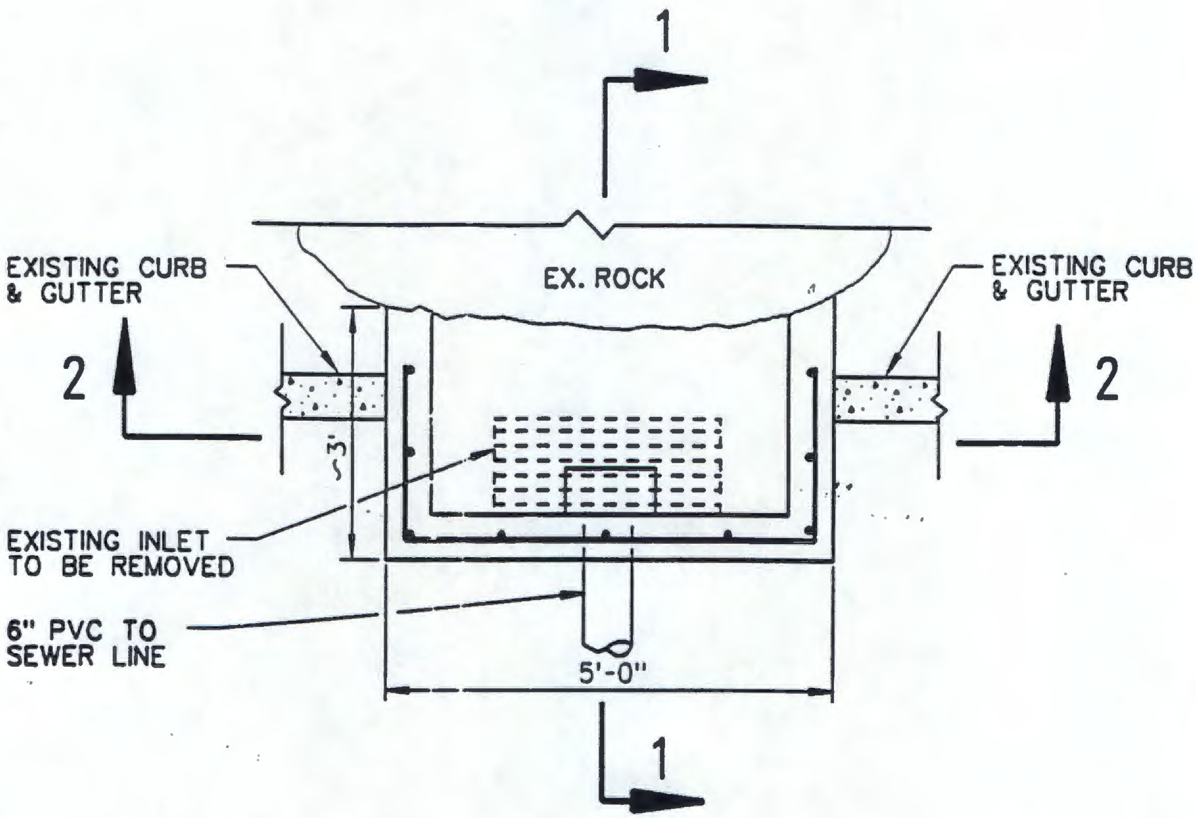

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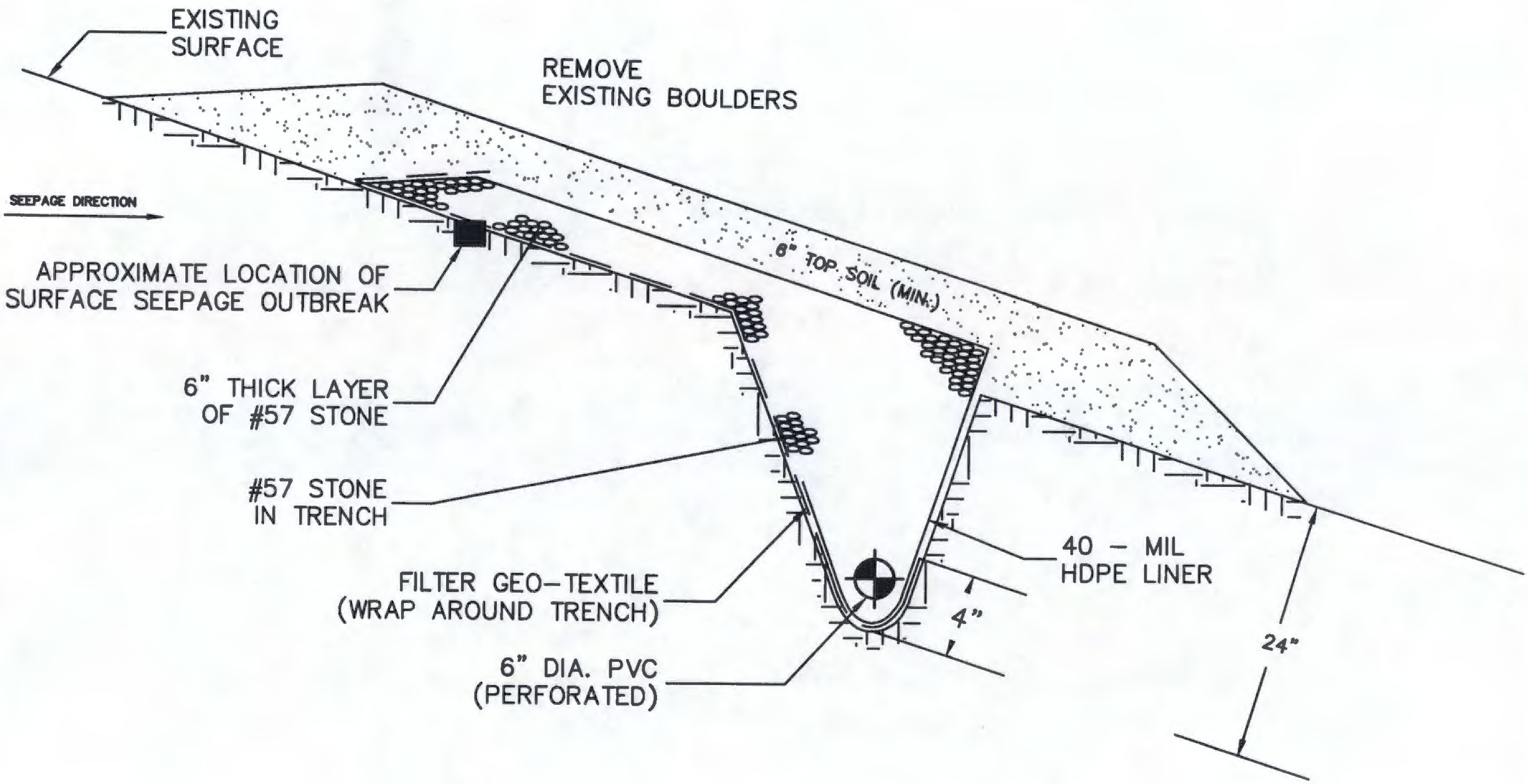
EA ENGINEERING, SCIENCE, AND TECHNOLOGY

SIX LANDFILLS
U.S. MILITARY ACADEMY
WEST POINT, NEW YORK

FIGURE B-4
PLAN VIEW
LEACHATE COLLECTION BOX
POST SCHOOL LANDFILL

PROJECT MGR	DESIGNED BY	DRAWN BY	CHECKED BY	SCALE	DATE	PROJECT NO	FILE No.
JHS	JCH	SY	JCH	N.T.S.	07/25/1995	60787.52	PLAN



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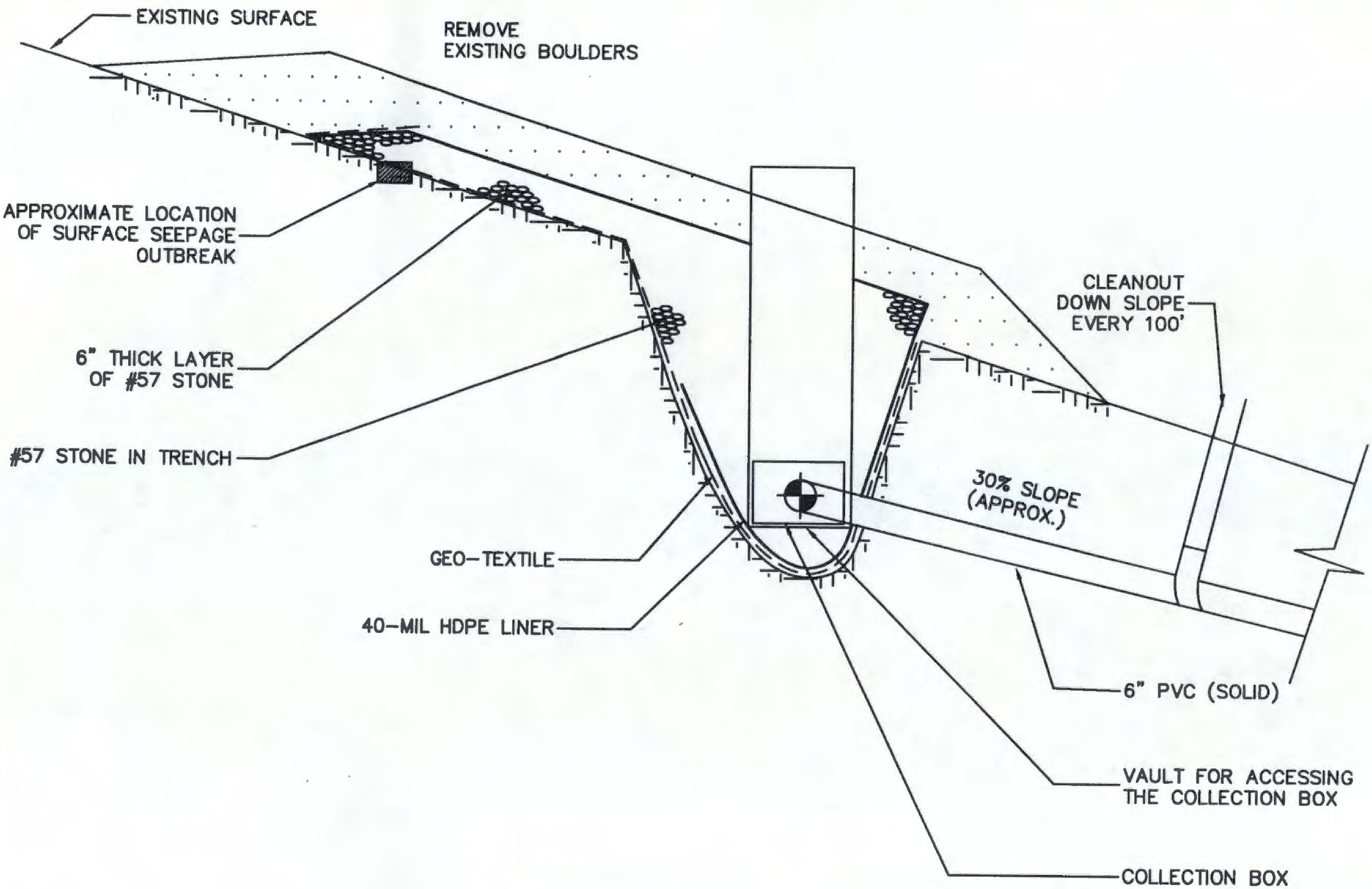
EA ENGINEERING, SCIENCE, AND TECHNOLOGY				SIX LANDFILLS U.S. MILITARY ACADEMY WEST POINT, NEW YORK		FIGURE B-5 SECTION 3-3 SURFACE COLLECTION OF LEACHATE PARKING LOT F	
PROJECT MGR JHS	DESIGNED BY JCH	DRAWN BY SY	CHECKED BY SMD	SCALE N.T.S.	DATE 07/26/95	PROJECT NO 60787.52	FILE No. SEC3-3



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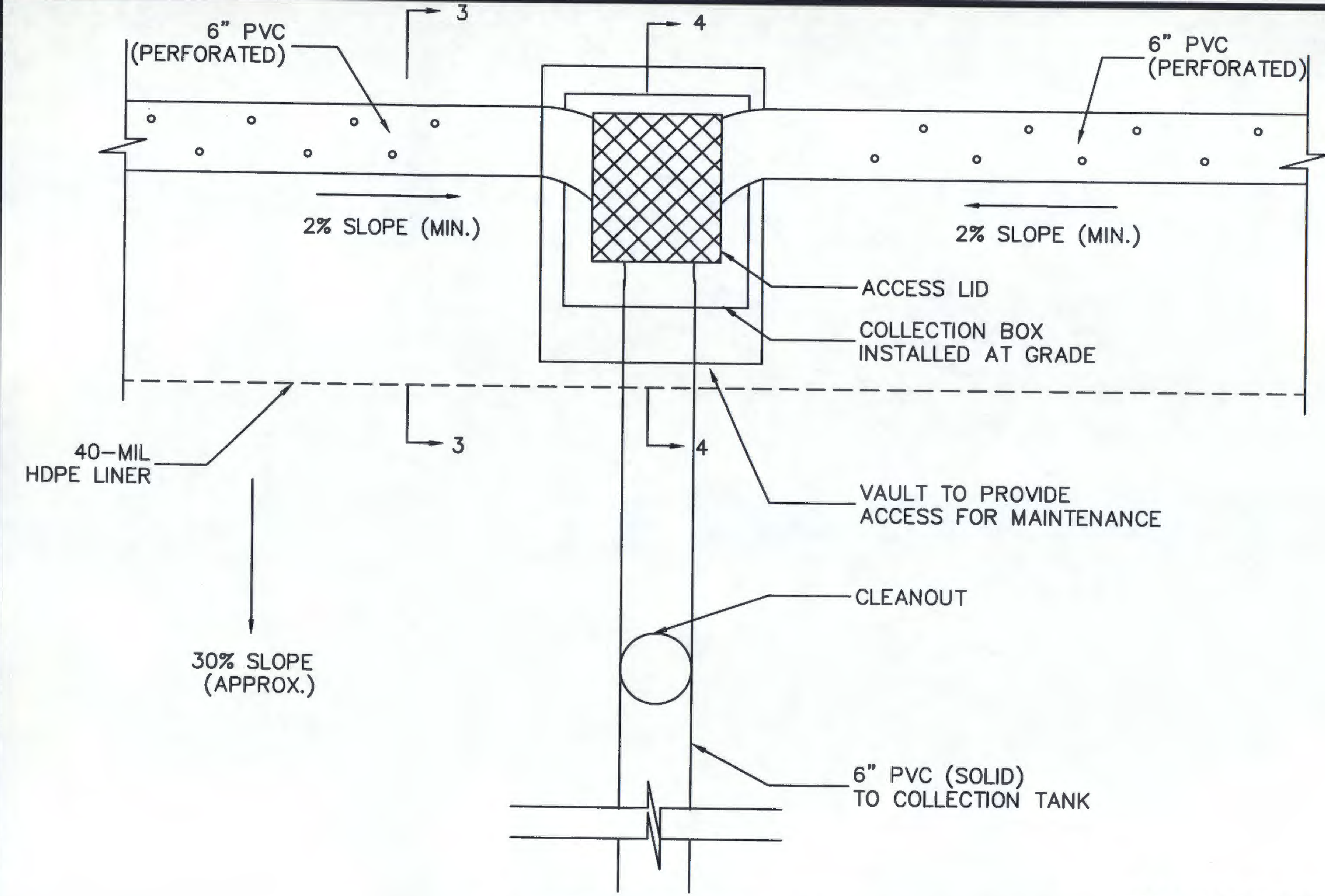
EA ENGINEERING, SCIENCE, AND TECHNOLOGY		SIX LANDFILLS U.S. MILITARY ACADEMY WEST POINT, NEW YORK				FIGURE B-6 SECTION 4-4 DISTRIBUTION OF COLLECTED LEACHATE PARKING LOT F	
PROJECT MGR JHS	DESIGNED BY JCH	DRAWN BY SY	CHECKED BY SMD	SCALE N.T.S.	DATE 07/25/95	PROJECT NO 60787.52	FILE No. SEC4-4



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EA ENGINEERING, SCIENCE, AND TECHNOLOGY

SIX LANDFILLS
U.S. MILITARY ACADEMY
WEST POINT, NEW YORK

FIGURE B-7
PLAN VIEW OF LEACHATE DISTRIBUTION
PARKING LOT F

PROJECT MGR	DESIGNED BY	DRAWN BY	CHECKED BY	SCALE	DATE	PROJECT NO	FILE No.
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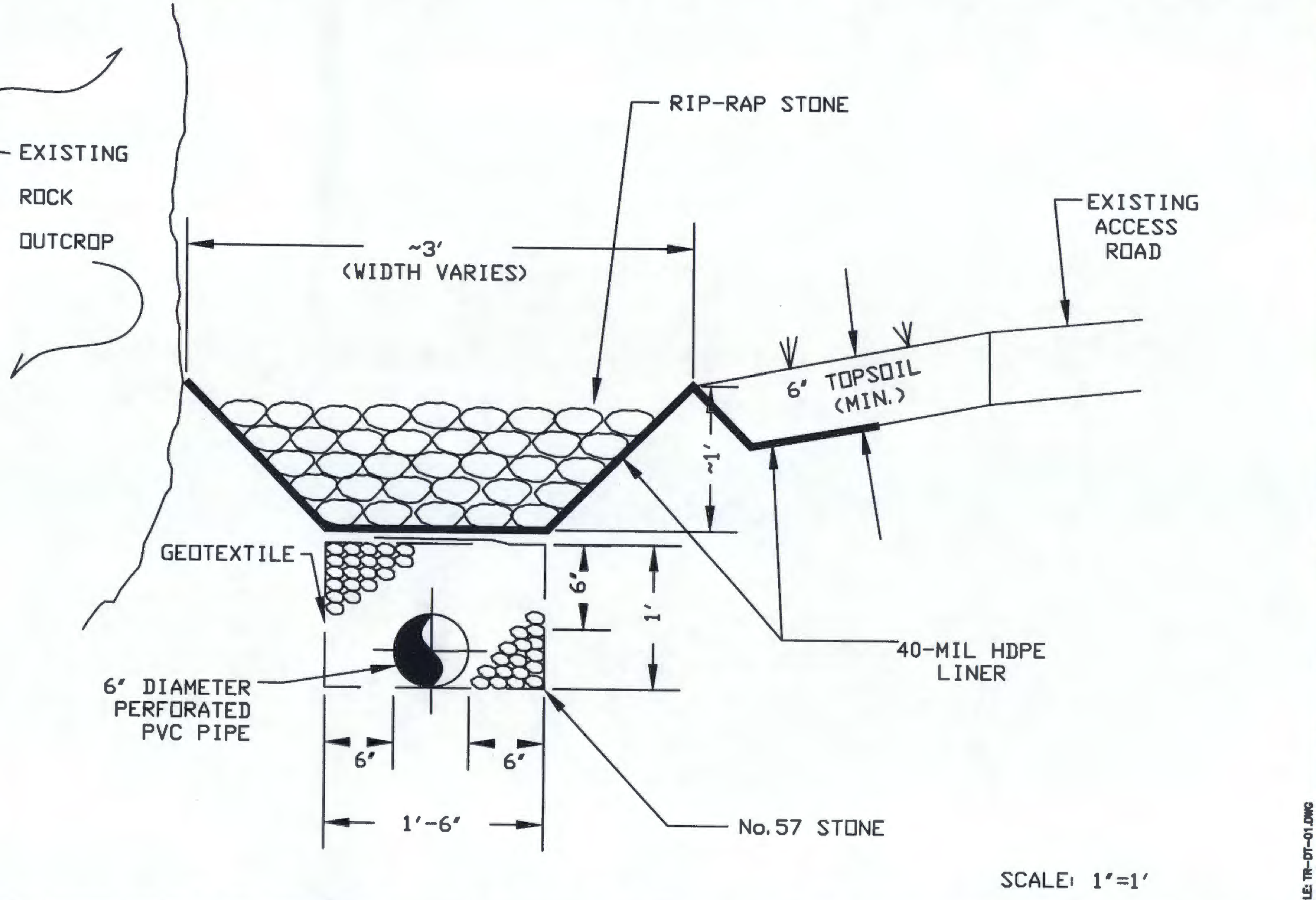
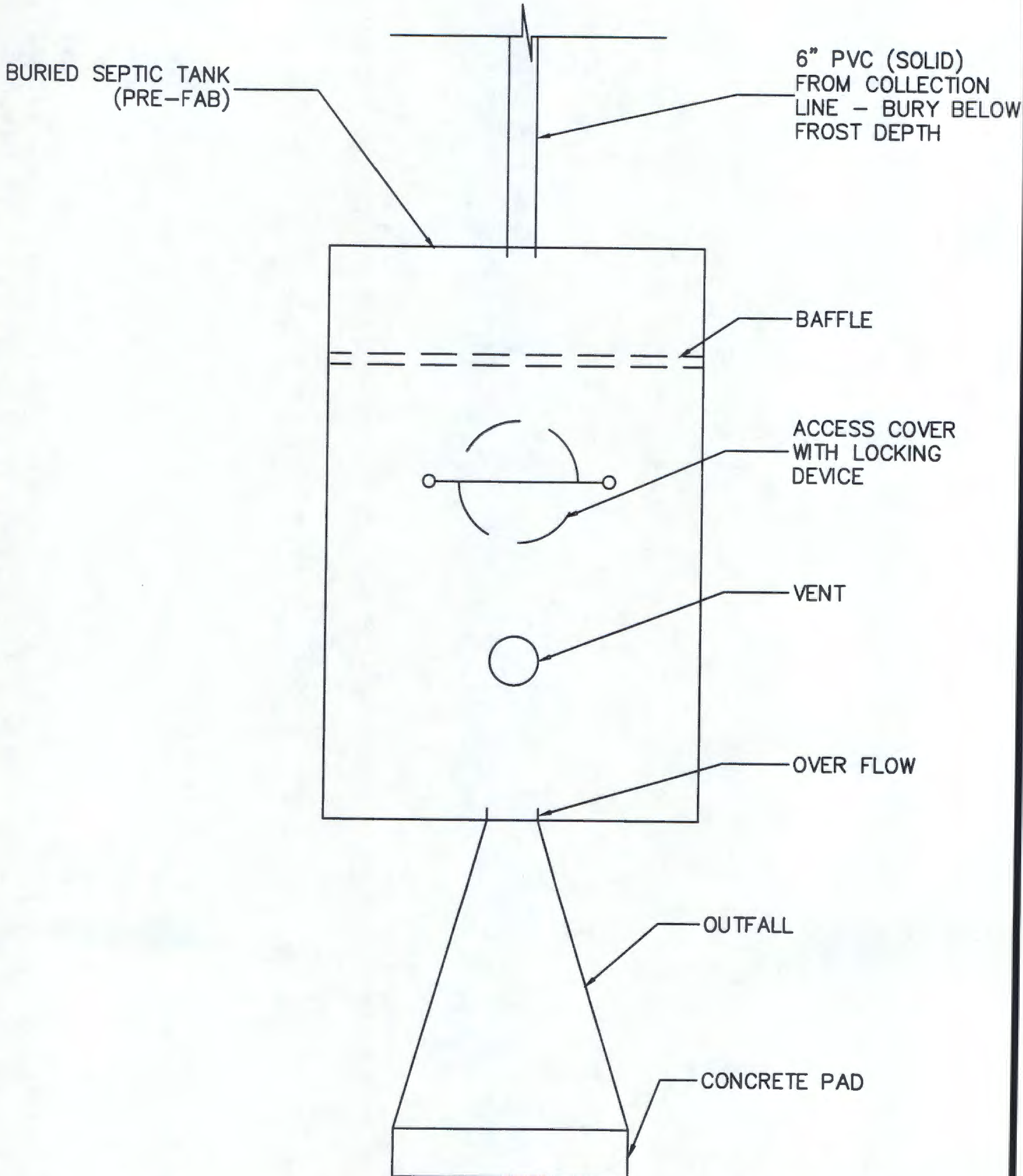


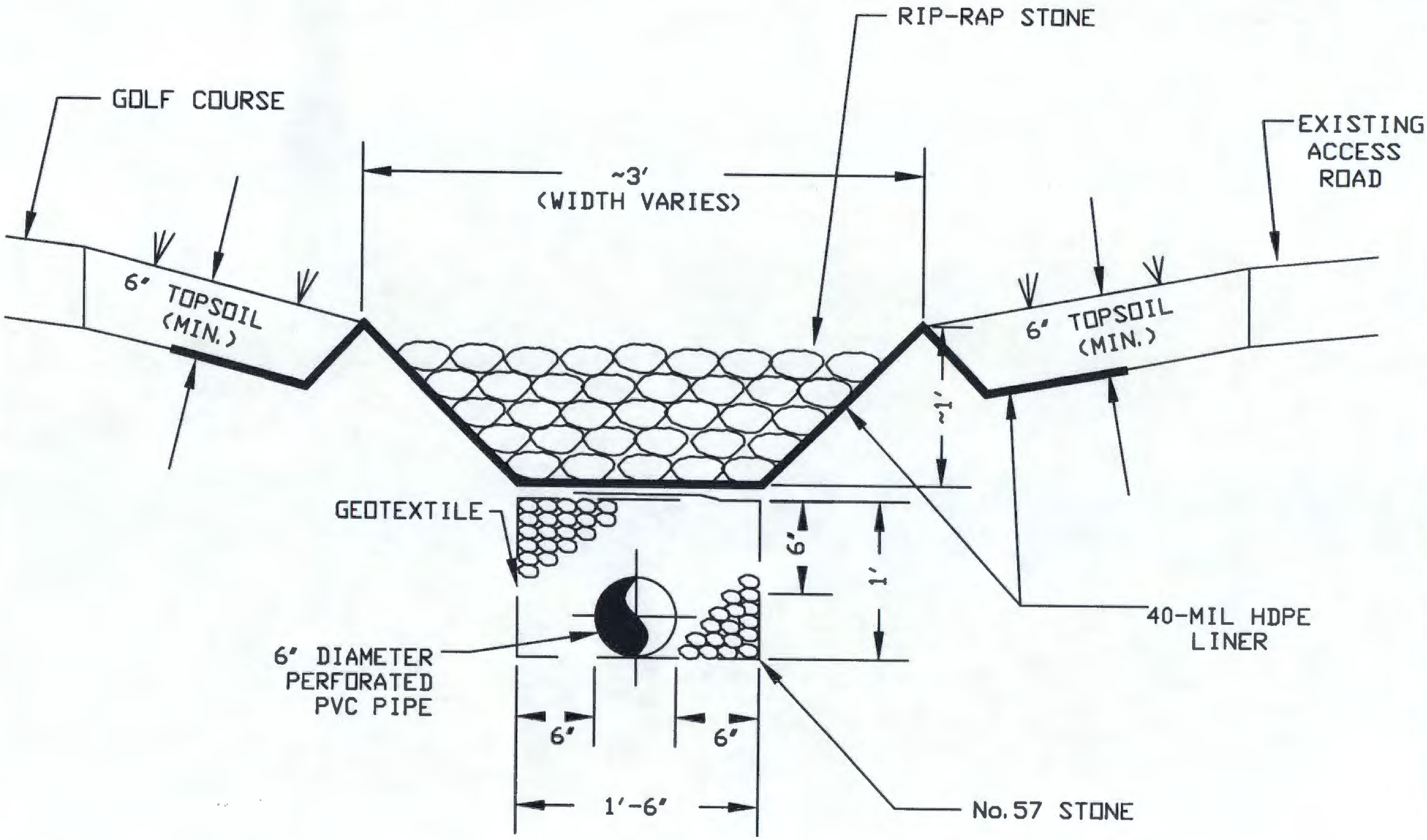
EA ENGINEERING, SCIENCE, AND TECHNOLOGY	SIX LANDFILLS U.S. MILITARY ACADEMY WEST POINT, NEW YORK	FIGURE B-8 TRENCH DETAIL FOR LOCATION LF95-LS-03	DESIGNED BY JCH	DRAWN BY JFW	DATE OCT. 5, 1995	PROJECT NO. 60787.52
			CHECKED BY SMD	PROJECT MGR. JHS	SCALE –	FIGURE –



DWG. FILE No. F:\CAD\60787\52\LF4

EA ENGINEERING, SCIENCE, AND TECHNOLOGY	SIX LANDFILLS U.S. MILITARY ACADEMY WEST POINT, NEW YORK	FIGURE B-9 PLAN VIEW OF LEACHATE COLLECTION TANK PARKING LOT F

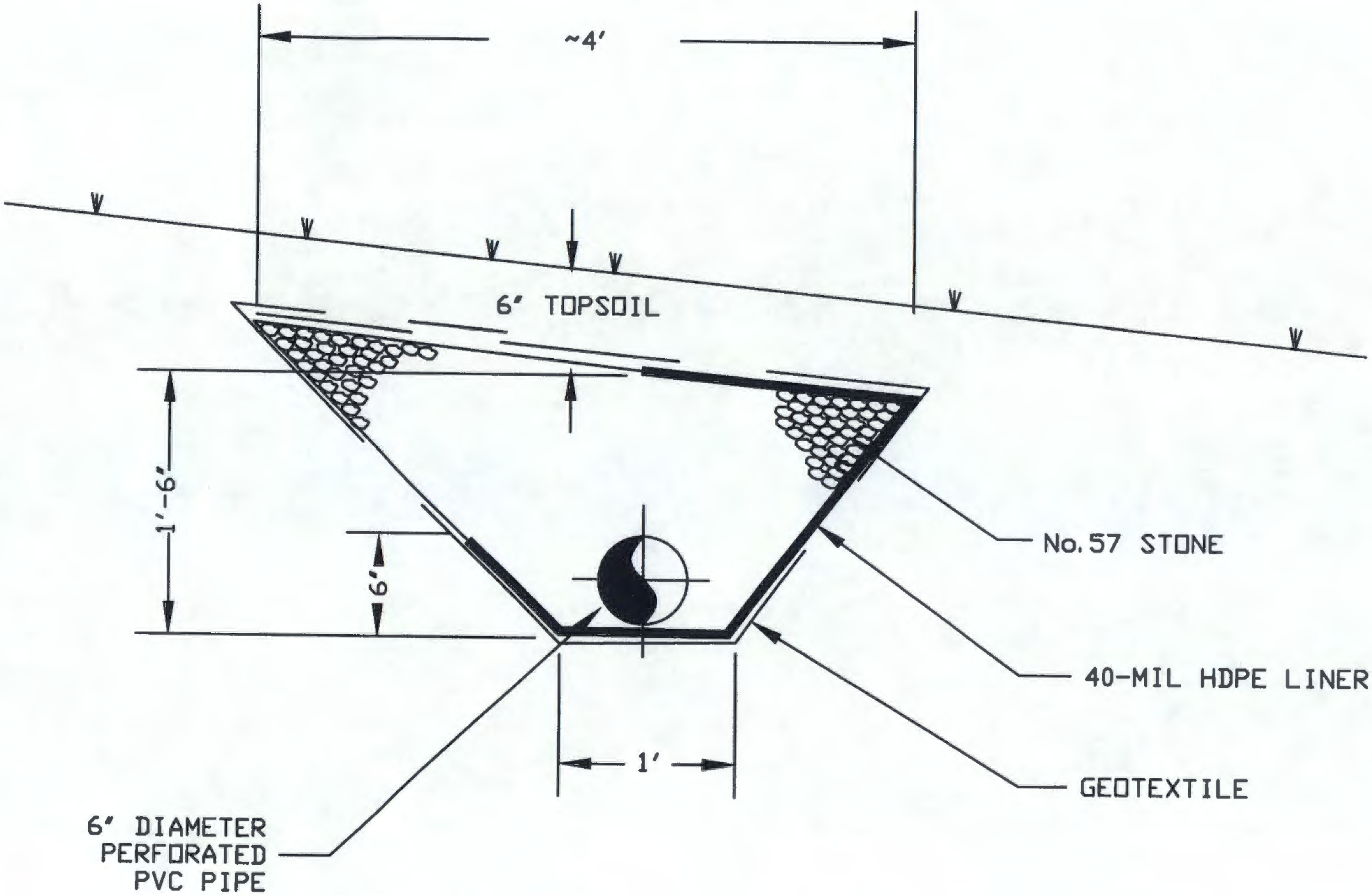
PROJECT MGR	DESIGNED BY	DRAWN BY	CHECKED BY	SCALE	DATE	PROJECT NO	FILE No.
JHS	JCH	SY	SMD	N.T.S.	07/25/1995	60787.52	LF4



SCALE: 1″=1′

FILE: TR-DT-03.DWG

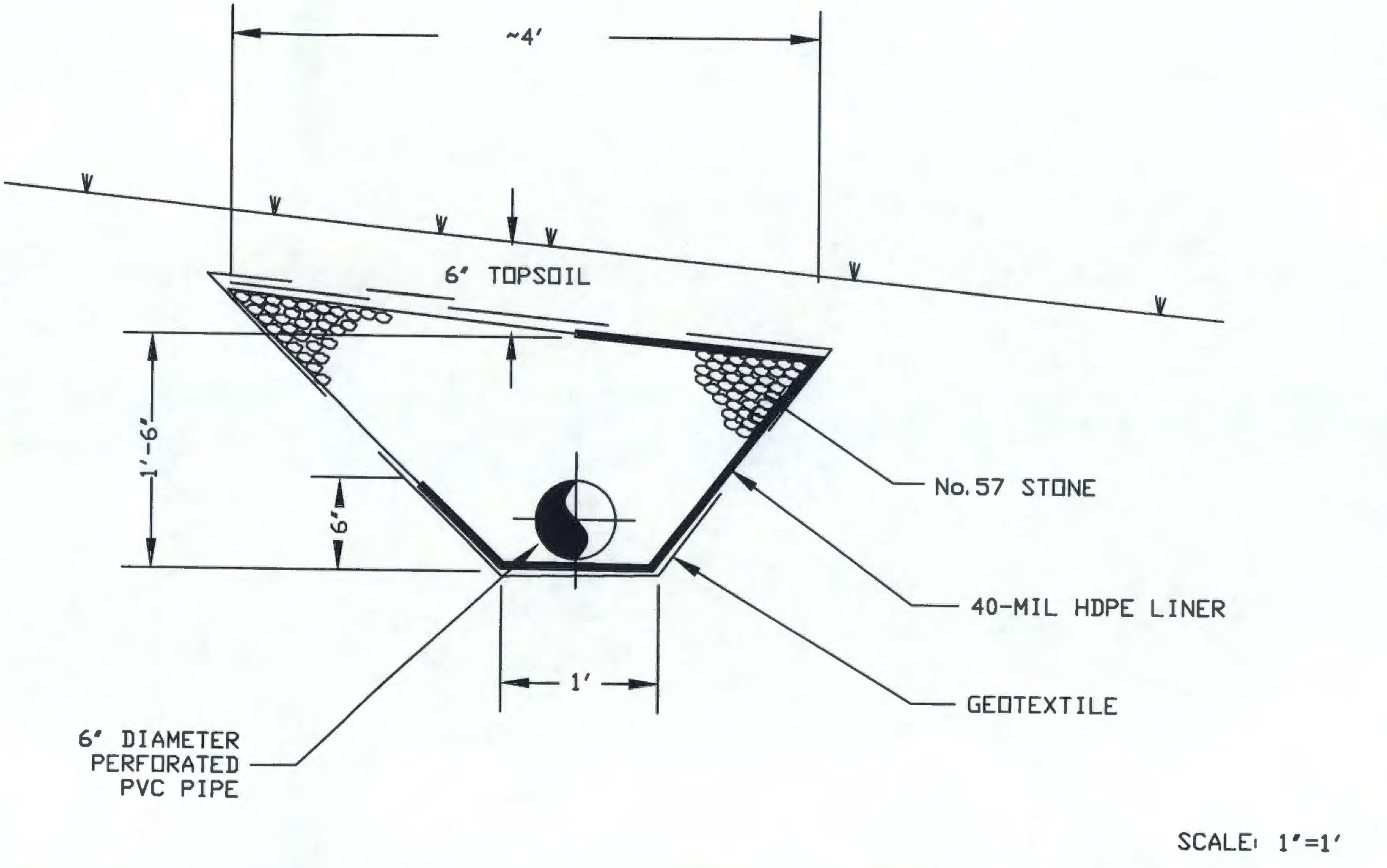
EA ENGINEERING, SCIENCE, AND TECHNOLOGY	SIX LANDFILLS U.S. MILITARY ACADEMY WEST POINT, NEW YORK	FIGURE B-10 TRENCH DETAIL FOR LOCATION SL95-LS-01	DESIGNED BY JCH	DRAWN BY JFW	DATE OCT. 5, 1995	PROJECT NO. 60787.52
			CHECKED BY SMD	PROJECT MGR. JHS	SCALE –	FIGURE –



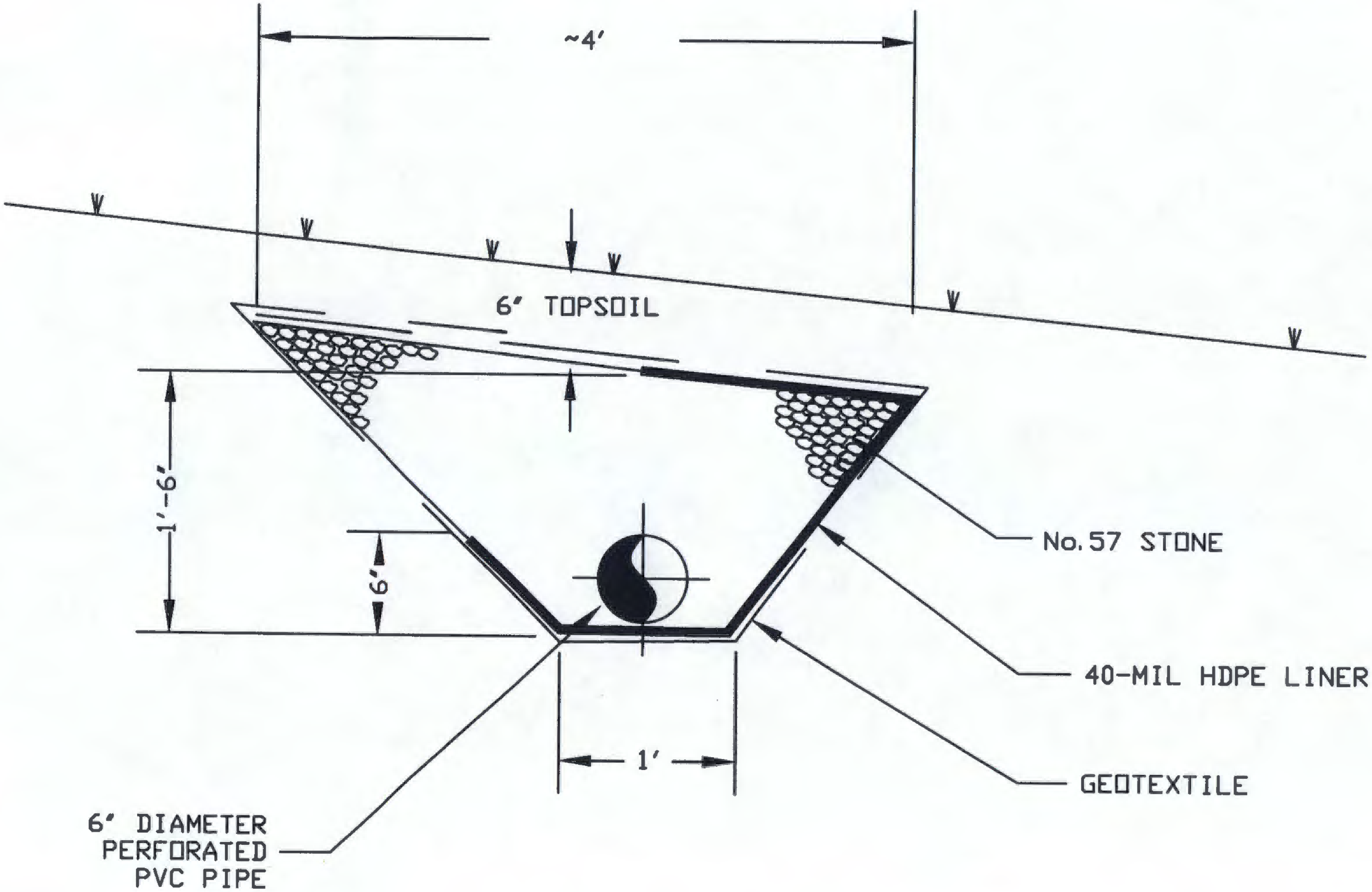
SCALE: 1'=1'

FILE: TR-DT-02.DWG

EA ENGINEERING, SCIENCE, AND TECHNOLOGY	SIX LANDFILLS U.S. MILITARY ACADEMY WEST POINT, NEW YORK	FIGURE B-11 TRENCH DETAIL FOR LOCATION SL95-LS-02	DESIGNED BY JCH	DRAWN BY JFW	DATE OCT. 5, 1995	PROJECT NO. 60787.52
			CHECKED BY SMD	PROJECT MGR. JHS	SCALE –	FIGURE –



EA ENGINEERING, SCIENCE, AND TECHNOLOGY	SIX LANDFILLS U.S. MILITARY ACADEMY WEST POINT, NEW YORK	FIGURE B-12 TRENCH DETAIL FOR LOCATION MP95-LS-01	DESIGNED BY JCH	DRAWN BY JFW	DATE OCT. 5, 1995	PROJECT NO. 60787.52
			CHECKED BY SMD	PROJECT MGR. JHS	SCALE –	FIGURE –



SCALE: 1"=1'

FILE: TR-DT-02.DWG

EA ENGINEERING, SCIENCE, AND TECHNOLOGY	SIX LANDFILLS U.S. MILITARY ACADEMY WEST POINT, NEW YORK	FIGURE B-13 TRENCH DETAIL FOR LOCATION MP95-LS-02	DESIGNED BY JCH	DRAWN BY JFW	DATE OCT. 5, 1995	PROJECT NO. 60787.52
			CHECKED BY SMD	PROJECT MGR. JHS	SCALE –	FIGURE –

Appendix C

Hydrologic Evaluation of Landfill Performance (HELP) Model

APPENDIX C

HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE (HELP) MODEL

The Hydrologic Evaluation of Landfill Performance (HELP) model, which was developed by the U.S. Army Corps of Engineers for the U.S. Environmental Protection Agency, was used to predict the amount of surface infiltration by precipitation at the Post School Landfill. The model utilizes both climatological and soil design data, which can be entered manually or by using a default mode. The model was used to evaluate the existing conditions at the landfill and provide a rough estimate of the quantity of leachate being generated by precipitation.

The HELP model makes several important assumptions, which are as follows:

- The entire landfill lies above the water table, and there is no flow through the sides of the landfill.
- Surface runoff from areas next to the landfill does not run onto the landfill.
- The physical characteristics of the landfill, as specified by the user, remain constant for the duration of the modeling period.

The characteristics of the existing cover at the Post School Landfill, as used for input in the HELP model, are shown in Table C-1.

TABLE C-1 HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE MODEL INPUT PARAMETERS FOR POST SCHOOL LANDFILL, SIX LANDFILLS, U.S. MILITARY ACADEMY, WEST POINT, NEW YORK

Parameter	Layer 1	Layer 2	Layer 3
Porosity	0.4630	0.4570	0.4750[(a)]
Field Capacity	0.2320	0.0831	0.3780[(a)]
Wilting Point	0.1157	0.0326	0.2650[(a)]
Initial Soil Water Content	0.2320	0.0831	0.3780[(a)]
Saturated Hydraulic Conductivity	1.55×10^{-3} cm/sec	3.1×10^{-3} cm/sec	$1.02\ 0 \times 10^{-5}$ cm/sec[(b)]

(a) Values shown are default values obtained from HELP Model, Table 4, which are consistent with saturated hydraulic conductivity of 1.02×10^{-5} cm/sec.

(b) Value for saturated hydraulic conductivity in Layer 3 was based upon results of permeameter test of remolded sample GTS95-PS-01. Sample GTS95-PS-01 was collected at intervals of 1-3 ft below ground surface.

NOTE: All values shown for Layers 1 and 2 are default values obtained from HELP Model, Table 4.

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POST SCHOOL LANDFILL
WEST POINT, NY
8 APR 1996

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LAYER 1

VERTICAL PERCOLATION LAYER

THICKNESS	=	2.00 INCHES
POROSITY	=	0.4630 VOL/VOL
FIELD CAPACITY	=	0.2320 VOL/VOL
WILTING POINT	=	0.1157 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2320 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.001553999959 CM/SEC

LAYER 2

VERTICAL PERCOLATION LAYER

THICKNESS	=	10.00 INCHES
POROSITY	=	0.4570 VOL/VOL
FIELD CAPACITY	=	0.0831 VOL/VOL
WILTING POINT	=	0.0326 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0831 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.003100000089 CM/SEC

LAYER 3

VERTICAL PERCOLATION LAYER

THICKNESS	=	24.00 INCHES
POROSITY	=	0.4750 VOL/VOL
FIELD CAPACITY	=	0.3780 VOL/VOL
WILTING POINT	=	0.2650 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.3780 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000010199999 CM/SEC

GENERAL SIMULATION DATA

SCS RUNOFF CURVE NUMBER	=	72.00
TOTAL AREA OF COVER	=	100000. SQ FT
EVAPORATIVE ZONE DEPTH	=	20.00 INCHES
UPPER LIMIT VEG. STORAGE	=	9.2960 INCHES
INITIAL VEG. STORAGE	=	4.9111 INCHES
INITIAL SNOW WATER CONTENT	=	0.0000 INCHES
INITIAL TOTAL WATER STORAGE IN SOIL AND WASTE LAYERS	=	10.3670 INCHES

SOIL WATER CONTENT INITIALIZED BY PROGRAM.

CLIMATOLOGICAL DATA

DEFAULT RAINFALL WITH SYNTHETIC DAILY TEMPERATURES AND
SOLAR RADIATION FOR NEW YORK CITY NEW YORK

MAXIMUM LEAF AREA INDEX	=	3.30
START OF GROWING SEASON (JULIAN DATE)	=	118
END OF GROWING SEASON (JULIAN DATE)	=	298

NORMAL MEAN MONTHLY TEMPERATURES, DEGREES FAHRENHEIT

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
31.80	33.30	41.00	51.90	61.70	71.00
76.40	75.30	68.20	57.50	47.10	36.20

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 74 THROUGH 78

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	4.59	2.46	3.50	2.69	3.68	3.60
	3.60	4.95	5.63	3.12	2.68	4.30
STD. DEVIATIONS	2.10	0.91	1.16	0.66	1.58	2.17
	2.52	1.94	2.87	1.17	2.42	1.70
RUNOFF						
TOTALS	0.150	0.000	0.009	0.000	0.000	0.011
	0.001	0.188	0.299	0.000	0.030	0.019

STD. DEVIATIONS	0.335	0.000	0.020	0.000	0.000	0.018
	0.001	0.415	0.667	0.000	0.063	0.034
EVAPOTRANSPIRATION						
TOTALS	0.929	1.424	2.499	2.677	3.723	3.410
	3.451	4.012	3.097	2.141	1.262	0.920
STD. DEVIATIONS	0.177	0.184	0.116	0.263	0.663	2.070
	1.973	0.951	1.002	0.325	0.378	0.154
PERCOLATION FROM LAYER 3						
TOTALS	2.3336	2.4770	1.2910	1.0482	0.4958	0.4115
	0.3876	0.6686	0.4058	1.5317	1.1661	2.1600
STD. DEVIATIONS	1.1959	1.7189	0.9406	0.7842	0.1995	0.3379
	0.3597	1.0046	0.4382	1.9010	1.5526	1.8747

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 74 THROUGH 78

	(INCHES)		(CU. FT.)	PERCENT
PRECIPITATION	44.79	(8.110)	373283.	100.00
RUNOFF	0.707	(0.593)	5890.	1.58
EVAPOTRANSPIRATION	29.547	(3.091)	246221.	65.96
PERCOLATION FROM LAYER 3	14.3768	(4.2310)	119806.	32.10
CHANGE IN WATER STORAGE	0.164	(1.549)	1366.	0.37

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PEAK DAILY VALUES FOR YEARS 74 THROUGH 78

	(INCHES)	(CU. FT.)
PRECIPITATION	3.77	31416.7
RUNOFF	1.470	12251.8
PERCOLATION FROM LAYER 3	0.3469	2891.2
SNOW WATER	3.96	32986.1

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.4648

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.1337

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FINAL WATER STORAGE AT END OF YEAR 78

LAYER	(INCHES)	(VOL/VOL)
1	0.33	0.1671
2	1.84	0.1839
3	10.63	0.4430
SNOW WATER	0.00	

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Appendix D

Cost Estimates for Leachate Source Reduction and Methane Handling Motor Pool Landfill

APPENDIX D - LIST OF TABLES

TABLE D-1 ALTERNATIVE MP-ALT S1: REPAVE SURFACE OF LOT LEACHATE HANDLING ECONOMIC ANALYSIS OF SIX LANDFILLS U.S. MILITARY ACADEMY, WEST POINT, NEW YORK

A. CAPITAL COSTS					
Item	Description	Quantity	Units	Unit Cost ($)	Total ($)
1	Repave Surface of Lot	25,000	sy	12.50	312,500
2	**SUBTOTAL**				**312,500**
3	Mobilization/Demobilization Construction Management, Site Services		10%		31,250
4	Implementation, Design, Permits		22%		68,750
5	Contingency		25%		78,125
6	**TOTAL**				**490,625**
B. OPERATION AND MANAGEMENT COSTS FOR YEAR 1					
1	Quarterly Inspection	24	hrs	70	1,680
2	Laboratory Analysis (4 samples/year)	4	ea	560	2,240
3	Snow Removal				
	— Labor	200	hrs	25	5,000
	— Equipment	200	hrs	8	1,600
4	Quarterly Reports	32	hrs	70	2,240
5	**TOTAL**				**12,760**
C. OPERATION AND MANAGEMENT COSTS FOR YEARS 2 THROUGH 30					
1	Quarterly Inspection	24	hrs	70	1,680
2	Laboratory Analysis (4 samples/year)	4	ea	560	2,240
3	Snow Removal				
	— Labor	200	hrs	27	5,400
	— Equipment	200	hrs	8	1,600
4	Quarterly Reports	32	hrs	70	2,240
5	**TOTAL**				**13,160**
PRESENT WORTH ANALYSIS					
Interest Rate (annual):			6%		
Number of Interest Periods (years):			29		
Present Worth (time zero):					12,760
Value (Year 2):					13,160
Total 30-Year Present Worth O&M Costs:					**186,178**

TABLE D-2 ALTERNATIVE MP-ALT S2: REPAVE SURFACE OF LOT WITHIN LIMITS OF PROPOSED SOIL VAPOR EXTRACTION SYSTEM LEACHATE HANDLING ECONOMIC ANALYSIS OF SIX LANDFILLS U.S. MILITARY ACADEMY, WEST POINT, NEW YORK

Item	Description	Quantity	Units	Unit Cost ($)	Total ($)
A. CAPITAL COSTS					
1	Repave Surface of Lot	17,775	sy	12.50	222,188
2	**SUBTOTAL**				**222,188**
3	Mobilization/Demobilization, Construction Management, Site Services		10%		22,219
4	Implementation, Design, Permits		22%		48,881
5	Contingency		25%		55,547
6	**TOTAL**				**348,834**
B. OPERATION AND MANAGEMENT COSTS FOR YEAR 1					
1	Quarterly Inspection	24	hrs	70	1,680
2	Laboratory Analysis (4 samples/year)	4	ea	560	2,240
3	Snow Removal				
	— Labor	200	hrs	25	5,000
	— Equipment	200	hrs	8	1,600
4	Quarterly Reports	32	hrs	70	2,240
5	**TOTAL**				**12,760**
C. OPERATION AND MANAGEMENT COSTS FOR YEARS 2 THROUGH 30					
1	Quarterly Inspection	24	hrs	70	1,680
2	Laboratory Analysis (4 samples/year)	4	ea	560	2,240
3	Snow Removal				
	— Labor	200	hrs	27	5,400
	— Equipment	200	hrs	8	1,600
4	Quarterly Reports	32	hrs	70	2,240
5	**TOTAL**				**13,160**
PRESENT WORTH ANALYSIS					
Interest Rate (annual):			6%		
Number of Interest Periods (years):			29		
Present Worth (time zero):					12,760
Value (Year 2):					13,160
Total 30-Year Present Worth O&M Costs:					**186,178**

TABLE D-3 ALTERNATIVE MP-ALT S3: SOIL VAPOR EXTRACTION LEACHATE HANDLING ECONOMIC ANALYSIS OF SIX LANDFILLS U.S. MILITARY ACADEMY, WEST POINT, NEW YORK

A. CAPITAL COSTS					
Item	Description	Quantity	Units	Unit Cost ($)	Total ($)
1	Skid-Mounted Soil Vapor Extraction Systems	2	ea	23,000	46,000
2	Soil Vapor Extraction Treatment Building	1	ea	10,775	10,775
3	Electrical Panel/Materials	1	lot	5,700	5,700
4	Passive Venting Points	6	ea	700	4,200
5	- 4-in. Schedule 80 PVC Pipe	6,000	ft	2	12,000
6	- 4-in. Schedule 80 PVC Elbows	40	ea	7	280
7	- 4-in. Schedule 80 PVC Tees	40	ea	10	400
8	- 4-in. Slotted Screen Sections, 10-ft length	72	ea	60	4,320
9	- 4-in. PVC Female Endcaps	36	ea	6	216
10	- 4-in. Schedule 80 PVC Couplings	300	ea	8	2,400
11	- 4-in. Schedule 80 PVC Spacers	36	ea	19	684
12	- 4-in. Schedule 80 PVC Male Plugs	18	ea	12	216
13	- 4-in. PVC Male Adaptors	18	ea	11	198
14	- 4-in. PVC Female Adaptors	18	ea	19	342
15	- 4-in. Carbon Steel Pipe	150	ft	4	600
16	- 4-in. CS Butterfly Valves	18	ea	850	15,300
17	- 4-in. CS Ball Valves	1	ea	450	450
18	- 4-in. × 2-in. Carbon Steel Reducers	36	ea	9	324
19	- 2-in. Carbon Steel Pipe	250	ft	1	250
20	- 2-in. Carbon Steel Unions	18	ea	5	90
21	- 2-in. Pitot Tubes	18	ea	38	684
22	Flow Gauges with Mounts	18	ea	53	954
23	Vapor Sampling Ports	18	ea	45	810
24	Vacuum Gauges	36	ea	47	1,692
25	- 2 ft × 2 ft Steel Manholes	18	ea	400	7,200
26	Autodialer	1	ea	3,560	3,560
27	- 55-gal Carbon Vessels	2	ea	500	1,000
28	Condensate Appurtenances	1	lot	400	400
29	Soil Vapor Extraction Building XP Room Heater	1	ea	450	450
30	Soil Vapor Extraction Building XP Exhaust Fan	1	ea	500	500
31	Excavate Soil Vapor Extraction Trenches	800	cy	3	2,400

A. CAPITAL COSTS (Continued)					
Item	Description	Quantity	Units	Unit Cost ($)	Total ($)
32	Backfill Soil Vapor Extraction Trenches	800	cy	20	16,000
33	Install Passive Venting Well	6	ea	180	1,080
34	Install Soil Vapor Extraction Piping	1	lot	14,500	14,500
35	Install Steel Manholes	18	ea	108	1,944
36	Concrete Work	14	cy	108	1,512
37	Assemble Soil Vapor Extraction Building	1	ea	1,300	1,300
38	Electrical Work	1	lot	7,920	7,920
39	Health and Safety Oversight	1	lot	1,600	1,600
40	Construction Inspection	1	ea	12,200	12,200
41	**SUBTOTAL**				**182,451**
42	Mobilization/Demobilization Construction		10%		18,245
43	Implementation, Design, Permits		22%		40,139
44	Contingency		25%		45,613
45	**TOTAL**				**286,448**

B. OPERATION AND MANAGEMENT COSTS FOR YEARS 1 THROUGH 5					
Item	Description	Quantity	Units	Unit Cost ($)	Total ($)
1	Quarterly Inspection	24	hrs	70	1,680
2	Quarterly Maintenance/Repairs	12	hrs	40	480
3	Quarterly Reports	48	hrs	70	3,360
4	**TOTAL**				**5,520**

PRESENT WORTH ANALYSIS		
Interest Rate (annual):	6%	
Number of Interest Periods (years):	4	
Present Worth (time zero):		5,520
Value (Year 2):		5,520
Total 30-Year Present Worth O&M Costs:		**24,647**

TABLE D-4 ALTERNATIVE MP-ALT S4: PASSIVE VENTING SYSTEM LEACHATE HANDLING ECONOMIC ANALYSIS OF SIX LANDFILLS U.S. MILITARY ACADEMY, WEST POINT, NEW YORK

A. CAPITAL COSTS					
Item	Description	Quantity	Units	Unit Cost ($)	Total ($)
1	Passive Venting Points	20	ea	700	14,000
	Ea point to include:				
	— Steel Manhole	1	ea	50	
	— PVC Riser Pipe	10	ft	4	
	— PVC Elbows	2	ea	4	
	— PVC Coupling	1	ea	4	
	— PVC Endcap	1	ea	4	
	— PVC Screen	3	ft	15	
	— Sand	0	LS	600	
	Pea Stone				
	Cement Grout				
	Labor				
2	Health and Safety Oversight	1	lot	1,600	1,600
3	Construction Inspection	1	ea	3,000	3,000
4	**SUBTOTAL**				**18,600**
5	Mobilization/Demobilization, Construction Management, Site Services		10%		1,860
6	Implementation, Design, Permits		22%		4,092
7	Contingency		25%		4,650
8	**TOTAL**				**29,202**

B. OPERATION AND MANAGEMENT COSTS FOR YEARS 1 THROUGH 5					
Item	Description	Quantity	Units	Unit Cost ($)	Total
1	Quarterly Inspection	2	hrs	70	140
2	Quarterly Maintenance/Repairs	12	hrs	40	480
3	Quarterly Reports	48	hrs	70	3,360
4	**TOTAL**				**3,980**

PRESENT WORTH ANALYSIS		
Interest Rate (annual):	6%	
Number of Interest Periods (years):	4	
Present Worth (time zero):		3,980
Value (Year 2):		3,980
Total 5-Year Present Worth O&M Costs:		**17,771**

Appendix E

Cost Estimates for Leachate Disposal Alternatives

APPENDIX E - LIST OF TABLES

TABLE E-1 ALTERNATIVE PS-ALT L1: NO ACTION WITH CONTINUED MONITORING
LEACHATE HANDLING ECONOMIC ANALYSIS OF SIX LANDFILLS
U.S. MILITARY ACADEMY, WEST POINT, NEW YORK

A. CAPITAL COSTS					
Item	Description	Quantity	Units	Unit Cost ($)	Total ($)
1	Clean out existing system	1	LS	500	500
	TOTAL				**500**

B. OPERATION AND MANAGEMENT COSTS FOR YEAR 1					
Item	Description	Quantity	Units	Unit Cost ($)	Total ($)
1	Monthly Inspection	24	hrs	50	1,200
2	Replacement Parts (e.g., grate)	2	ea	400	800
3	Laboratory Analysis (4 samples/year)	4	ea	560	2,240
4	Clean Out Catch Basin and Disposal	1	LS	200	200
	TOTAL				**4,440**

C. OPERATION AND MANAGEMENT COSTS FOR YEARS 2 THROUGH 30					
Item	Description	Quantity	Units	Unit Cost ($)	Total ($)
1	Monthly Inspection	24	hrs	50	1,200
2	Replacement Parts (e.g., grate)	2	ea	400	800
3	Laboratory Analysis (4 samples/year)	4	ea	560	2,240
4	Clean Out Catch Basin and Disposal	1	LS	200	200
	TOTAL				**4,440**

PRESENT WORTH ANALYSIS		
Interest rate (annual):	6%	
Number of interest periods (years):	29	
Present worth (time zero):		4,440
Value (Year 2):		4,440
Total 30-Year Present Worth O&M Costs:		**60,343**

TABLE E-2 ALTERNATIVE PS-ALT L2: COLLECTION AND DISCHARGE TO U.S. MILITARY ACADEMY TREATMENT PLANT LEACHATE HANDLING ECONOMIC ANALYSIS OF SIX LANDFILLS U.S. MILITARY ACADEMY, WEST POINT, NEW YORK

A. CAPITAL COSTS					
Item	Description	Quantity	Units	Unit Cost ($)	Total ($)
1	Abandon Existing Leachate Tank	1	LS	500	500
2	Leachate Collection Box	1	ea	700	700
3	New Inlet for Collection Box	I	ea	900	900
4	Remove Existing Catch Basin and Drain	1	ea	500	500
5	Connection Line to Sanitary Manhole	50	ft	30	1,500
6	New Concrete Manhole	1	ea	1,500	1,500
7	New Macadam Paving	50	sf	4	200
8	Seed and Erosion Control	200	sf	2	400
9	6-in. Topsoil	100	cu ft	1	100
10	Excavate Trench	15	cu yd	5	75
11	Backfill Trench	15	cu yd	10	150
	SUBTOTAL				**6,525**
12	Mobilization/Demobilization Construction Management Site		10%		653
13	Implementation, Design, Permits		22%		1,436
14	Contingency		25%		1,631
	TOTAL				**10,244**

B. OPERATION AND MANAGEMENT COSTS FOR YEAR 1					
Item	Description	Quantity	Units	Unit Cost ($)	Total ($)
1	Monthly Inspection	24	hrs	50	1,200
2	Replacement Parts (e.g., grate)	2	ea	400	800
3	Laboratory Analysis (4 samples/year)	4	ea	560	2,240
4	Clean Out Collection Box and Disposal	1	LS	200	200
	TOTAL				**4,440**

C. OPERATION AND MANAGEMENT COSTS FOR YEARS 2 THROUGH 30					
Item	Description	Quantity	Units	Unit Cost ($)	Total ($)
1	Monthly Inspection	24	hrs	50	1,200
2	Replacement Parts (e.g., grate)	2	ea	400	800
3	Laboratory Analysis (4 samples/year)	4	ea	560	2,240
4	Clean Out Collection Box and Disposal	1	LS	200	200
	TOTAL				**4,440**

PRESENT WORTH ANALYSIS		
Interest Rate (annual):	6%	
Number of Interest Periods (years):	29	
Present Worth (time zero):		4,440
Value (Year 2):		4,440
Total 30-Year Present Worth O&M Costs:		**60,343**

TABLE E-3 ALTERNATIVE PS-ALT L3: COLLECTION AND DISCHARGE TO STORMWATER SYSTEM LEACHATE HANDLING ECONOMIC ANALYSIS OF SIX LANDFILLS U.S. MILITARY ACADEMY, WEST POINT, NEW YORK

A. CAPITAL COSTS

Item	Description	Quantity	Units	Unit Cost ($)	Total ($)
1	Abandon Existing Leachate Tank	1	LS	500	500
2	Leachate Collection Box	1	ea	700	700
3	New Inlet for Collection Box	1	ea	900	900
4	Remove Existing Catch Basin and Drain	1	LS	500	500
5	Connection Line to Pretreatment Unit (6-in. PVC)	50	ft	30	1,500
6	Pretreatment Filtration Vessel	1	ea	50,000	50,000
7	Pretreatment Plant Foundation (slab)	1	ea	1,000	1,000
8	Pump System	1	ea	5,000	5,000
9	Plant Startup	1	ea	5,000	5,000
10	Treatment System Housing	1	ea	3,000	3,000
11	Connection Line to Stormwater System (6-in. PVC)	50	ft	30	1,500
12	New Macadam Paving	50	sf	4	200
13	Seed and Erosion Control	200	sf	2	400
14	6-in. Topsoil	100	cu ft	1	100
15	Excavate Trenches	30	cu yd	5	150
16	Backfill Trenches	30	cu yd	20	600
17	Electrical Panel/Materials	1	lot	5,000	5,000
	SUBTOTAL				**76,050**
18	Mobilization/Demobilization Construction Management Site Services		10%		7,605
19	Implementation, Design, Permits		22%		16,731
20	Contingency		25%		19,013
	TOTAL				**119,399**

B. OPERATION AND MANAGEMENT COSTS FOR YEAR 1

Item	Description	Quantity	Units	Unit Cost ($)	Total ($)
1	Monthly Inspection	24	hrs	50	1,200
2	Replacement Parts (e.g., grate)	2	ea	400	800
3	Laboratory Analysis (4 samples/year)	4	ea	560	2,240
4	Plant Operations Cost	1	ea	7,500	7,500
5	Clean Out Collection Box and Disposal	1	LS	200	200
	TOTAL				**11,940**

C. OPERATION AND MANAGEMENT COSTS FOR YEARS 2 THROUGH 30					
Item	Description	Quantity	Units	Unit Cost ($)	Total ($)
1	Monthly Inspection	24	hrs	50	1,200
2	Replacement Parts (e.g., grate)	2	ea	400	800
3	Laboratory Analysis (4 samples/year)	4	ea	560	2,240
4	Plant Operations Cost	1	ea	7,500	7,500
5	Clean Out Collection Box and Disposal	1	LS	200	200
	TOTAL				**11,940**

PRESENT WORTH ANALYSIS		
Interest rate (annual):	6%	
Number of interest periods (years):	29	
Present worth (time zero):		11,940
Value (Year 2):		11,940
Total 30-Year Present Worth O&M Costs:		**162,273**

TABLE E-4 ALTERNATIVE PS-ALT L4: UPTAKE OF LEACHATE BY VEGETATION LEACHATE HANDLING ECONOMIC ANALYSIS OF SIX LANDFILLS U.S. MILITARY ACADEMY, WEST POINT, NEW YORK

A. CAPITAL COSTS					
Item	Description	Quantity	Units	Unit Cost ($)	Total ($)
1	Regrading	1	LS	750	750
2	Cleanout of Existing System	1	ea	500	500
3	6-in. Topsoil	100	cu ft	1	100
4	Seed and Erosion Control	1	ea	500	500
5	Shrubs (Arborvitae)	50	ea	15	750
	SUBTOTAL				**2,600**
6	Mobilization/Demobilization Construction Management Site Services		10%		260
7	Implementation, Design, Permits		22%		572
8	Contingency		25%		650
	TOTAL				**4,082**

B. OPERATION AND MANAGEMENT COSTS FOR YEAR 1					
Item	Description	Quantity	Units	Unit Cost ($)	Total ($)
1	Monthly Inspection	24	hrs	50	1,200
2	Replacement Shrubs	10	ea	15	150
3	Laboratory Analysis (4 samples/year)	4	ea	560	2,240
4	Clean Out Catch Basin and Disposal	1	LS	200	200
	TOTAL				**3,790**

C. OPERATION AND MANAGEMENT COSTS FOR YEARS 2 THROUGH 30					
Item	Description	Quantity	Units	Unit Cost ($)	Total ($)
1	Monthly Inspection	24	hrs	50	1,200
2	Replacement Shrubs	10	ea	15	150
3	Laboratory Analysis (4 samples/year)	4	ea	560	2,240
4	Clean Out Catch Basin and Disposal	1	LS	200	200
	TOTAL				**3,790**

PRESENT WORTH ANALYSIS		
Interest rate (annual):	6%	
Number of interest periods (years):	29	
Present worth (time zero):		3,790
Value (Year 2):		3,790
Total 30-Year Present Worth O&M Costs:		**51,509**

TABLE E-5 ALTERNATIVE LF-ALT L1: NO ACTION WITH CONTINUED MONITORING
LEACHATE HANDLING ECONOMIC ANALYSIS OF SIX LANDFILLS
U.S. MILITARY ACADEMY, WEST POINT, NEW YORK

A. CAPITAL COSTS					
Item	Description	Quantity	Units	Unit Cost ($)	Total ($)
1	Remove Debris from Swale and Disposal	1	LS	500	500
	TOTAL				**500**

B. OPERATION AND MANAGEMENT COSTS FOR YEAR 1					
Item	Description	Quantity	Units	Unit Cost ($)	Total ($)
1	Monthly Inspection	24	hrs	50	1,200
2	Laboratory Analysis (4 samples/year)	4	ea	560	2,240
3	Remove Debris from Swale and Disposal	1	LS	200	200
	TOTAL				**3,640**

C. OPERATION AND MANAGEMENT COSTS FOR YEARS 2 THROUGH 30					
Item	Description	Quantity	Units	Unit Cost ($)	Total ($)
1	Monthly Inspection	24	hrs	50	1,200
2	Laboratory Analysis (4 samples/year)	4	ea	560	2,240
3	Remove Debris from Swale and Disposal	1	LS	200	200
	TOTAL				**3,640**

PRESENT WORTH ANALYSIS		
Interest rate (annual):	6%	
Number of interest periods (years):	29	
Present worth (time zero):		3,640
Value (Year 2):		3,640
Total 30-Year Present Worth O&M Costs:		**49,470**

TABLE E-6 ALTERNATIVE LF-ALT L2: COLLECTION AND TRANSPORT TO U.S. MILITARY ACADEMY TREATMENT PLANT
LEACHATE HANDLING ECONOMIC ANALYSIS OF SIX LANDFILLS
U.S. MILITARY ACADEMY, WEST POINT, NEW YORK

A. CAPITAL COSTS

Item	Description	Quantity	Units	Unit Cost ($)	Total ($)
1	Remove Existing Gutter Along Access Road	200	ft	5	1,000
2	Remove Existing Storm Drain	1	ea	500	500
3	Lateral Collection Lines (6-in. perforated PVC)	150	ft	20	3,000
4	40-mil HDPE	1400	sf	0.60	840
5	Geotextile	900	sf	0.25	225
6	Collection Box	1	ea	35	35
7	Vault - Prefab Concrete	1	ea	1,000	1,000
8	Excavate Trenches				
	— Connection Lines	100	cu yd	28	2,800
	— Collection Lines	50	cu yd	28	1,400
9	Backfill Trenches				
	— Connection Lines	100	cu yd	20	2,000
	— Collection Lines	30	cu yd	20	600
10	Rip-Rap Stone	20	cu yd	25	500
11	Connection Lines (6-in. PVC) to Collection	325	ft	30	9,750
12	New Collection Tank - Precast Concrete	1	ea	5,200	5,200
13	Prefabricated Concrete Outfalls with Pads	2	ea	150	300
	SUBTOTAL				**29,150**
14	Mobilization/Demobilization Construction Management Site Services			10%	2,915
15	Implementation, Design, Permits			22%	6,413
16	Contingency			25%	7,288
	TOTAL				**45,766**

B. OPERATION AND MANAGEMENT COSTS FOR YEAR 1

Item	Description	Quantity	Units	Unit Cost ($)	Total ($)
1	Monthly Inspection	24	hrs	50	1,200
2	Laboratory Analysis (4 samples/year)	4	ea	560	2,240
3	Pump New Collection Tank (4,000 gal)				
	— Labor	365	hrs	25	9,125
	— Equipment	365	hrs	150	54,750
4	Pump Existing Collection Tank (1,000 gal)				
	— Labor	183	hrs	25	4,575
	— Equipment	183	hrs	150	27,450
5	Transport to Treatment Plant (round trip)				
	— Labor	183	hrs	25	4,575
	— Equipment	183	hrs	150	27,450
6	Clean Out Collection Lines and Disposal	1	LS	200	200
	TOTAL				**131,565**

C. OPERATION AND MANAGEMENT COSTS FOR YEARS 2 THROUGH 30					
Item	Description	Quantity	Units	Unit Cost ($)	Total ($)
1	Monthly Inspection	24	hrs	50	1,200
2	Laboratory Analysis (4 samples/year)	4	ea	560	2,240
3	Pump New Collection Tank (4,000 gal)				
	— Labor	365	hrs	25	9,125
	— Equipment	365	hrs	150	54,750
4	Pump Existing Collection Tank (1,000 gal)				
	— Labor	183	hrs	25	4,575
	— Equipment	183	hrs	150	27,450
5	Transport to Treatment Plant (round trip)				
	— Labor	183	hrs	25	4,575
	— Equipment	183	hrs	150	27,450
6	Clean Out Collection Lines and Disposal	1	LS	200	200
	TOTAL				**131,565**

PRESENT WORTH ANALYSIS		
Interest rate (annual):	6%	
Number of interest periods (years):	29	
Present worth (time zero):		131,565
Value (Year 2):		131,565
Total 30-Year Present Worth O&M Costs:		**1,788,063**

TABLE E-7 ALTERNATIVE LF-ALT L3: COLLECTION AND DISCHARGE TO STORMWATER SYSTEM LEACHATE HANDLING ECONOMIC ANALYSIS OF SIX LANDFILLS U.S. MILITARY ACADEMY, WEST POINT, NEW YORK

A. CAPITAL COSTS

Item	Description	Quantity	Units	Unit Cost ($)	Total ($)
1	Abandon Existing Leachate Tank	1	LS	500	500
2	Lateral Collection Lines (6-in. perforated PVC)	150	ft	20	3,000
3	40-mil HDPE	1400	sf	0.60	840
4	Geotextile	850	sf	0.25	213
5	Collection Box	1	ea	35	35
6	Vault - Prefab Concrete	1	ea	350	350
7	Excavate Trenches				
	— Connection Lines	100	cu yd	28	2,800
	— Collection Lines	50	cu yd	28	1,400
8	Backfill Trenches				
	— Connection Lines	100	cu yd	20	2,000
	— Collection Lines	30	cu yd	20	600
9	Rip-Rap Stone	20	cu yd	25	500
10	Connection Lines to Pretreatment Units (6-in. PVC)	275	ft	30	8,250
11	Pretreatment Filtration Vessel	2	ea	50,000	100,000
12	Pretreatment Plant Foundation (slab)	2	ea	1,000	2,000
13	Pump System	2	ea	5,000	10,000
14	Plant Startup	2	ea	5,000	10,000
15	Treatment System Housing	2	ea	3,000	6,000
16	Connection Line to Storm Water (6-in. PVC)	50	ft	30	1,500
17	Prefabricated Concrete Outfall with Pad	1	ea	150	150
18	New Macadam Paving	50	sf	4	200
19	Electrical Panel/Materials	2	lot	5,000	10,000
	SUBTOTAL				**160,338**
20	Mobilization/Demobilization Construction Management Site Services		10%		16,034
21	Implementation, Design, Permits		22%		35,274
22	Contingency		25%		40,084
	TOTAL				**251,730**

B. OPERATION AND MANAGEMENT COSTS FOR YEAR 1

Item	Description	Quantity	Units	Unit Cost ($)	Total ($)
1	Monthly Inspection	24	hrs	50	1,200
2	Laboratory Analysis (4 samples/year)	4	ea	560	2,240
3	Plant Operations Cost	2	ea	7,500	15,000
4	Clean Out Collection Lines and Disposal	1	LS	200	200
	TOTAL				**18,640**

C. OPERATION AND MANAGEMENT COSTS FOR YEARS 2 THROUGH 30					
Item	Description	Quantity	Units	Unit Cost ($)	Total ($)
1	Monthly Inspection	24	hrs	50	1,200
2	Laboratory Analysis (4 samples/year)	4	ea	560	2,240
3	Plant Operations Cost	2	ea	7,500	15,000
4	Clean out Collection Lines and Disposal	1	LS	200	200
	TOTAL				**18,640**

PRESENT WORTH ANALYSIS		
Interest rate (annual):	6%	
Number of interest periods (years):	29	
Present worth (time zero):		18,640
Value (Year 2):		18,640
Total 30-Year Present Worth O&M Costs:		**253,331**

TABLE E-8 ALTERNATIVE LF-ALT L4: COLLECTION AND DISCHARGE TO U.S. MILITARY ACADEMY TREATMENT PLANT LEACHATE HANDLING ECONOMIC ANALYSIS OF SIX LANDFILLS U.S. MILITARY ACADEMY, WEST POINT, NEW YORK

A. CAPITAL COSTS

Item	Description	Quantity	Units	Unit Cost ($)	Total ($)
1	Remove Existing Gutter Along Access Road	200	ft	5	1,000
2	Remove Existing Storm Drain	1	ea	500	500
3	Lateral Collection Lines (6-in. perforated PVC)	150	ft	20	3,000
4	Connection Lines to Sanitary Sewer (8-in. diameter)	2,000	ft	30	60,000
5	40-mil HDPE	1,400	sf	0.60	840
6	Geotextile	850	sf	0.25	213
7	Collection Box	2	ea	35	70
8	Vault - Prefab Concrete	1	ea	350	350
9	Excavate Trenches				
	— Connection Lines	600	cu yd	28	16,800
	— Collection Lines (laterals)	50	cu yd	28	1,400
10	Backfill Trenches				
	— Connection Lines	600	cu yd	20	12,000
	— Collection Lines (laterals)	30	cu yd	20	600
11	Rip-Rap Stone	20	cu yd	25	500
12	Manholes	6	ea	1,500	9,000
	SUBTOTAL				**106,273**
13	Mobilization/Demobilization Construction Management Site Services		10%		10,627
14	Implementation, Design, Permits		22%		23,380
15	Contingency		25%		26,568
	TOTAL				**166,848**

B. OPERATION AND MANAGEMENT COSTS FOR YEAR 1

Item	Description	Quantity	Units	Unit Cost ($)	Total ($)
1	Monthly Inspection	24	hrs	50	1,200
2	Laboratory Analysis (4 samples/year)	4	ea	560	2,240
3	Clean Out Collection Line and Disposal	1	LS	100	100
4	Clean Out Connection Line and Disposal	1	LS	500	500
	TOTAL				**4,040**

C. OPERATION AND MANAGEMENT COSTS FOR YEARS 2 THROUGH 30

Item	Description	Quantity	Units	Unit Cost ($)	Total ($)
1	Monthly Inspection	24	hrs	50	1,200
2	Laboratory Analysis (4 samples/year)	4	ea	560	2,240
3	Clean Out Collection Line and Disposal	1	LS	100	100
4	Clean Out Connection Line and Disposal	1	LS	500	500
	TOTAL				**4,040**

PRESENT WORTH ANALYSIS		
Interest rate (annual):	6%	
Number of interest periods (years):	29	
Present worth (time zero):		4,040
Value (Year 2):		4,040
Total 30-Year Present Worth O&M Costs:		**54,907**

TABLE E-9 ALTERNATIVE OC-ALT L1: NO ACTION WITH CONTINUED MONITORING LEACHATE HANDLING ECONOMIC ANALYSIS OF SIX LANDFILLS U.S. MILITARY ACADEMY, WEST POINT, NEW YORK

A. CAPITAL COSTS					
Item	**Description**	**Quantity**	**Units**	**Unit Cost ($)**	**Total ($)**
1	Clean Out Existing System	1	LS	500	500
	TOTAL				**500**

B. OPERATION AND MANAGEMENT COSTS FOR YEAR 1					
Item	**Description**	**Quantity**	**Units**	**Unit Cost ($)**	**Total ($)**
1	Monthly Inspection	24	hrs	50	1,200
2	Laboratory Analysis (4 samples/year)	4	ea	560	2,240
3	Pump Existing Collection Tank (750 gal)				
	— Labor	6	hrs	25	150
	— Equipment	6	hrs	150	900
4	Transport to Treatment Plant (round trip)				
	— Labor	6	hrs	25	150
	— Equipment	6	hrs	150	900
5	Clean Out Collection Lines and Disposal	1	LS	200	200
	TOTAL				**5,740**

C. OPERATION AND MANAGEMENT COSTS FOR YEARS 2 THROUGH 30					
Item	**Description**	**Quantity**	**Units**	**Unit Cost ($)**	**Total ($)**
1	Monthly Inspection	24	hrs	50	1,200
2	Laboratory Analysis (4 samples/year)	4	ea	560	2,240
3	Pump Existing Collection Tank (750 gal)				
	— Labor	6	hrs	25	150
	— Equipment	6	hrs	150	900
4	Transport to Treatment Plant (round trip)				
	— Labor	6	hrs	25	150
	— Equipment	6	hrs	150	900
5	Clean Out Collection Lines and Disposal	1	LS	200	200
	TOTAL				**5,740**

PRESENT WORTH ANALYSIS		
Interest rate (annual):	6%	
Number of interest periods (years):	29	
Present worth (time zero):		5,740
Value (Year 2):		5,740
Total 30-Year Present Worth O&M Costs:		**78,011**

TABLE E-10 ALTERNATIVE OC-ALT L2: COLLECTION AND DISCHARGE TO STORM WATER LEACHATE HANDLING ECONOMIC ANALYSIS OF SIX LANDFILLS U.S. MILITARY ACADEMY, WEST POINT, NEW YORK

A. CAPITAL COSTS

Item	Description	Quantity	Units	Cost Unit ($)	Total ($)
1	Pretreatment Filtration Vessel	1	ea	50,000	50,000
2	Pretreatment Plant Foundation (slab)	1	ea	1,000	1,000
3	Pump System	1	ea	5,000	5,000
4	Plant Startup	1	ea	5,000	5,000
5	Treatment System Housing	1	ea	3,000	3,000
6	Connection Line to Pretreatment Unit (6-in. PVC)	50	ft	30	1,500
7	Prefabricated Concrete Outfall with Pad	1	ea	150	150
8	Excavate Trench	15	cy	3	45
9	Backfill Trench	15	cy	20	300
10	Electrical Panel/Materials	1	lot	5,000	5,000
	SUBTOTAL				**70,995**
11	Mobilization/Demobilization Construction Management Site Services		10%		7,100
12	Implementation, Design, Permits		22%		15,619
13	Contingency		25%		17,749
	TOTAL				**111,462**

B. OPERATION AND MANAGEMENT COSTS FOR YEAR 1

Item	Description	Quantity	Units	Unit Cost ($)	Total ($)
1	Monthly Inspection	12	hrs	50	600
2	Laboratory Analysis (4 samples/year)	4	ea	560	2,240
3	Plant Operations Cost	1	ea	7,500	7,500
4	Clean Out Collection Lines and Disposal	1	LS	200	200
	TOTAL				**10,540**

C. OPERATION AND MANAGEMENT COSTS FOR YEARS 2 THROUGH 30

Item	Description	Quantity	Units	Unit Cost ($)	Total ($)
1	Monthly Inspection	12	hrs	50	600
2	Laboratory Analysis (4 samples/year)	4	ea	560	2,240
3	Plant Operations Cost	1	ea	7,500	7,500
4	Clean Out Collection Lines and Disposal	1	LS	200	200
	TOTAL				**10,540**

PRESENT WORTH ANALYSIS

Interest rate (annual):	6%	
Number of interest periods (years):	29	
Present worth (time zero):		10,540
Value (Year 2):		10,540
Total 30-Year Present Worth O&M Costs:		**143,246**

TABLE E-11 ALTERNATIVE OC-ALT L3: COLLECTION AND DISCHARGE TO U.S. MILITARY TREATMENT PLANT LEACHATE HANDLING ECONOMIC ANALYSIS OF SIX LANDFILLS U.S. MILITARY ACADEMY, WEST POINT, NEW YORK

A. CAPITAL COSTS					
Item	Description	Quantity	Units	Unit Cost ($)	Total ($)
1	Connection Line to Sanitary Sewer (8-in. diameter)	500	ft	30	15,000
2	Excavate Trench for Connection Line	150	cu yd	28	4,200
3	Backfill Trench for Connection Line	150	cu yd	20	3,000
4	Manholes	4	ea	1,500	6,000
	SUBTOTAL				**28,200**
5	Mobilization/Demobilization Construction Management Site Services		10%		2,820
6	Implementation, Design, Permits		22%		6,204
7	Contingency		25%		7,050
	TOTAL				**44,274**

B. OPERATION AND MANAGEMENT COSTS FOR YEAR 1					
Item	Description	Quantity	Units	Unit Cost ($)	Total ($)
1	Monthly Inspection	24	hrs	50	1,200
2	Laboratory Analysis (4 samples/year)	4	ea	560	2,240
3	Clean Out Collection Line and Disposal	1	LS	100	100
4	Clean Out Connection Line and Disposal	1	LS	500	500
	TOTAL				**4,040**

C. OPERATION AND MANAGEMENT COSTS FOR YEARS 2 THROUGH 30					
Item	Description	Quantity	Units	Unit Cost ($)	Total ($)
1	Monthly Inspection	24	hrs	50	1,200
2	Laboratory Analysis (4 samples/year)	4	ea	560	2,240
3	Clean Out Collection Line and Disposal	1	LS	100	100
4	Clean Out Connection Line and Disposal	1	LS	500	500
	TOTAL				**4,040**

PRESENT WORTH ANALYSIS		
Interest rate (annual):	6%	
Number of interest periods (years):	29	
Present worth (time zero):		4,040
Value (Year 2):		4,040
Total 30-Year Present Worth O&M Costs:		**54,907**

TABLE E-12 ALTERNATIVE SL-ALT L1: NO ACTION WITH CONTINUED MONITORING
LEACHATE HANDLING ECONOMIC ANALYSIS OF SIX LANDFILLS
U.S. MILITARY ACADEMY, WEST POINT, NEW YORK

Item	Description	Quantity	Units	Unit Cost ($)	Total ($)
A. CAPITAL COSTS					
1	Remove Debris from Swale and Disposal	1	LS	500	500
	TOTAL				**500**
B. OPERATION AND MANAGEMENT COSTS FOR YEAR 1					
1	Monthly Inspection	24	hrs	50	1,200
2	Laboratory Analysis (4 samples/year)	4	ea	560	2,240
3	Remove Debris from Swale and Disposal	1	LS	200	200
	TOTAL				**3,640**
C. OPERATION AND MANAGEMENT COSTS FOR YEARS 2 THROUGH 30					
1	Monthly Inspection	24	hrs	50	1,200
2	Laboratory Analysis (4 samples/year)	4	ea	560	2,240
3	Remove Debris from Swale and Disposal	1	LS	200	200
	TOTAL				**3,640**

PRESENT WORTH ANALYSIS		
Interest rate (annual):	6%	
Number of interest periods (years):	29	
Present worth (time zero):		3,640
Value (Year 2):		3,640
Total 30-Year Present Worth O&M Costs:		**49,470**

TABLE E-13 ALTERNATIVE SL-ALT L2: COLLECTION AND TRANSPORT TO U.S. MILITARY ACADEMY TREATMENT PLANT LEACHATE HANDLING ECONOMIC ANALYSIS OF SIX LANDFILLS U.S. MILITARY ACADEMY, WEST POINT, NEW YORK

A. CAPITAL COSTS					
Item	Description	Quantity	Units	Unit Cost ($)	Total ($)
1	Clearing and Grubbing (woods)	1	LS	1,000	1,000
2	Lateral Collection Lines (6-in. perforated PVC)	150	ft	20	3,000
3	40-mil HDPE	750	sf	0.60	450
4	Geotextile	1150	sf	0.25	288
5	Excavate Trenches				
	— Connection Lines	30	cu yd	28	840
	— Collection Lines	20	cu yd	28	560
6	Backfill Trenches				
	— Connection Lines	30	cu yd	20	600
	— Collection Lines	15	cu yd	20	300
7	Rip-Rap Stone	5	cu yd	25	125
8	Connection Lines (6-in. PVC) to Collection Tanks	100	ft	30	3,000
9	New Collection Tank - Precast Concrete (1,000 gal)	2	ea	1,000	2,000
10	Prefabricated Concrete Outfalls with Pads	2	ea	150	300
	SUBTOTAL				**12,463**
11	Mobilization/Demobilization Construction Management Site Services		10%		1,246
12	Implementation, Design, Permits		22%		2,742
13	Contingency		25%		3,116
	TOTAL				**19,566**

B. OPERATION AND MANAGEMENT COSTS FOR YEAR 1					
Item	Description	Quantity	Units	Unit Cost ($)	Total ($)
1	Monthly Inspection	24	hrs	50	1,200
2	Laboratory Analysis (4 samples/year)	4	ea	560	2,240
3	Pump New Collection Tanks (1,000 gal)				
	— Labor	12	hrs	25	300
	— Equipment	12	hrs	150	1,800
4	Transport to Treatment Plant (round trip)				
	— Labor	6	hrs	25	150
	— Equipment	6	hrs	150	900
6	Clean Out Collection Line and Disposal	1	LS	200	200
	TOTAL				**6,790**

C. OPERATION AND MANAGEMENT COSTS FOR YEARS 2 THROUGH 30					
Item	Description	Quantity	Units	Unit Cost ($)	Total ($)
1	Monthly Inspection	24	hrs	50	1,200
2	Laboratory Analysis (4 samples/year)	4	ea	560	2,240
3	Pump New Collection Tanks (1,000 gal)				
	— Labor	12	hrs	15	180
	— Equipment	12	hrs	10	120
4	Transport to Treatment Plant (round trip)				
	— Labor	6	hrs	15	90
	— Equipment	6	hrs	10	60
5	Clean Out Collection Line and Disposal	1	LS	200	200
	TOTAL				**4,090**

PRESENT WORTH ANALYSIS		
Interest rate (annual):	6%	
Number of interest periods (years):	29	
Present worth (time zero):		6,790
Value (Year 2):		4,090
Total 30-Year Present Worth O&M Costs:		**55,586**

TABLE E-14 ALTERNATIVE SL-ALT L3: COLLECTION AND DISCHARGE TO SURFACE WATER LEACHATE HANDLING ECONOMIC ANALYSIS OF SIX LANDFILLS U.S. MILITARY ACADEMY, WEST POINT, NEW YORK

A. CAPITAL COSTS					
Item	Description	Quantity	Units	Unit Cost ($)	Total ($)
1	Clearing and Grubbing (woods)	1	LS	1,000	1,000
2	Lateral collection lines (6-in. perforated PVC)	150	ft	20	3,000
3	40-mil HDPE	750	sf	0.60	450
4	Geotextile	1150	sf	0.25	288
5	Excavate Trenches				
	— Connection Lines	60	cu yd	28	1,680
	— Collection Lines	20	cu yd	28	560
6	Backfill Trenches				
	— Connection Lines	60	cu yd	20	1,200
	— Collection Lines	15	cu yd	20	300
7	Rip-Rap Stone	5	cu yd	25	125
8	Connection Lines to Pretreatment Units (6-in. PVC)	200	ft	30	6,000
9	Pretreatment Filtration Vessel	2	ea	50,000	100,000
10	Pretreatment Plant Foundation (slab)	2	ea	1,000	2,000
11	Pump System	2	ea	5,000	10,000
12	Plant Startup	2	ea	5,000	10,000
13	Treatment System Housing	2	ea	3,000	6,000
14	Prefabricated Concrete Outfall with Pad	2	ea	150	300
15	Electrical Panel/Materials	2	lot	5,000	10,000
	SUBTOTAL				**152,903**
16	Mobilization/Demobilization Construction Management Site Services		10%		15,290
17	Implementation, Design, Permits		22%		33,639
18	Contingency		25%		38,226
	TOTAL				**240,057**

B. OPERATION AND MANAGEMENT COSTS FOR YEAR 1					
Item	Description	Quantity	Units	Unit Cost ($)	Total ($)
1	Monthly Inspection	24	hrs	50	1,200
2	Laboratory Analysis (4 samples/year)	4	ea	560	2,240
3	Plant Operations Cost	2	ea	7,500	15,000
4	Clean Out Collection Line and Disposal	1	LS	200	200
	TOTAL				**18,640**

C. OPERATION AND MANAGEMENT COSTS FOR YEARS 2 THROUGH 30					
Item	Description	Quantity	Units	Unit Cost ($)	Total ($)
1	Monthly Inspection	24	hrs	50	1,200
2	Laboratory Analysis (4 samples/year)	4	ea	560	2,240
3	Plant Operations Cost	2	ea	7,500	15,000
4	Clean Out Collection Line and Disposal	1	LS	200	200
	TOTAL				**18,640**

PRESENT WORTH ANALYSIS		
Interest rate (annual):	6%	
Number of interest periods (years):	29	
Present worth (time zero):		18,640
Value (Year 2):		18,640
Total 30-Year Present Worth O&M Costs:		**253,331**

TABLE E-15 ALTERNATIVE SL-ALT L4: COLLECTION AND DISCHARGE TO U.S. MILITARY ACADEMY TREATMENT PLANT LEACHATE HANDLING ECONOMIC ANALYSIS OF SIX LANDFILLS U.S. MILITARY ACADEMY, WEST POINT, NEW YORK

A. CAPITAL COSTS

Item	Description	Quantity	Units	Unit Cost ($)	Total ($)
1	Lateral Collection Line (6-in. perforated PVC)	150	ft	20	3,000
2	Connection Lines to Sanitary Sewer (8-in. diameter)	900	ft	30	27,000
3	New Macadam Paving	50	sf	4	200
4	Excavate Trenches				
	— Connection Lines	270	cu yd	28	7,560
	— Collection Lines	20	cu yd	28	560
5	Backfill Trenches				
	— Connection Lines	270	cu yd	20	5,400
	— Collection Lines	15	cu yd	20	300
6	Rip-Rap Stone	5	cu yd	25	125
7	Manholes	4	ea	1,500	6,000
	SUBTOTAL				**50,145**
8	Mobilization/Demobilization Construction Management Site Services		10%		5,015
9	Implementation, Design, Permits		22%		11,032
10	Contingency		25%		12,536
	TOTAL				**78,728**

B. OPERATION AND MANAGEMENT COSTS FOR YEAR 1

Item	Description	Quantity	Units	Unit Cost ($)	Total ($)
1	Monthly Inspection	24	hrs	50	1,200
2	Laboratory Analysis (4 samples/year)	4	ea	560	2,240
3	Clean Out Collection Line and Disposal	1	LS	100	100
4	Clean Out Connection Line and Disposal	1	LS	500	500
	TOTAL				**4,040**

C. OPERATION AND MANAGEMENT COSTS FOR YEARS 2 THROUGH 30

Item	Description	Quantity	Units	Unit Cost ($)	Total ($)
1	Monthly Inspection	24	hrs	50	1,200
2	Laboratory Analysis (4 samples/year)	4	ea	560	2,240
3	Clean Out Collection Lines and Disposal	1	LS	100	100
4	Clean Out Connection Lines and Disposal	1	LS	500	500
	TOTAL				**4,040**

PRESENT WORTH ANALYSIS

Interest rate (annual):	6%	
Number of interest periods (years):	29	
Present worth (time zero):		4,040
Value (Year 2):		4,040
Total 30-Year Present Worth O&M Costs:		**54,907**

TABLE E-16 ALTERNATIVE MP-ALT L1: NO ACTION WITH CONTINUED MONITORING LEACHATE HANDLING ECONOMIC ANALYSIS OF SIX LANDFILLS U.S. MILITARY ACADEMY, WEST POINT, NEW YORK

Item	Description	Quantity	Units	Unit Cost ($)	Total ($)
A. CAPITAL COSTS					
Item	Description	Quantity	Units	Unit Cost ($)	Total ($)
1	None				**0**
B. OPERATION AND MANAGEMENT COSTS FOR YEAR 1					
Item	Description	Quantity	Units	Unit Cost ($)	Total ($)
1	Monthly Inspection	24	hrs	50	1,200
2	Laboratory Analysis (4 samples/year)	4	ea	560	2,240
	TOTAL				**3,440**
C. OPERATION AND MANAGEMENT COSTS FOR YEARS 2 THROUGH 30					
Item	Description	Quantity	Units	Unit Cost ($)	Total ($)
1	Monthly Inspection	24	hrs	50	1,200
2	Laboratory Analysis (4 samples/year)	4	ea	560	2,240
	TOTAL				**3,440**
PRESENT WORTH ANALYSIS					
Interest rate (annual):			6%		
Number of interest periods (years):			29		
Present worth (time zero):					3,440
Value (Year 2):					3,440
Total 30-Year Present Worth O&M Costs:					**46,752**

TABLE E-17 ALTERNATIVE MP-ALT L2: COLLECTION AND DISCHARGE TO U.S. MILITARY ACADEMY TREATMENT PLANT
LEACHATE HANDLING ECONOMIC ANALYSIS OF SIX LANDFILLS
U.S. MILITARY ACADEMY, WEST POINT, NEW YORK

A. CAPITAL COSTS

Item	Description	Quantity	Units	Unit Cost ($)	Total ($)
1	Lateral Collection Lines (6-in. perforated PVC)	100	ft	20	2,000
2	40-mil HDPE	550	sf	0.60	330
3	Geotextile	900	sf	0.25	225
4	Connection Line to Existing Sewer (6-in. solid PVC)	50	ft	30	1,500
5	Seed and Erosion Control	500	sf	2	1,000
6	6-in. Topsoil	250	cu ft	1	250
7	Excavate Trenches				
	— Connection Lines	30	cu yd	5	150
	— Collection Lines	20	cu yd	5	100
8	Backfill Trenches				
	— Connection Lines	30	cu yd	20	600
	— Collection Lines	20	cu yd	20	400
9	Scavenger Tank	1	ea	1,000	1,000
10	Pump System	1	ea	5,000	5,000
11	3-in. diameter PVC Force Main	50	ft	10	500
12	Plant Startup	1	ea	5,000	5,000
13	Manholes	2	ea	1,500	3,000
14	Electrical Panel/Materials	1	lot	5,000	5,000
	SUBTOTAL				**26,055**
15	Mobilization/Demobilization Construction Management Site Services		10%		2,606
16	Implementation, Design, Permits		22%		5,732
17	Contingency		25%		6,514
	TOTAL				**40,906**

B. OPERATION AND MANAGEMENT COSTS FOR YEAR 1

Item	Description	Quantity	Units	Unit Cost ($)	Total ($)
1	Monthly Inspection	24	hrs	50	1,200
2	Laboratory Analysis (4 samples/year)	4	ea	560	2,240
3	Clean Out Collection Line and Disposal	1	LS	100	100
4	Clean Out Connection Line and Disposal	1	LS	500	500
	TOTAL				**4,040**

C. OPERATION AND MANAGEMENT COSTS FOR YEARS 2 THROUGH 30

Item	Description	Quantity	Units	Unit Cost ($)	Total ($)
1	Monthly Inspection	24	hrs	50	1,200
2	Laboratory Analysis (4 samples/year)	4	ea	560	2,240
3	Clean Out Collection Line and Disposal	1	LS	100	100
4	Clean Out Connection Line and Disposal	1	LS	500	500
	TOTAL				**4,040**

PRESENT WORTH ANALYSIS		
Interest rate (annual):	6%	
Number of interest periods (years):	29	
Present worth (time zero):		4,040
Value (Year 2):		4,040
Total 30-Year Present Worth O&M Costs:		**54,907**

TABLE E-18 ALTERNATIVE MP-ALT L3: COLLECTION AND DISCHARGE TO SURFACE WATER LEACHATE HANDLING ECONOMIC ANALYSIS OF SIX LANDFILLS U.S. MILITARY ACADEMY, WEST POINT, NEW YORK

A. CAPITAL COSTS

Item	Description	Quantity	Units	Unit Cost ($)	Total ($)
1	Lateral collection lines (6-in. perforated PVC)	100	ft	20	2,000
2	40-mil HDPE	550	sf	0.60	330
3	Geotextile	900	sf	0.25	225
4	Excavate Trenches				
	— Connection Lines	75	cu yd	5	375
	— Collection Lines	20	cu yd	5	100
5	Backfill Trenches				
	— Connection Lines	75	cu yd	20	1,500
	— Collection Lines	20	cu yd	20	400
6	Seed and Erosion Control	500	sf	2	1,000
7	Connection Lines to Pretreatment Unit (6-in. PVC)	250	ft	30	7,500
8	Pretreatment Filtration Vessel	1	ea	50,000	50,000
9	Pretreatment Plant Foundation (slab)	1	ea	1,000	1,000
10	Pump System	1	ea	5,000	5,000
11	Plant Startup	1	ea	5,000	5,000
12	Treatment System Housing	1	ea	3,000	3,000
13	Prefabricated Concrete Outfall with Pad	1	ea	150	150
14	Electrical Panel/Materials	1	lot	5,000	5,000
	SUBTOTAL				**82,580**
15	Mobilization/Demobilization Construction Management Site Services		10%		8,258
16	Implementation, Design, Permits		22%		18,168
17	Contingency		25%		20,645
	TOTAL				**129,651**

B. OPERATION AND MANAGEMENT COSTS FOR YEAR 1

Item	Description	Quantity	Units	Unit Costs ($)	Total ($)
1	Monthly Inspection	24	hrs	50	1,200
2	Laboratory Analysis (4 samples/year)	4	ea	560	2,240
3	Plant Operations Cost	1	ea	7,500	7,500
4	Clean Out Collection Line and Disposal	1	LS	200	200
	TOTAL				**11,140**

C. OPERATION AND MANAGEMENT COSTS FOR YEARS 2 THROUGH 30					
Item	Description	Quantity	Units	Unit Costs ($)	Total ($)
1	Monthly Inspection	24	hrs	50	1,200
2	Laboratory Analysis (4 samples/year)	4	ea	560	2,240
3	Plant Operations Cost	1	ea	7,500	7,500
4	Clean Out Collection Line and Disposal	1	LS	200	200
	TOTAL				**11,140**

PRESENT WORTH ANALYSIS		
Interest rate (annual):	6%	
Number of interest periods (years):	29	
Present worth (time zero):		11,140
Value (Year 2):		11,140
Total 30-Year Present Worth O&M Costs:		**151,401**

Appendix F

Cost Estimates for Leachate Source Reduction Alternatives

APPENDIX F - LIST OF TABLES

TABLE F-1 ALTERNATIVE PS-ALT S1: CAPPING (GEOCOMPOSITE) WITH SURFACE WATER AND GAS VENT CONTROLS LEACHATE HANDLING ECONOMIC ANALYSIS OF SIX LANDFILLS U.S. MILITARY ACADEMY, WEST POINT, NEW YORK

A. CAPITAL COSTS					
Item	Description	Quantity	Units	Unit Cost ($)	Total ($)
1	Security Fence/Gate	1,500	ft	15.00	22,500
2	Site Regrading	2,500	cy	6.00	15,000
3	Erosion/Sediment Control	0	LS		15,000
4	Soil Backfill for Capping Support	6,800	cy	15.00	102,000
5	Capping System				
	— Select Backfill	10,000	cy	8.00	80,000
	— Geonet	180,000	sf	0.30	54,000
	— 40-mil HDPE	90,000	sf	0.60	54,000
	— Topsoil	1,700	cy	12.00	20,400
	— Seeding/Revegetation	90,000	sf	0.03	2,700
6	Gas Vents	2	ea	400.00	800
7	Surface Water Diversion - West/North	900	ft	25.00	22,500
8	Surface Water Diversion - East/South	1,000	ft	10.00	10,000
9	Leachate Collection Line				
	— Trenching	12,000	cy	6.00	72,000
	— Stone	1,700	cy	20.00	34,000
	— 6-in. PVC Collection Line	1,000	ft	25.00	25,000
	— 40-mil HDPE	21,000	sf	0.60	12,600
	— Geotextile	28,000	sf	0.25	7,000
	— Manhole	1	ea	1,500.00	1,500
10	**SUBTOTAL**				**551,000**
11	Mobilization/Demobilization, Construction Management, Site Services		10%		55,100
12	Implementation, Design, Permits		22%		121,220
13	Contingency		25%		137,750
14	**TOTAL**				**865,070**

B. OPERATION AND MANAGEMENT COSTS FOR YEAR 1					
Item	Description	Quantity	Units	Unit Cost ($)	Total ($)
1	Quarterly Inspection	32	hrs	70	2,240
2	Laboratory Analysis (4 rounds/year)				
	— Monitoring Wells	12	ea	1,300	15,600
	— Surface Water	8	ea	1,300	10,400
	— Field Blank	4	ea	1,300	5,200
	— Trip Blank	4	ea	175	700
3	Lawn Mowing				
	— Labor	80	hrs	25	2,000
	— Equipment	80	hrs	8	640
4	Quarterly Reports	48	hrs	70	3,360
5	**SUBTOTAL**				**40,140**

C. OPERATION AND MANAGEMENT COSTS FOR YEARS 2 THROUGH 30					
Item	Description	Quantity	Units	Unit Cost ($)	Total ($)
1	Quarterly Inspection	32	hrs	74	2,374
2	Laboratory Analysis (4 rounds/yr)				
	— Monitoring Wells	12	ea	1,378	16,536
	— Surface Water	8	ea	1,378	11,024
	— Field Blank	4	ea	1,378	5,512
	— Trip Blank	4	ea	186	742
3	Lawn Mowing				
	— Labor	80	hrs	27	2,120
	— Equipment	80	hrs	8	678
4	Quarterly Reports	48	hrs	74	3,562
5	**SUBTOTAL**				**42,548**

PRESENT WORTH ANALYSIS		
Interest Rate (annual):	6%	
Number of Interest Periods (years):	29	
Present Worth (time zero):		40,140
Value (Year 2):		42,548
Total 30-Year Present Worth O&M Costs:		**585,672**

TABLE F-2 ALTERNATIVE PS-ALT S2: CAPPING (CLAY) WITH SURFACE WATER AND GAS VENT CONTROLS LEACHATE HANDLING ECONOMIC ANALYSIS OF SIX LANDFILLS U.S. MILITARY ACADEMY, WEST POINT, NEW YORK

A. CAPITAL COSTS					
Item	Description	Quantity	Units	Unit Cost ($)	Total ($)
1	Security Fence/Gate	1,800	ft	15.00	27,000
2	Site Regrading	7,300	cy	6.00	43,800
3	Erosion/Sediment Control	0	LS		15,000
4	Soil Backfill for Capping Support	11,000	cy	15.00	165,000
5	Capping System				
	— Sand	5,200	cy	12.00	62,400
	— Clay	11,000	cy	20.00	220,000
	— Select Backfill	11,000	cy	8.00	88,000
	— Topsoil	2,600	cy	12.00	31,200
	— Seeding/Revegetation	140,000	sf	0.03	4,200
6	Gas Vents	3	ea	400.00	1,200
7	Surface Water Diversion - West/North	750	ft	25.00	18,750
8	Surface Water Diversion - East/South	1,500	ft	10.00	15,000
9	Leachate Collection Line				
	— Trenching	17,000	cy	6.00	102,000
	— Stone	2,500	cy	20.00	50,000
	— 6-in. PVC Collection Line	1,000	ft	25.00	25,000
	— 40-mil HDPE	32,000	sf	0.60	19,200
	— Geotextile	42,000	sf	0.25	10,500
	— Manhole	1	ea	1,500.00	1,500
10	**SUBTOTAL**				**899,750**
11	Mobilization/Demobilization, Construction Management, Site Services		10%		89,975
12	Implementation, Design, Permits		22%		197,945
13	Contingency		25%		224,938
14	**TOTAL**				**1,412,608**

B. OPERATION AND MANAGEMENT COSTS FOR YEAR 1					
Item	Description	Quantity	Units	Unit Cost ($)	Total ($)
1	Quarterly Inspection	32	hrs	70	2,240
2	Laboratory Analysis (4 rounds/year)				
	— Monitoring wells	12	ea	1,300	15,600
	— Surface water	8	ea	1,300	10,400
	— Field Blank	4	ea	1,300	5,200
	— Trip Blank	4	ea	175	700
3	Lawn Mowing				
	— Labor	80	hrs	25	2,000
	— Equipment	80	hrs	8	640
4	Quarterly Reports	48	hrs	70	3,360
5	**TOTAL**				**40,140**

C. OPERATION AND MANAGEMENT COSTS FOR YEARS 2 THROUGH 30					
Item	Description	Quantity	Units	Unit Cost ($)	Total ($)
1	Quarterly Inspection	32	hrs	74	2,374
2	Laboratory Analysis (4 rounds/year)				
	— Monitoring Wells	12	ea	1,378	16,536
	— Surface Water	8	ea	1,378	11,024
	— Field Blank	4	ea	1,378	5,512
	— Trip Blank	4	ea	186	742
3	Lawn Mowing				
	— Labor	80	hrs	27	2,120
	— Equipment	80	hrs	8	678
4	Quarterly Reports	48	hrs	74	3,562
5	**SUBTOTAL**				**42,548**

PRESENT WORTH ANALYSIS		
Interest Rate (annual):	6%	
Number of Interest Periods (years):	29	
Present Worth (time zero):		40,140
Value (Year 2):		42,548
Total 30-Year Present Worth O&M Costs:		**585,672**

TABLE F-3 ALTERNATIVE LF-ALT S1: REPAVE SURFACE AND IMPROVE SWALE DRAINAGE CHARACTERISTICS LEACHATE HANDLING ECONOMIC ANALYSIS OF SIX LANDFILLS U.S. MILITARY ACADEMY, WEST POINT, NEW YORK

A. CAPITAL COSTS

Item	Description	Quantity	Units	Unit Cost ($)	Total ($)
1	Repave Surface of Parking Area	13,900	sy	12.50	173,750
2	Surface Water Diversion				
	— Improve Channel	1,100	ft	10.00	11,000
	— Pave Bottom and Sides of Swale	1,225	sy	9.00	11,025
3	**SUBTOTAL**				**195,775**
4	Mobilization/Demobilization, Construction Management, Site Services		10%		19,578
5	Implementation, Design, Permits		22%		43,071
6	Contingency		25%		48,944
7	**TOTAL**				**307,367**

B. OPERATION AND MANAGEMENT COSTS FOR YEAR 1

Item	Description	Quantity	Units	Unit Cost ($)	Total ($)
1	Quarterly Inspection	24	hrs	70	1,680
2	Laboratory Analysis (4 samples/year)	4	ea	560	2,240
3	Snow Removal				
	— Labor	200	hrs	25	5,000
	— Equipment	200	hrs	8	1,600
4	Quarterly Reports	32	hrs	70	2,240
5	**TOTAL**				**12,760**

C. OPERATION AND MANAGEMENT COSTS FOR YEARS 2 THROUGH 30

Item	Description	Quantity	Units	Unit Cost ($)	Total ($)
1	Quarterly Inspection	24	hrs	70	1,680
2	Laboratory Analysis (4 samples/year)	4	ea	560	2,240
3	Snow Removal				
	— Labor	200	hrs	27	5,400
	— Equipment	200	hrs	8	1,600
4	Quarterly Reports	32	hrs	70	2,240
5	**TOTAL**				**13,160**

PRESENT WORTH ANALYSIS

Interest Rate (annual):	6%	
Number of Interest Periods (years):	29	
Present Worth (time zero):		12,760
Value (Year 2):		13,160
Total 30-Year Present Worth O&M Costs:		**186,178**

TABLE F-4 ALTERNATIVE LF-ALT S2: CAPPING WITH SURFACE WATER CONTROLS LEACHATE HANDLING ECONOMIC ANALYSIS OF SIX LANDFILLS U.S. MILITARY ACADEMY, WEST POINT, NEW YORK

A. CAPITAL COSTS

Item	Description	Quantity	Units	Unit Cost ($)	Total ($)
1	Security Fence	2,400	ft	15.00	36,000
2	Site Regrading	2,400	cy	6.00	14,400
3	Erosion/Sediment Control	0	LS		15,000
4	Soil Backfill for Capping	4,900	cy	15.00	73,500
5	Capping System				
	— Sand	4,700	cy	12.00	56,400
	— Clay	9,300	cy	20.00	186,000
	— Select Backfill	9,300	cy	8.00	74,400
	— Topsoil	2,400	cy	12.00	28,800
	— Seeding/Revegetation	125,000	sf	0.03	3,750
6	Surface Water Diversion - West/North	1,250	ft	25.00	31,250
7	Surface Water Diversion - East/South	1,150	ft	10.00	11,500
8	**SUBTOTAL**				**531,000**
9	Mobilization/Demobilization, Construction Management, Site Services		10%		53,100
10	Implementation, Design, Permits		22%		116,820
11	Contingency		25%		132,750
12	**TOTAL**				**833,670**

B. OPERATION AND MANAGEMENT COSTS FOR YEAR 1

Item	Description	Quantity	Units	Unit Cost ($)	Total ($)
1	Quarterly Inspection	32	hrs	70	2,240
2	Laboratory Analysis (4 rounds/year)				
	— Monitoring Wells	12	ea	1,300	15,600
	— Surface Water	8	ea	1,300	10,400
	— Field Blank	4	ea	1,300	5,200
	— Trip Blank	4	ea	175	700
3	Lawn Mowing				
	— Labor	80	hrs	25	2,000
	— Equipment	80	hrs	8	640
4	Quarterly Reports	48	hrs	70	3,360
5	**TOTAL**				**40,140**

C. OPERATION AND MANAGEMENT COSTS FOR YEARS 2 THROUGH 30					
Item	Description	Quantity	Units	Unit Cost ($)	Total ($)
1	Quarterly Inspection	32	hrs	74	2,374
2	Laboratory Analysis (4 rounds/year)				
	— Monitoring Wells	12	ea	1,378	16,536
	— Surface Water	8	ea	1,378	11,024
	— Field Blank	4	ea	1,378	5,512
	— Trip Blank	4	ea	186	742
3	Lawn Mowing				
	— Labor	80	hrs	27	2,160
	— Equipment	80	hrs	8	678
4	Quarterly Reports	48	hrs	74	3,562
5	**SUBTOTAL**				**42,588**
PRESENT WORTH ANALYSIS					
Interest Rate (annual):			6%		
Number of Interest Periods (years):			29		
Present Worth (time zero):					40,140
Value (Year 2):					42,588
Total 30-Year Present Worth O&M Costs:					**585,672**

TABLE F-5 ALTERNATIVE OC-ALT S1: REPAVE SURFACE OF LOT LEACHATE HANDLING ECONOMIC ANALYSIS OF SIX LANDFILLS U.S. MILITARY ACADEMY, WEST POINT, NEW YORK

A. CAPITAL COSTS					
Item	Description	Quantity	Units	Unit Cost ($)	Total ($)
1	Repave Surface of Lot	1,700	sy	12.50	21,250
2	**SUBTOTAL**				**21,250**
3	Mobilization/Demobilization Construction Management, Site Services		10%		2,125
4	Implementation, Design, Permits		22%		4,675
5	Contingency		25%		5,313
6	**TOTAL**				**33,363**
B. OPERATION AND MANAGEMENT COSTS FOR YEAR 1					
Item	Description	Quantity	Units	Unit Cost ($)	Total ($)
1	Quarterly Inspection	24	hrs	70	1,680
2	Laboratory Analysis (4 samples/year)	4	ea	560	2,240
3	Snow Removal				
	— Labor	200	hrs	25	5,000
	— Equipment	200	hrs	8	1,600
4	Quarterly Reports	32	hrs	70	2,240
5	**TOTAL**				**12,760**
C. OPERATION AND MANAGEMENT COSTS FOR YEARS 2 THROUGH 30					
Item	Description	Quantity	Units	Unit Cost ($)	Total ($)
1	Quarterly Inspection	24	hrs	70	1,680
2	Laboratory Analysis (4 samples/year)	4	ea	560	2,240
3	Snow Removal				
	— Labor	200	hrs	27	5,400
	— Equipment	200	hrs	8	1,600
4	Quarterly Reports	32	hrs	70	2,240
5	**TOTAL**				**13,160**
PRESENT WORTH ANALYSIS					
Interest Rate (annual):			6%		
Number of Interest Periods (years):			29		
Present Worth (time zero):					12,760
Value (Year 2):					13,160
Total 30-Year Present Worth O&M Costs:					**186,178**

TABLE F-6 ALTERNATIVE SL-ALT S1: REPAVE SURFACE OF LOT AND IMPROVE SWALE DRAINAGE CHARACTERISTICS LEACHATE HANDLING ECONOMIC ANALYSIS OF SIX LANDFILLS U.S. MILITARY ACADEMY, WEST POINT, NEW YORK

A. CAPITAL COSTS					
Item	Description	Quantity	Units	Unit Cost ($)	Total ($)
1	Repave Surface of Lot	10,000	sy	12.50	125,000
2	**SUBTOTAL**				**125,000**
3	Mobilization/Demobilization, Construction Management, Site Services		10%		12,500
4	Implementation, Design, Permits		22%		27,500
5	Contingency		25%		31,250
6	**TOTAL**				**196,250**
B. OPERATION AND MANAGEMENT COSTS FOR YEAR 1					
Item	Description	Quantity	Units	Unit Cost ($)	Total ($)
1	Quarterly Inspection	24	hrs	70	1,680
2	Laboratory Analysis (4 samples/year)	4	ea	560	2,240
3	Snow Removal				
	— Labor	200	hrs	25	5,000
	— Equipment	200	hrs	8	1,600
4	Quarterly Reports	32	hrs	70	2,240
5	**TOTAL**				**12,760**
C. OPERATION AND MANAGEMENT COSTS FOR YEARS 2 THROUGH 30					
Item	Description	Quantity	Units	Unit Cost ($)	Total ($)
1	Quarterly Inspection	24	hrs	70	1,680
2	Laboratory Analysis (4 samples/year)	4	ea	560	2,240
3	Snow Removal				
	— Labor	200	hrs	27	5,400
	— Equipment	200	hrs	8	1,600
4	Quarterly Reports	32	hrs	70	2,240
5	**TOTAL**				**13,160**
PRESENT WORTH ANALYSIS					
Interest Rate (annual):			6%		
Number of Interest Periods (years):			29		
Present Worth (time zero):					12,760
Value (Year 2):					13,160
Total 30-Year Present Worth O&M Costs:					**186,178**