USACE
U.S. Army Corps of Engineers

BALTIMORE DISTRICT

FINAL

Feasibility Study Report

Landfill 10 (LF Site)
Fort Lee, Virginia

Prepared for:

U.S. Army Corps of Engineers
Baltimore District
Baltimore, Maryland

Contract Number: DACW45-93-D-0024

Prepared by:
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April 2002

FLUOR DANIEL

APPROVAL

FINAL
FEASIBILITY STUDY
FOR
LANDFILL 10 (LF SITE)

DATE: April 10, 2002

PROJECT NAME: Fort Lee Military Reservation, Ft. Lee, Virginia

Approved By: _____
Myron Price, USACE Project Manager — Date

Approved By: _____
Hank Hennigar, Fort Lee - Environmental Coordinator — Date

Approved By: _____
Ashley Sapyta, Fluor Daniel Project Manager — Date

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U.S. DEPARTMENT OF DEFENSE (DOD)
U.S. ARMY CORPS OF ENGINEERS
(USACE)

CONTRACT 06644700

CLIENT CONTRACT NO.:DACW45-93-D-0024

FLUOR DANIEL ENVIRONMENTAL SERVICES, INC.

FINAL FEASIBILITY STUDY FOR LANDFILL 10 (LF SITE)

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REVISION STATUS LOG

Rev.	Date	Section	Revision Description	Originator	Chkd	Apvd	QA Review
0	09/24/99	All	Issue Draft Feasibility Study (FS) Report for Landfill 10 (LF Site)	A. Sapyta			
1	01/28/00	All	Issue Final Feasibility Study (FS) Report for Landfill 10 (LF Site)	A. Sapyta			
2	06/04/01	All	Reissue Draft Feasibility Study (FS) Report for Landfill 10 (LF Site)	A. Sapyta			
3	04/10/02	All	Reissue Final Feasibility Study (FS) Report for Landfill 10 (LF Site)	A. Sapyta			

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ARARs	Applicable or Relevant and Appropriate Requirements
bls	Below land surface
BNAs	Base-neutral and acid extractable compounds
BTAG	Biological Technical Assistance Guideline
CERCLA	Comprehensive Environmental Response, Compensation & Liability Act
COC	Contaminant of Concern
COPC	Contaminant of Potential Concern
Fluor Daniel	Fluor Daniel Environmental Services, Inc.
Fort Lee	Fort Lee Military Reservation
FS	Feasibility Study
Ft	feet
ft/yr	feet per year
GETA	General Evaluation and Testing Area
HI	Hazard Index
HQ	Hazard Quotient
LF Site	Landfill 10
MCL	Maximum Contaminant Level
MF Site	Military-in-the-Field Training Area
msl	Mean sea level
NCP	National Oil and Hazardous Substances Contingency Plan
NPL	National Priorities List
PA/SI	Preliminary Assessment/Site Investigation
POTW	Publically Owned Treatment Works
PCB	Polychlorinated Biphenyls
PRG	Preliminary Remedial Goal
RBC	Risk-based Concentration
RfD	Reference Dose
RI/FS	Remedial Investigation/Feasibility Study
RI	Remedial Investigation
SF	Slope Factor
SSL	Soil Screening Level
TAL	Target Analyte List
TBC	To Be Considered
TRV	Toxic Reference Value
USACE	U.S. Army Corps of Engineers
USEPA	United States Environmental Protection Agency
VaDEQ	Virginia Department of Environmental Quality
VOC	Volatile Organic Compound

1.0 INTRODUCTION

This document is a Feasibility Study (FS) prepared to evaluate remedial alternatives for addressing contamination at the Landfill 10 (LF Site) at the Fort Lee Military Reservation (Fort Lee) near Petersburg, Virginia. A vicinity map for Fort Lee is presented as Figure 1-1. The general location of the LF Site is shown on Figure 1-2. This FS report addresses the recommendations of the Remedial Investigation (RI) Report (Fluor Daniel, 1999) through an evaluation of remedial alternatives.

1.1 Purpose and Scope

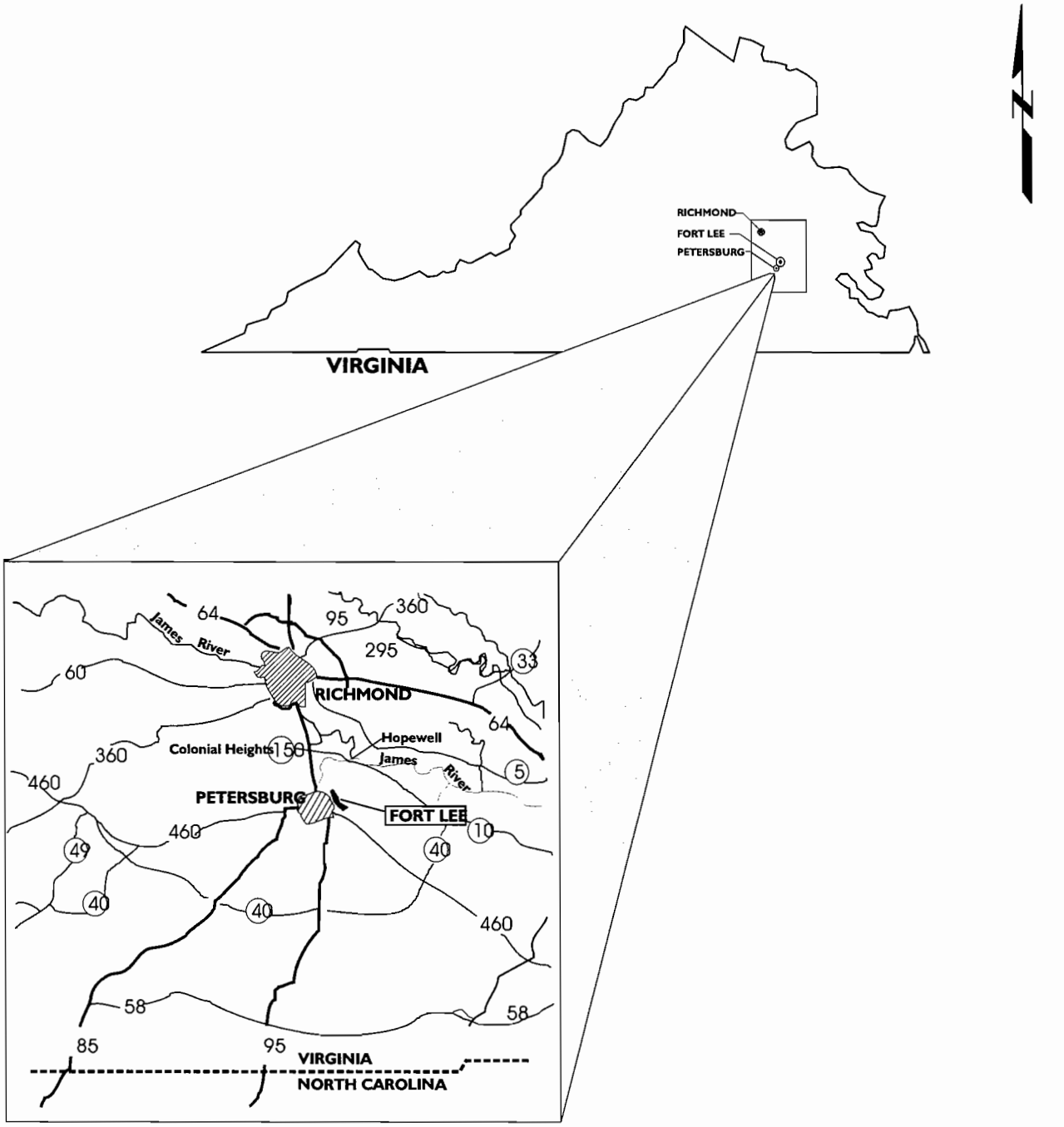
This FS was designed to present technologies and remedial alternatives appropriate for mitigating risk to human health and the environment and for ensuring regulatory compliance.

The FS process was based on the following steps:

Development of remedial action objectives
Development of general response actions to satisfy the remedial action objectives
Identification of volumes or areas of media to which general response actions are applicable
Identification and screening of technologies applicable to the identified general response actions
Identification and evaluation of technology process options
Assembly of alternatives representing a range of treatment and containment combinations
Detailed analysis of remedial alternatives

The purpose of the FS is to provide decision makers with sufficient information to select an appropriate remedy for the site.

The LF Site is not listed on the National Priorities List (NPL or Superfund site); however, it is being remediated following the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) process as directed by the Defense Environmental Restoration Act with the Department of the Army as lead agency and the Virginia Department of Environmental Quality (VaDEQ) as the lead regulatory agency.



CREATED BY M. VIGIL	DATE 7/23/97
REVISED BY R. MURRAY	DATE 04/20/01
APPROVED BY J Gervais	DATE 04/17/01

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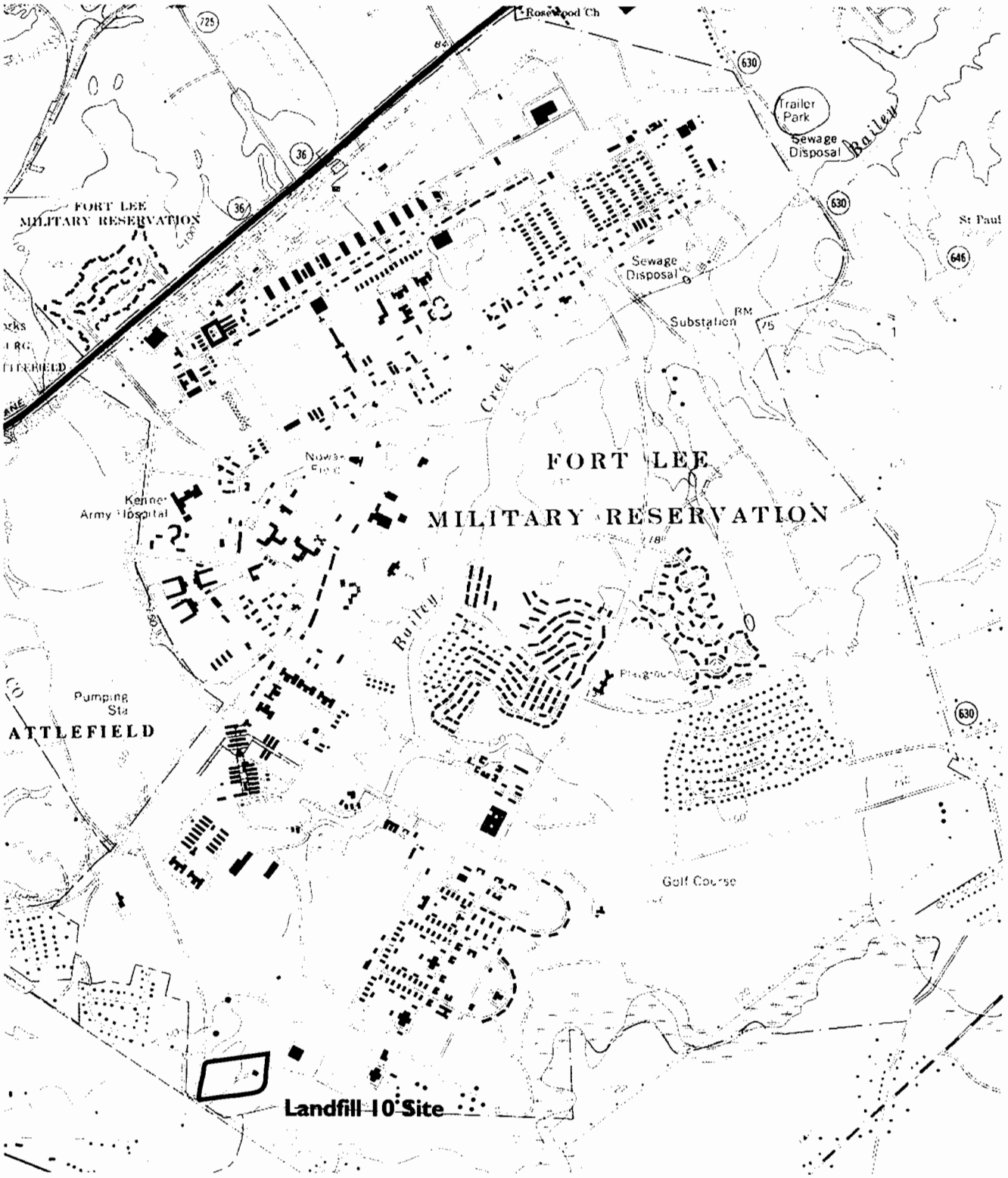
GREENVILLE SOUTH CAROLINA

VICINITY MAP
FORT LEE, VIRGINIA

FIGURE 1-1 | **REV 1**

FIG 1-1.cdr



REFERENCE: U.S.G.S. 7.5 MINUTE
TOPOGRAPHIC QUADRANGLE:
PRINCE GEORGE, VA. AND
HOPEWELL, VW.

FLUOR DANIEL
GREENVILLE, SC

SITE LOCATION
FORT LEE, VIRGINIA

SCALE: AS SHOWN	DRAWN BY: BJW	CHECKED BY:
JOB NO: 06644700	DATE: 10-22-97	FIGURE NO: 1-2

1.2 Report Organization

The format of the FS report follows the suggested FS report format provided in Guidance for Conducting Remedial Investigations and Feasibility Studies under the Comprehensive Environmental Response, Compensation & Liability Act (CERCLA) (USEPA, 1988).

The FS report is organized into the following sections:

Section 1.0 – Introduction: This section presents the purpose and scope of the FS and summarizes the site history, site description and environmental setting, nature and extent of contamination, contaminant fate and transport and baseline risk assessment.

Section 2.0 – Development of Remedial Action Objectives: This section identifies the media of concern, selects the Applicable or Relevant and Appropriate Requirements (ARARs), and discusses the Preliminary Risk-Based Goals (PRGs) for the LF Site.

Section 3.0 – Identification and Screening of Technologies: This section identifies a selected number of technologies appropriate for the remedial action objectives and screens the technologies.

Section 4.0 – Development of Remedial Alternatives: This section combines the technologies which passed the screening phase to form a range of remedial alternatives.

Section 5.0 – Detailed Analysis of Alternatives: This section describes each alternative developed and presents a technical assessment of each alternative.

Section 6.0 – Comparative Analysis of Alternatives: This section presents a comparative analysis of the alternatives that underwent detailed analysis relative to one another using the criteria from the detailed analysis.

Section 7.0 – References

The appendices of the report include the boring logs for a post-RI field study, the ARAR screening tables and the calculations for estimating remedial costs.

1.3 Background - LF Site

1.3.1 Site Description

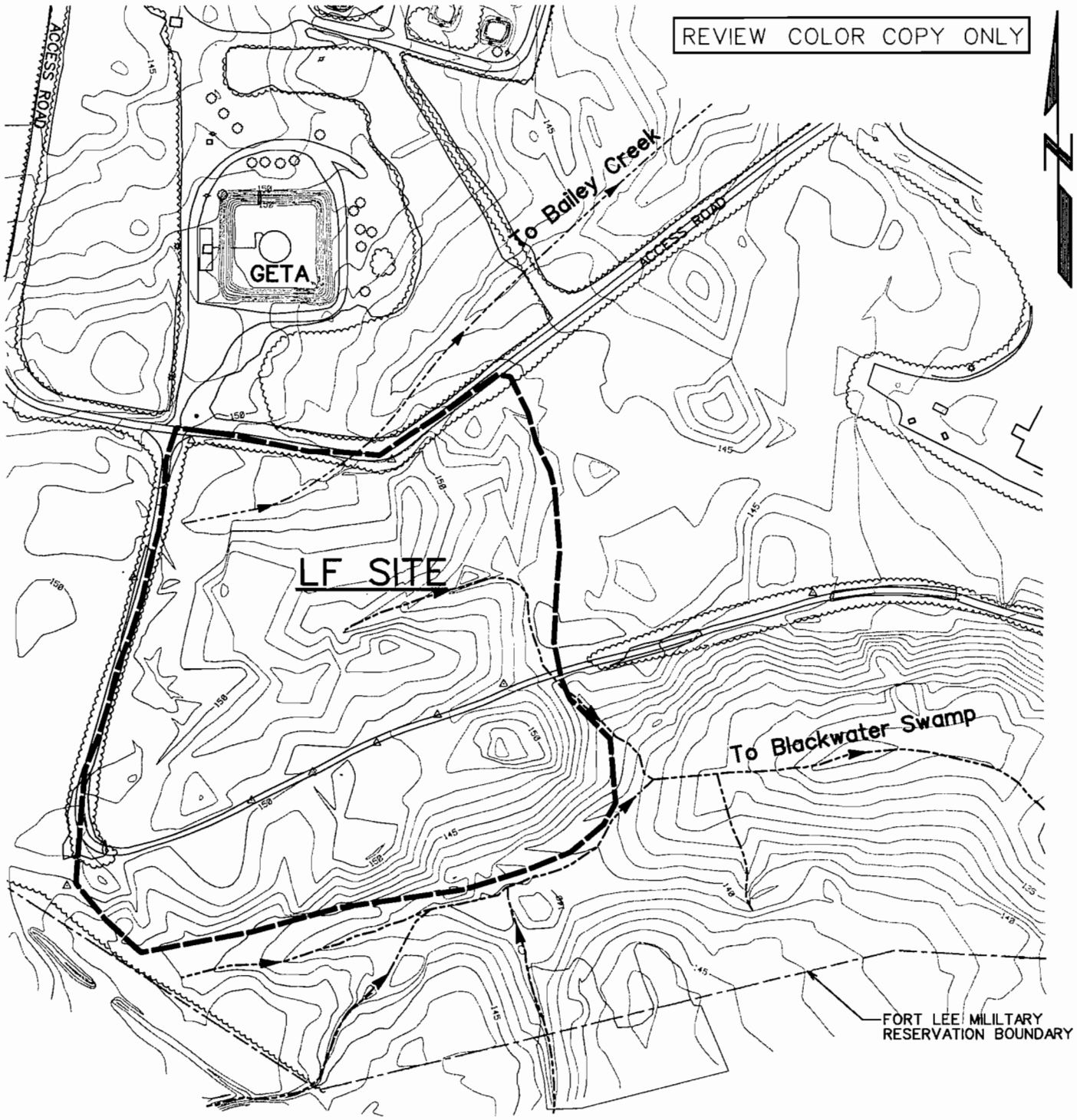
The LF Site is located along the southern property line of Fort Lee near 38th Street, west of the corner of 38th Street and Hobby Avenue along a gravel road (see Figure 1-3). The LF Site is bounded to the north by both the General Evaluation and Testing Area (GETA) and the Military-in-the-Field Training Area (MF Site), to the east by a forested training area, to the west by a residential area and to the south by a gas line easement, mobile home park, and cleared fields.

The LF Site is located along the north side of an east-west trending topographic high, at an elevation of approximately 150 feet above mean sea level (msl). The 150-foot topographic contour marks the highest elevations on the southern portion of Fort Lee.

The LF Site has an irregular rolling or hummocky topography and is heavily vegetated. The heavy vegetation restricts vehicle and equipment access to the central part of the site. The unique topography of the site and its location on the base help create a surface water drainage divide through the northern portion of the site. The northern corner of the site drains northeast toward Bailey Creek, while the remainder of the site drains eastward, then south to an ephemeral stream which drains into Blackwater Swamp.

1.3.2 Site History

The landfill, which covers approximately ten (10) acres, is suspected to have been in operation from the late 1950s to the early 1960s. Aerial photographs dating from this period indicate the landfill was probably of the trench and fill type into which non-specified debris were dumped and covered with soil. Two (2) test pits dug into the north side of the landfill during the RI confirmed the trench and fill nature of the landfill. The approximate boundary of the landfill area is illustrated on Figure 1-3.



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REVISED BY D. ASTI	DATE 06/07/98
APPROVED BY D. ASTI	DATE 06/08/98

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TITLE

LANDFILL BOUNDARY MAP
LANDFILL 10 (LF) SITE
FORT LEE, VIRGINIA

FIGURE NO. 1-3 | REV. 0

64474-3.FIG

A Preliminary Assessment/Site Investigation (PA/SI) was conducted at the LF Site in 1992 by James Montgomery Consulting Engineers Inc. Confirmatory sampling was conducted by Fluor Daniel Environmental Services (Fluor Daniel) in 1994 to verify the conclusions of the PA/SI. As a result of the findings of these investigations, Fluor Daniel was contracted by the U.S. Army Corps of Engineers (USACE) to perform a Remedial Investigation/Feasibility Study (RI/FS) of the site under Contract No. DACW45-93-D-0024, Delivery Order No. D015. A RI was conducted at the LF Site in 1998 and the RI report was issued as a final document in April 1999.

1.3.3 Environmental Setting

1.3.3.1 Geology

Data gathered during Confirmatory Sampling and the RI were used to construct geologic cross-sections for the site. The location of the cross-sections are shown in Figure 1-4. A north-south cross-section (Figure 1-5) and a west-east cross-section (Figure 1-6) are provided to show a graphic representation of the geology at the LF Site.

The shallow geology of the LF Site consists of three definable units. The first unit has been classified from field observations and laboratory analysis as a sandy to silty, low plasticity orange clay. The unit extends from the land surface to a depth of approximately 10 feet below land surface (bls). This clay layer appears to thin toward the north side of the site and also toward the east and southeast side of the site where the stream channel begins. The contact between the clay and the underlying sand is level and gradational, suggesting that this contact is not an erosional surface.

The second unit, beneath the clay, has been classified from field and laboratory analysis as clayey, fine to medium grained sand. Occasional fine gravels were also found in this unit. The color of the sand is variable, from mottled orange-brown to gray/white. This unit extends from approximately 10 feet bls to approximately 24 feet bls.

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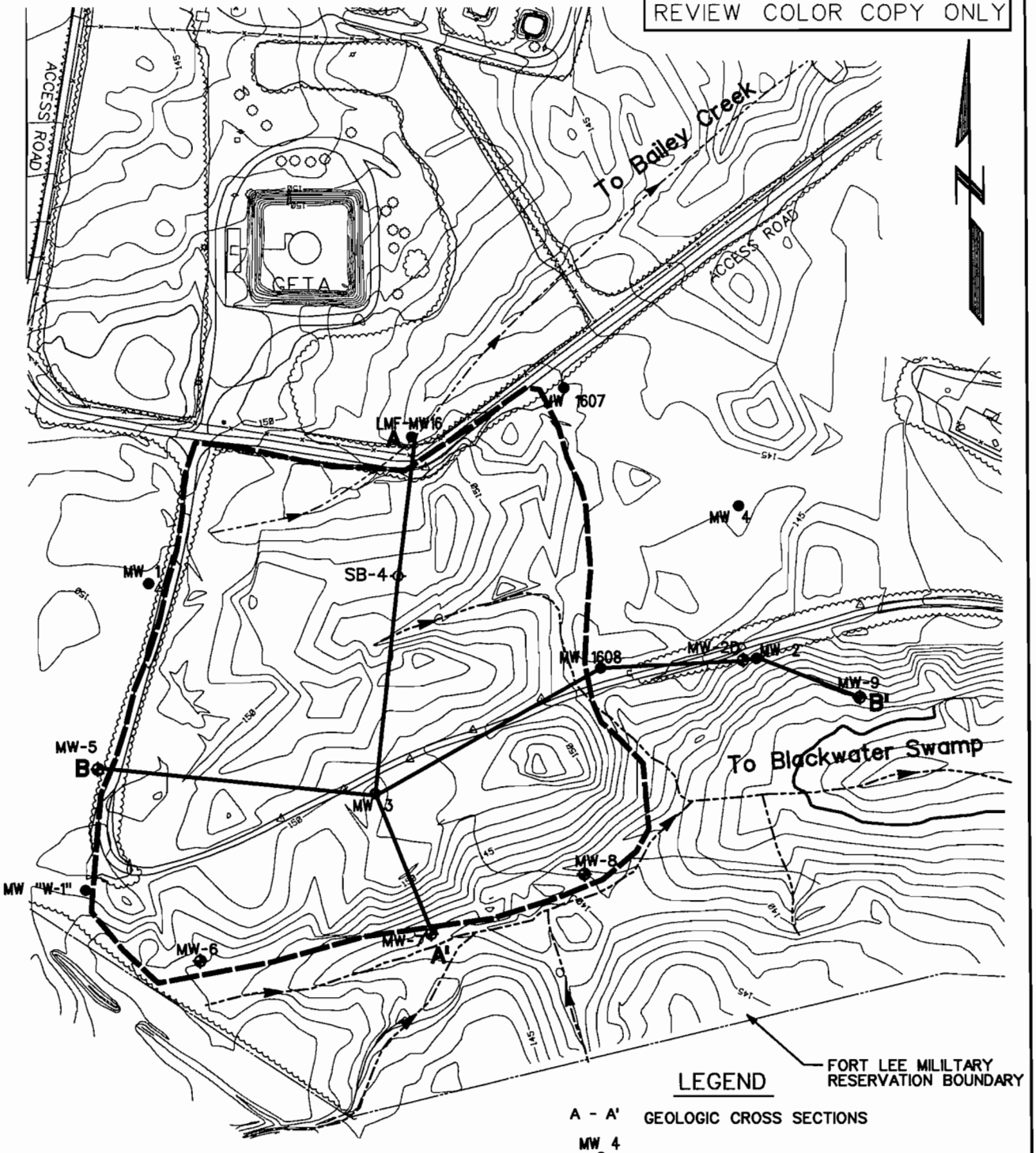

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APPROVED BY A. SAPYTA	DATE 04/20/01

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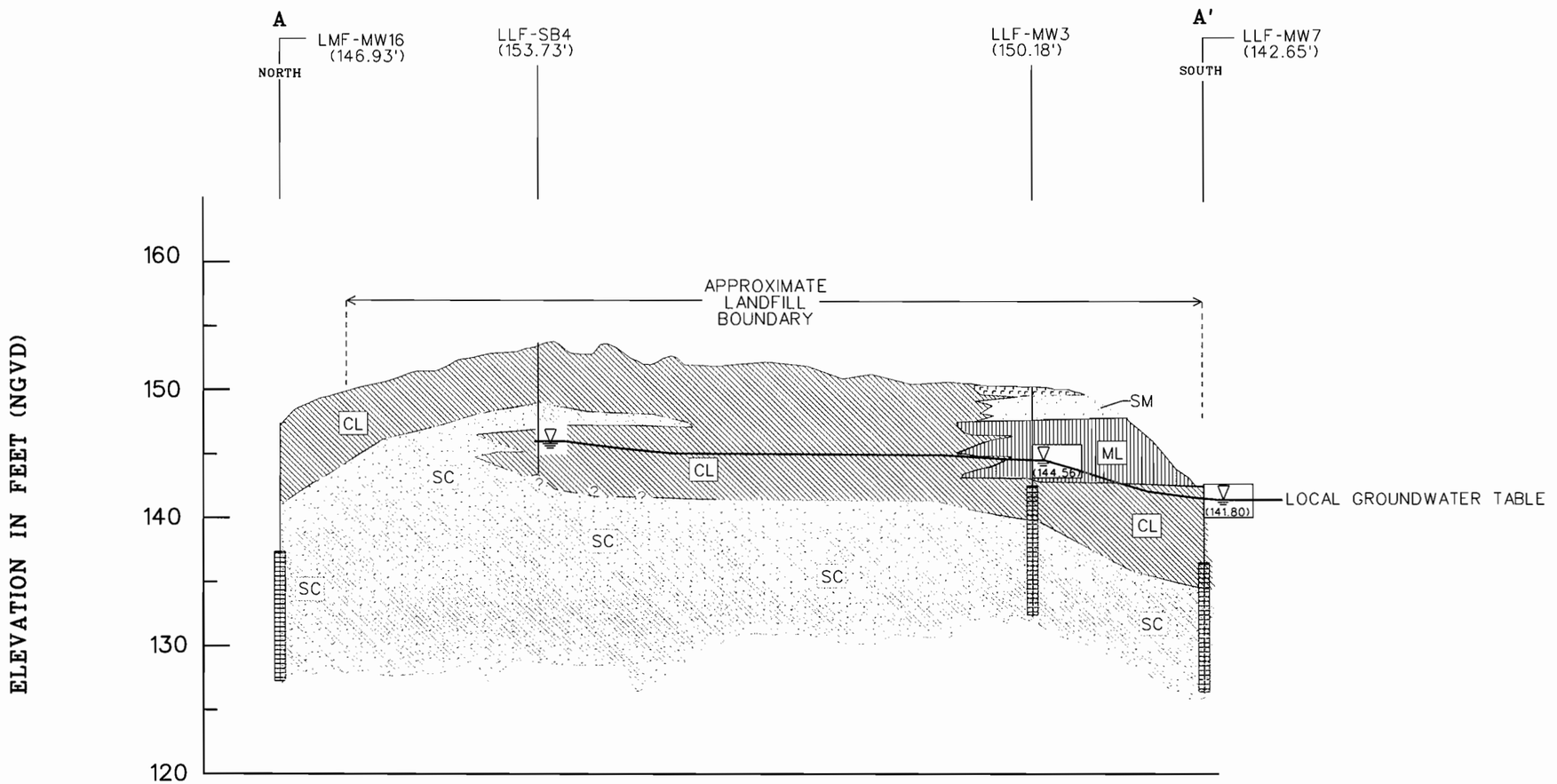
TITLE

CROSS SECTION LOCATION MAP
LANDFILL 10 (LF) SITE
FORT LEE, VIRGINIA

FIGURE 1-4 | REV. 0

FIG-1-4.DGNN



LEGEND

- CLAYEY SANDS, SAND-CLAY MIXTURES (SC)
- SILTY SAND-SANDY SILTS (SM)
- SILTY CLAYS, SANDY CLAYS, LOW PLASTICITY (CL)
- INORGANIC SILTS AND VERY FINE SANDS, CLAYEY SILTS (ML)
- ASH, CINDERS
- (146.82') LAND SURFACE ELEVATION
- 10' GROUNDWATER MONITORING WELL SCREEN
- (144.56') GROUNDWATER ELEVATION @ 3/25/98
- LOCAL GROUNDWATER TABLE

0 50 100 200

VERTICAL EXAGGERATION: 10x

NOTE:

GROUNDWATER LEVEL IN LLF-SB4 WAS MEASURED PRIOR TO ABANDONING THE BOREHOLE.
LLF-MW16 IS SHOWN FOR GEOLOGIC CONTROL ONLY.

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TITLE
GEOLOGIC CROSS SECTION (A-A')
LANDFILL 10 (LF) SITE
FORT LEE, VIRGINIA

REV. 0

FIGURE NO. 1-5

LFCROSS1.DGN

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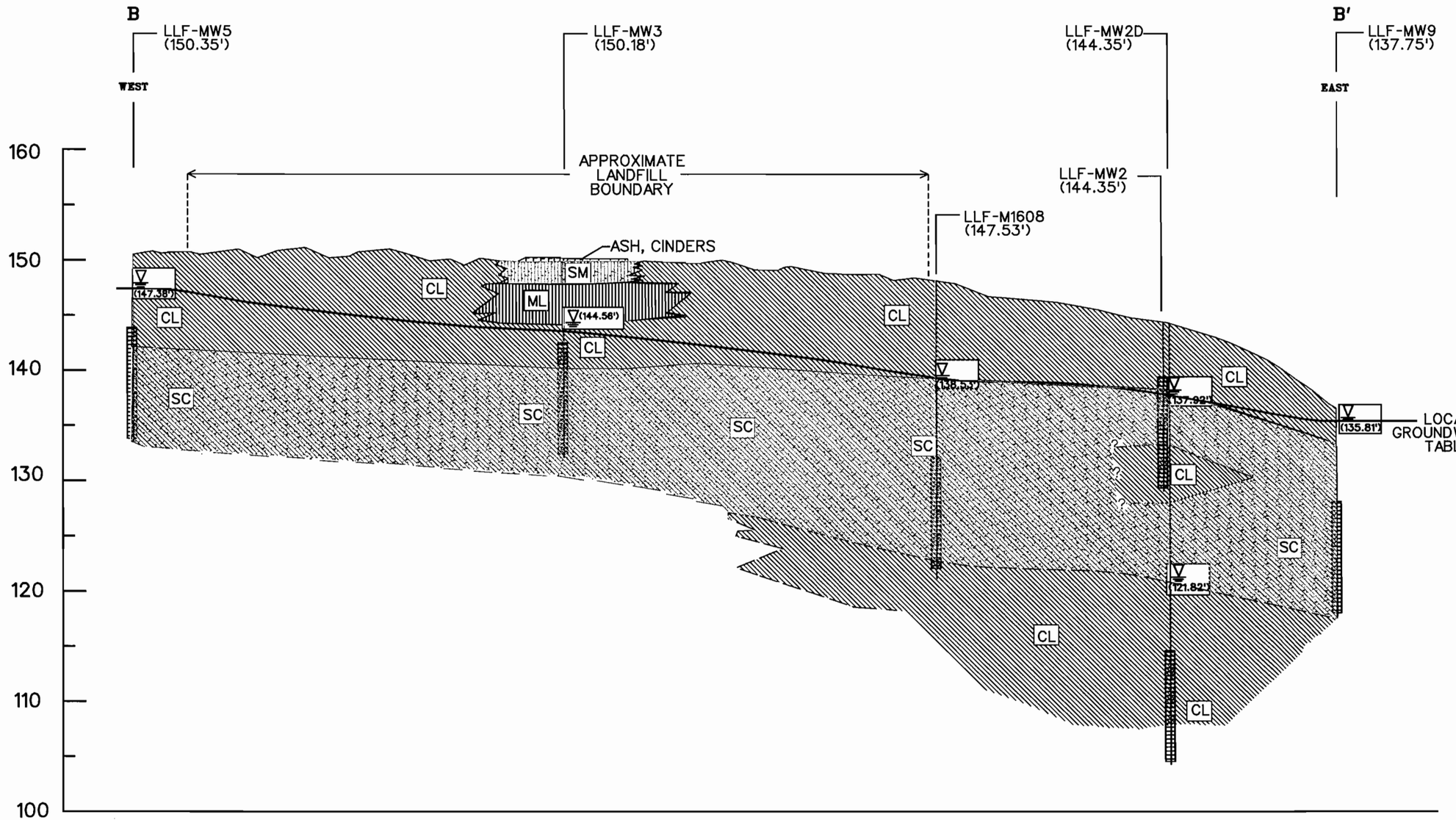
DRAWN BY	BJ WHITFIELD	DATE 04/23/98
REVISED BY	J.T.MITCHELL	DATE 01/30/02
APPROVED BY	D. ASTI	DATE 06/13/98



LEGEND

- INORGANIC SILTS AND VERY FINE SANDS, CLAYEY SILTS (ML)
- ASH, CINDERS
- 10' GROUNDWATER MONITORING WELL SCREEN
- (144.56') GROUNDWATER ELEVATION @ 3/25/98
- LOCAL GROUNDWATER TABLE
- CLAYEY SANDS, SAND-CLAY MIXTURES (SC)
- SILTY SAND-SANDY SILTS (SM)
- SILTY CLAYS, SANDY CLAYS, LOW PLASTICITY (CL)
- (150.35') LAND SURFACE ELEVATION

0 50 100 200

VERTICAL EXAGGERATION: 10x

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TITLE
GEOLOGIC CROSS SECTION
(B-B')
LANDFILL 10 (LF) SITE
FORT LEE, VIRGINIA

REV. 0

FIGURE NO. 1-6

LFCROSS1.DGN

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GREENVILLE SOUTH CAROLINA

DRAWN BY	BJ WHITFIELD	DATE 04/23/98
REVISED BY	R. MURRAY	DATE 04/20/01
APPROVED BY	A. SAPYTA	DATE 04/20/01

Beneath the sand layer the material graded back to a dark gray, medium plasticity clay. The thickness of this deeper clay unit is not known, but it is believed to be the upper confining unit for the shallow aquifer in the Petersburg area.

1.3.3.2 Hydrogeology

Shallow groundwater at the site is found in the sand unit located beneath the surficial clay unit. Recharge of the sand unit occurs primarily through infiltration due to precipitation. The presence of large areas of ponded water following precipitation events suggests that the recharge rate through the surficial clay is slow.

Contoured groundwater elevation data indicated that shallow groundwater flows in an east to southeast direction across the site under a hydraulic gradient of 0.011 ft(feet)/ft. The hydraulic conductivity was estimated between 168 feet per year (ft/yr) and 191 ft/yr.

1.3.3.3 Ecology

The terrestrial plant community at the site is predominated primarily by upland forest and some bottomland hardwood forest species. The community supports diverse populations of birds, mammals, reptiles, and insects.

Woodland habitat (second growth deciduous and coniferous [pine] forest) occupies the majority of the site. There are a few areas devoid of vegetation which could be a result of the type of refuse/contaminants disposed during landfill operations. Narrow edges along the dirt roads that dissect and border the site consist of late-stage forb-shrub-sapling communities (primary/ secondary transition zones) merging into woodland habitat on the east, south, and southwest. Bottomland hardwoods and accompanying wetlands are present along the intermittent stream. The wetlands are considered palustrine, forested, broad-leaved deciduous, seasonal saturated.

No Federal or State protected floral or faunal species were observed on the site; however, two species of special concern

(red-shouldered hawk and merlin) were observed on the site during a site visit. A pair of bald eagles (*Haliataeetus leucocephalus*) nest and forage along the Appomattox River approximately 3.0 miles northwest of the LF Site.

1.3.4 Nature and Extent of Contamination

The RI prepared for the LF Site included the collection of surface soil, subsurface soil, groundwater and surface water samples and subsequent analyses for volatile organic compounds (VOCs), pesticides/ polychlorinated biphenyls (PCBs), chlorinated herbicides and Target Analyte List (TAL) metals. Surface soil samples were also analyzed for base-neutral and acid extractable compounds (BNAs). Subsurface soil, groundwater and surface water were not analyzed for BNAs since the Confirmatory Sampling completed as a follow-up to the PA/SI did not detect BNAs in these media.

Chlorinated herbicides were not detected at the site in any of the media sampled. Chemicals for each of the remaining chemical suites (VOCs, pesticides/PCBs, BNAs and metals) were detected in at least one sample from each medium sampled.

A detailed description of the sampling and the analytical results from the RI is presented in Sections 3, 4 and 5 of the RI Report (Fluor Daniel 1999).

The risk assessment, Sections 7 and 8 of the RI Report, evaluated each detected chemical to determine which were contaminants of potential concern (COPCs) for each medium.

COPCs identified through the human health and ecological risk assessments for each medium at the LF Site are presented in Table 1-1. In determining COPCs, the risk assessment considered data from the RI as well as data from previous fieldwork. Also noted on Table 1-1 are the contaminants detected in soil at concentrations greater than the soil screening levels (SSLs) (USEPA, 1996) for the soil to groundwater pathway which could be COPCs based on future concentrations in groundwater resulting from migration from soil.

TABLE 1-1
CONTAMINANTS OF POTENTIAL CONCERN
LF SITE FEASIBILITY STUDY
FORT LEE, VIRGINIA

Contaminant	Subsurface Soils	Surface Soils/ Sediments	Surface Water	Groundwater
VOCs				
Chloroform				H
BNAs				
Benzo(a)anthracene		E		
Benzo(b)fluoranthene		E		
Benzo(k)fluoranthene		E		
Benzo(g,h,i)perylene		E		
Benzo(a)pyrene		H,E		
Chrysene		E		
Dibenzofuran		E		
Fluoranthene		E		
Indeno(1,2,3,-cd)pyrene		H,E		
Naphathalene		E		
Phenanthrene		E		
Pyrene		E		
Pesticides/PCBs				
alpha-BHC				H
delta-BHC		S		
Aroclor 1260		E		
4,4'-DDD	S,E	E		
4,4'-DDE	E	S,E		
4,4'-DDT	E	E	H	H
Metals				
Aluminum		H,E	E	
Antimony	E	E		H
Arsenic	H,S	H,S		
Barium	S,E	S,E		
Cadmium	E		E	
Chromium	S,E	E		
Copper	E	E	E	
Iron	H,E	H,E	H,E	H
Lead	E	E	H,E	
Manganese	E	H,E	E	H

TABLE 1-1 (Continued)
CONTAMINANTS OF POTENTIAL CONCERN
LF SITE FEASIBILITY STUDY
FORT LEE, VIRGINIA

Contaminant	Subsurface Soils	Surface Soils/ Sediments	Surface Water	Groundwater
Mercury	E	E	H,E	
Nickel	E	E		
Selenium		S,E	E	
Silver	E	E	E	
Thallium	E			
Vanadium	E	E		
Zinc	E	E	E	

Notes:
E = Contaminant of potential concern (COPC) based on ecological risk assessment.
H = COPC based on human health risk assessment.
S = Contaminant with soil concentration exceeding generic soil screening level (SSL) for groundwater protection.
No chlorinated herbicides were identified as COPCs.

The following discussion describes, by chemical class, the distribution of COPCs across the site media.

1.3.4.1 Volatile Organic Compounds (VOCs)

VOCs were detected in six (6) of seven (7) groundwater samples at the site. VOC concentrations were highest in the southern half of the site; however, none of the concentrations detected exceeded Federal Maximum Contaminant Levels (MCLs) for groundwater. Chloroform was identified as a COPC for human health based on screening against the United States Environmental Protection Agency (USEPA) Region III Risk-based Concentrations (RBCs) for tap water ingestion.

VOCs were detected in two (2) of 23 surface soil samples, 14 of 25 subsurface soil samples and one (1) of six (6) sediment samples collected at Landfill 10. VOC concentrations in soil and sediment did not exceed the USEPA Region III SSLs. VOCs were not identified as COPCs for human health or the environment in soil or sediments.

VOCs were detected in three (3) of six (6) surface water samples collected at Landfill 10; however, Virginia Water Quality Standards were not promulgated for the detected VOCs. VOCs in surface water were not identified as COPCs during risk-based screening.

1.3.4.2 Base-Neutral and Acid Extractable Compounds (BNAs)

Groundwater, subsurface soil, surface water and sediment were not analyzed for BNAs during the RI since they were not detected during the Confirmatory Sampling.

BNAs were detected in 13 of 23 surface soil samples. BNAs were distributed throughout the site; however, the concentrations did not exceed the USEPA Region III SSLs. BNAs were identified as COPCs in surface soil for human health and the environment based on risk-based screening.

1.3.4.3 Pesticides/Polychlorinated Biphenyls (PCBs)

Pesticides were detected in one (1) of 14 groundwater samples collected at the site. The concentrations detected did not exceed MCLs. However, alpha BHC and 4,4'-DDT were identified as COPCs in groundwater for human health based on screening against the USEPA Region III RBCs for tap water ingestion.

Pesticides were detected in 20 of the 23 surface soil samples collected at the site. Many of the samples had concentrations of 4,4'-DDE, and 4,4'-DDT above background levels. The highest concentrations were detected along the western boundary of the landfill. Pesticides were detected in five (5) of six (6) sediment samples collected at the site. The highest concentrations of these pesticides were found along the eastern boundary of the landfill. Pesticide concentrations of 4,4'-DDE and delta-BHC exceeded the SSLs in either surface soil or sediment and 4,4'-DDD, 4,4'-DDE, 4,4'-DDT and Aroclor 1260 were identified as COPCs for ecological receptors. Pesticides were not identified as COPCs for human health based on risk-based screening.

Pesticides were detected in three (3) of 25 subsurface samples collected at the site. The highest concentrations of these pesticides were found in the northeast corner of the landfill. 4,4'-DDD exceeded the SSL for groundwater and 4,4'-DDD, 4,4'-DDE and 4,4'-DDT were identified as COPCs for ecological receptors. Pesticides were not identified as COPCs for human health based on risk-based screening.

Pesticides were not detected in any of the six (6) surface water samples collected at Landfill 10; however, previous field sampling detected 4,4'-DDT at a concentration exceeding human health risk-based screening levels. Therefore, 4,4'-DDT was determined to be a COPC for human health in surface water.

1.3.4.4 Metals

Several metals were detected in groundwater at concentrations exceeding background levels. None of the metals exceeded the MCLs; however, lead exceeded the USEPA Drinking Water

Standard. Antimony, iron and manganese were determined to be COPCs based on risk-based screening.

Several metals were detected in surface soil and sediment samples above background levels. Concentrations of arsenic, barium, and selenium exceeded the SSLs in surface soil or sediment. Aluminum, arsenic, iron and manganese were determined to be COPCs based on risk-based screening. Fourteen metals were determined to be ecological COPCs.

Several metals were detected in subsurface soil samples above background levels. Metals were distributed throughout the site; however, the greatest frequencies above background concentrations were found in the eastern portion of the site. Concentrations of arsenic, barium, and chromium exceeded the SSLs in surface soil. Arsenic and iron were determined to be human health COPCs based on risk-based screening. Fourteen metals were determined to be ecological COPCs.

Several metals were detected in surface water samples at concentrations exceeding the Virginia Water Quality Standards. Iron, lead and mercury were selected as human health COPCs for surface water. Ten metals were determined to be ecological COPCs.

1.3.4.5 Chlorinated Herbicides

Chlorinated herbicides were not detected in groundwater, surface soil, subsurface soil, surface water or sediment samples collected at the LF Site.

1.3.5 Contaminant Fate and Transport

As detailed in the LF Site RI Report, chloroform was the only VOC in groundwater identified as a COPC. Chloroform has a migration rate of 7.6 ft/yr and a biodegradation half-life of 0.5 year. Future impact to Blackwater Swamp is not expected due to biodegradation and natural attenuation.

BNA and pesticide COPCs are expected to persist in subsurface soils due to their low biodegradation rates and high adsorption potentials. They are not predicted to migrate beyond the LF Site boundary.

Nine (9) metal COPCs for soil (antimony, barium, cadmium, copper, lead, mercury, silver, thallium, and zinc) were above the background soil concentrations and had distributions which were not similar to background data. Barium is moderately mobile with a retardation factor of 117.6 and a migration rate of 0.08 ft/year. Groundwater modeling presented in the RI concluded that it would take approximately 47,000 years for barium from the site to reach the closest surface water body. The remaining metals have higher adsorption coefficients and, therefore, an even more limited migration potential.

Antimony was the only metal COPC at the LF site that was determined to be statistically different from the background groundwater samples; however, fate and transport modeling indicated that it would take antimony in excess of 20,000 years to reach the closest surface water body.

1.3.6 Baseline Risk Assessment

1.3.6.1 Human Health

The LF Site is currently unoccupied and there are no drinking water wells either on or adjacent to the site. The site is no longer utilized for industrial activities. Currently, there are residences located west of the site. Since groundwater potentials indicate that groundwater flows into the Blackwater Swamp, the groundwater from the LF Site was not considered a future source of off-site groundwater available for residential use; however, future exposure concentrations in the surface water may be affected by this discharge.

The trespasser at the LF Site was determined to be the most sensitive receptor under the current use scenario. The trespasser exposure pathways included oral, dermal, and inhalation exposure to contaminants in surface soil and surface water. The total cancer risk was determined to be less than the

target risk of $1x10^{-6}$ and the hazard index (HI) was calculated to be less than the target value of one (1).

Future onsite receptors included an onsite resident exposed to surface soil and groundwater, an industrial worker exposed to surface soil, a construction worker exposed to subsurface soil, and a trespasser exposed to surface soil, surface water and sediment. Oral, dermal, and inhalation exposures were considered for all scenarios. The cancer risks for the trespasser and workers were within the acceptable range ($1x10^{-6}$ to $1x10^{-4}$) and the hazard indices were below the target value (1).

The cancer risk for the onsite resident was within the target risk range ($1x10^{-6}$ to $1x10^{-4}$); however the HI exceeded the target (1) for both child (5.2) and adult (2.4) primarily due to exposure to groundwater. Based on the risk assessment, surface soil was eliminated as a medium of concern. Groundwater contaminants of concern (COCs) for the future onsite resident included chloroform, 4,4'-DDT, alpha BHC, antimony, iron and manganese. As summarized in Table 1-2, iron contributed 68 percent of the total calculated HI. As explained in the risk assessment, there is a large degree of uncertainty associated with the toxicity value for iron. The toxicity value is based on the recommended daily allowance and is considered to be over-protective. Since it is within an order of magnitude of the toxicity value it is unlikely that the concentration of iron would present a hazard. The concentrations of the remaining contaminants would collectively result in an HI greater than one (1); however, the contaminants affect different target organs. The target organ for both chloroform and 4,4'-DDT (combined HI of 0.49) is the liver. The target organ for antimony (HI of 0.46) is the circulatory system; specifically, the blood/glucose component. The target organ for manganese (HI of 0.38) is the central nervous system. For these reasons, the calculated hazard index associated with the residential use of groundwater is considered to be over-protective.

Based on these conclusions, it was determined that the LF Site does not present a risk to human health under the current or

TABLE 1-2
CONTAMINANT CONTRIBUTIONS TO RISK AND HAZARD
LF SITE FEASIBILITY STUDY
FORT LEE, VIRGINIA

Contaminant[1]	Cancer Risk [Total Risk=2.25E-5][2]			Hazard Index [Total HI=4.08][3]		
	Oral	Dermal	Inhalation	Oral	Dermal	Inhalation
Chloroform	--	--	26%	--	--	8%
4,4-DDT	2%	28%	22%	--	3%	--
Alpha-BHC	16%	6%	--	--	--	--
Antimony	--	--	--	11%	--	--
Iron	--	--	--	66%	2%	--
Manganese	--	--	--	9%	--	--

-- Contaminant contributed less than 1% of risk or hazard.
[1] Contaminant contributing greater than 1% of risk or hazard.
[2] Total excess cancer risk for lifetime resident exposed to groundwater.
[3] Total hazard index of residential child (1-6 years) exposed to groundwater.

predicted future land use scenarios. Although an unlikely scenario, a potential hazard was calculated for future onsite residents exposed to groundwater; however, this risk has been over-estimated since it did not consider the target organs affected by the individual contaminants.

1.3.6.2 Ecological

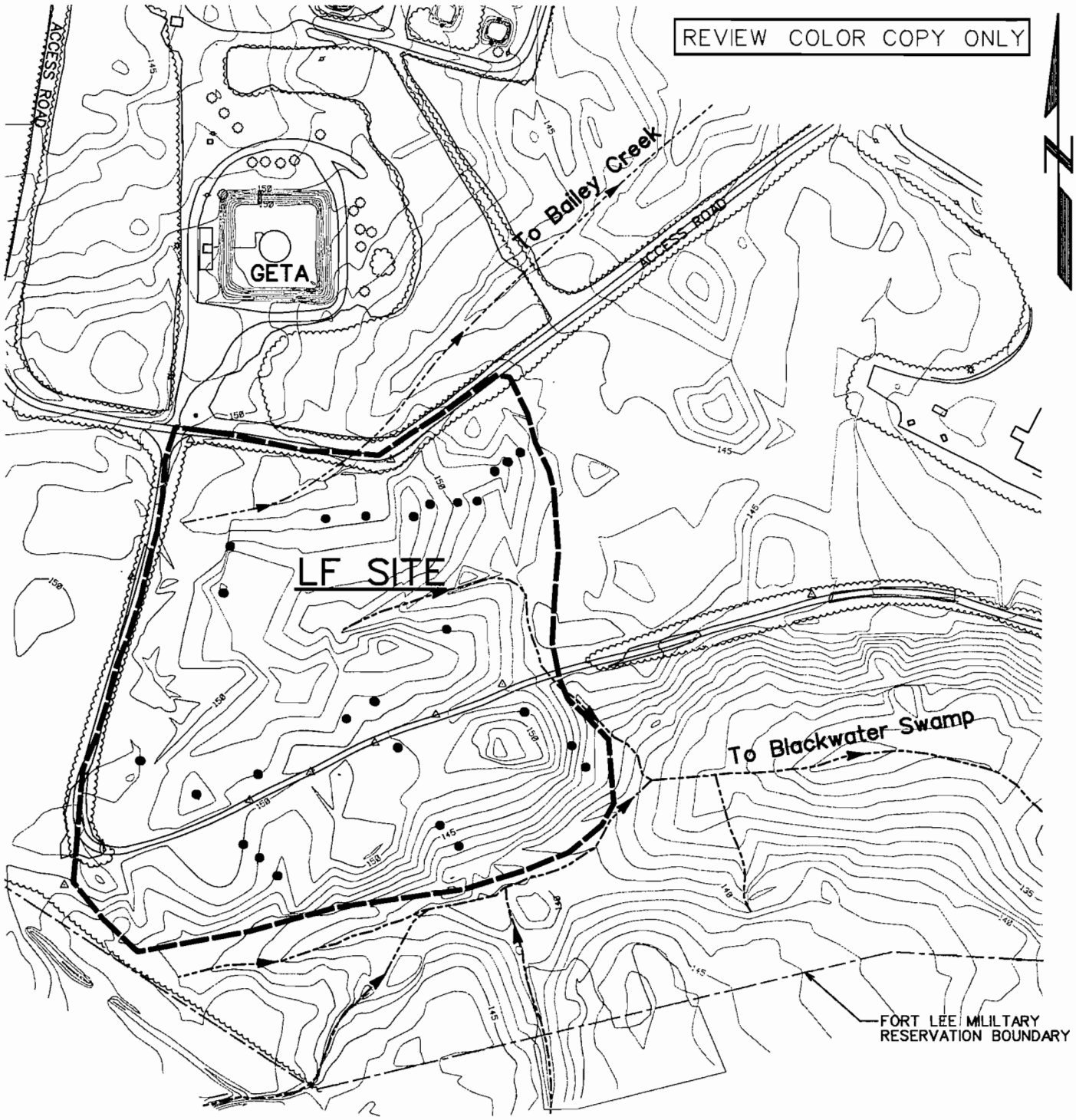
Ecological risks were evaluated for terrestrial receptors at the LF Site. Terrestrial receptors were determined not to have significant risks associated with contaminants in surface or subsurface soils. The onsite surface water does not support an aquatic community since it is related to stormwater runoff and there are no nearby surface water bodies. Therefore, ecological risks were not evaluated for aquatic receptors under the current scenario. No future scenario was evaluated for aquatic receptors since groundwater contaminant discharge to Blackwater Swamp would not occur for more than 20,000 years and, due to degradation and dispersion, concentrations were predicted to be insignificant.

Based on these conclusions, it was determined that the LF Site does not present a significant risk to ecological receptors under the current or future scenarios.

1.3.7 Post-RI Investigation

A field survey was completed at the LF Site on September 17, 2000, to determine if the soil cover over the landfill area met the relevant and appropriate requirements of the Virginia Solid Waste Regulations. Essentially, the operative portion of these regulations requires two (2) feet of clean soil cover.

The study consisted of the installation of hand auger borings to a maximum depth of three (3) feet. Twenty-seven sampling locations were selected to provide coverage for the entire landfill. Boring locations are shown on Figure 1-7. The locations were randomized; however, topographic highs were preferentially selected since previous experience with Army trench and fill landfills indicated that topographic highs usually correspond to cover material over landfill trenches.



DRAWN BY B.J. WHITFIELD	DATE 4/29/97
REVISED BY R. MURRAY	DATE 04/20/01
APPROVED BY A. SAPYTA	DATE 04/20/01

FLUOR DANIEL

ENGINEERING

GREENVILLE SOUTH CAROLINA

TITLE

COVER STUDY, BORING LOCATIONS AND RESULTS
LANDFILL 10 (LF) SITE
FORT LEE, VIRGINIA

FIGURE 1-7 | REV. 0

64474-3.FIG

Material was removed from the borings in four (4) to six (6) inch intervals and classified for soil type as well as color. Materials other than soil were classified by visual description. The most common waste material identified was an ash or slag material or a combination of these materials mixed with soil. Glass, metal, paper and other trash or debris were also detected. Boring logs are provided in Appendix A.

The results of the field study indicated that the landfill cover was not sufficient. More than 70 percent of the samples indicated less than the two (2) feet of required cover and more than 40 percent of the locations had essentially no cover. Eight of the samples (30 percent) indicated cover exceeded the required two (2) feet; however, these sampling locations were interspersed with locations demonstrating inadequate cover. Figure 1-7 illustrates the sampling locations and the degree of cover based on the field study.

In addition to widespread lack of adequate cover material, the topographic conditions resulting from the operation of the trench and fill landfill appeared to provide inadequate drainage at the site.

2.0 DEVELOPMENT OF REMEDIAL ACTION OBJECTIVES

Remedial action objectives were developed for the LF Site by taking into consideration media of concern, PRGs and ARARs and integrating this information into the recommendations from the RI.

2.1 Identification of Media of Concern

Groundwater was identified as the only medium of concern at the LF Site based on a potential hazard calculated by the risk assessment. Based on the absence of significant risk, there are no media of concern at the LF Site based on human health or ecological risk under the current or predicted future land use scenarios. However, the site could present a potential noncarcinogenic risk for a future onsite resident using groundwater as a tap water source.

2.2 Preliminary Risk-Based Remedial Goals

2.2.1 Human Health Risk-Based Remedial Goals

In the baseline Human Health risk assessment, oral reference doses (RfDs) for noncarcinogens and carcinogenic slope factors (SFs) for carcinogens, obtained from Integrated Risk Information System (USEPA, 1998) and Health Effects Assessment Summary Tables (USEPA, 1995b), were used with the risk methodology outlined in the USEPA's Risk Assessment Guidance for Superfund (USEPA, 1989), to evaluate the site-specific risks.

Groundwater was identified as the only potential medium of concern at the LF Site based on calculated risks. Table 1-2 shows the portion of the hazard and/or risk attributable to individual contaminants in groundwater under the worst-case exposure scenario, a future onsite residential groundwater use. Although an unlikely future land use, PRGs were also calculated based on a residential scenario with groundwater used as a tap water source. Since the excess cancer risks for all the groundwater exposure scenarios considered were less than the upper end of the target risk range ($1x10^{-4}$), PRGs were not calculated for carcinogens. The PRGs for noncarcinogenic contaminants were calculated based on the USEPA standard default factors as were presented in the risk assessment (Fluor Daniel 1999). The PRGs are summarized in Table 2-1. The frequency detected above PRGs presented in the table is based

TABLE 2-1
PRELIMINARY REMEDIAL GOALS FOR GROUNDWATER
LF SITE FEASIBILITY STUDY
FORT LEE, VIRGINIA

Chemical	Maximum Detected Concentration (µg/L)	Maximum Detection Limit (µg/L)	Preliminary Remedial Goal (PRG)[1] (µg/L)	Frequency Exceeding PRG	Wells Exceeding PRG
Chloroform	0.9	5	0.15	3/13	MW-2D, 4, 7
4,4-DDT	0.25	0.1	0.20	2/27	MW-3, 4
Antimony	2.8	40	1.5	2/13	MW-7, 8
Iron	12700	40 [2]	1100	6/13	MW-6, 7, 8, 9, 2D, 1608
Manganese	180	[3]	73	3/13	MW-3, 8, 9

[1] Preliminary Remedial Goal based on use as tap water with a target hazard quotient of 0.1.
[2] Reported as less than detection limit only in filtered samples. Detected in all unfiltered samples.
[3] Detected in all 13 samples.

on unfiltered groundwater samples. Sample locations exceeding the groundwater PRGs are indicated in Figure 2-1. The frequency detected above PRGs was reduced to one (1) out of 13 (MW-8) for both iron and manganese in filtered samples.

It should also be noted that the background concentrations of both iron (10,900 µg/L) and manganese (161 µg/L) exceeded the PRGs.

As shown in Table 2-1, chloroform and 4,4'-DDT did not exceed the PRGs in the same wells that antimony and manganese exceeded the PRGs. Therefore, excluding iron, the hazard index did not exceed the cumulative target of one (1) in any of the wells.

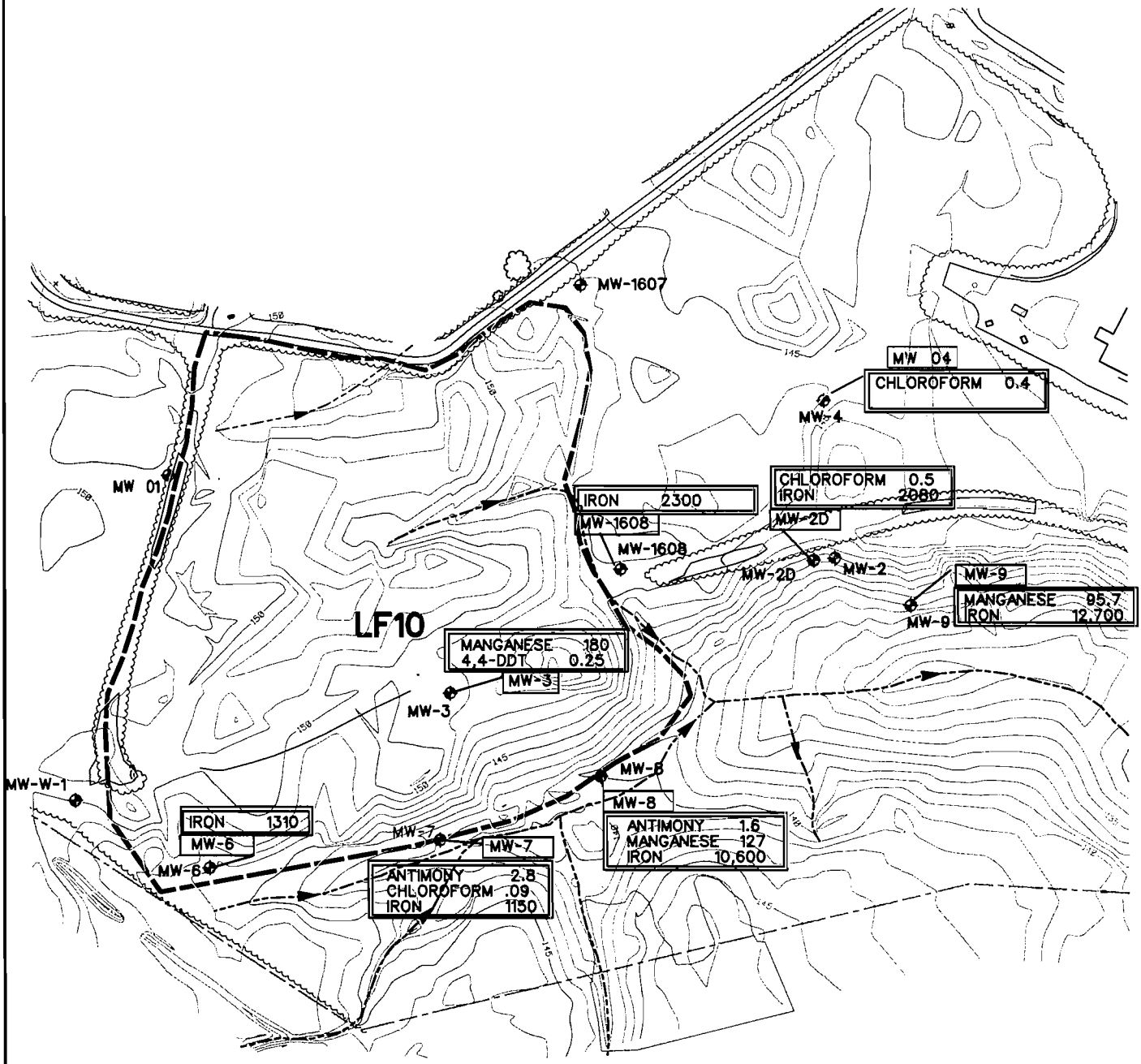
2.2.2 Ecological Risk-Based Remedial Goals

Three (3) protected species are known to exist at or near the LF Site, the Bald Eagle, Cooper's Hawk and American Kestrel. However, no significant ecological effects to the habitat at Fort Lee were observed.

Ecological risk was evaluated by utilizing a Hazard Quotient (HQ), which was calculated by developing a Toxic Reference Value (TRV) and dividing that by the contaminant concentration. Table 2-2 shows the medium and contaminants for which the HQ exceeded 1. If the HQ>1, then there was presumed to be a potential for ecological impact. If the HQ>50, then the ecological impact was considered to be significant. Based on this methodology, it was concluded that none of the COPCs present a potential for significant ecological impact; therefore, site-specific PRGs were not calculated.

Surface water and sediment samples were collected from areas of the site where water accumulated after a rain event. There is not a continuous source of surface water at the site. Sediment samples collected during the RI were, therefore, evaluated in the ecological risk assessment as surface soil samples. Although surface water is intermittent, it was evaluated as though it was a continuous source,

All ecological exposure pathways would be eliminated by the installation of a soil cover. The cover would be graded to prevent ponding of rainwater. The cover would therefore effectively eliminate the direct



LEGEND

- LANDFILL 10 BOUNDARY
- EXISTING MONITORING WELL
- INTERMITTENT STREAM

PRELIMINARY REMEDIATION GOALS (PRGs)

COPC	CONC. (ug/L)
CHLOROFORM	.015
4,4-DDT	0.2
ANTIMONY	1.5
IRON	1100
MANGANESE	73

Note: All Concentrations Provided in ug/l.

DRAWN BY B.J. WHITFIELD	DATE 4/20/95	FLUOR DANIEL ENGINEERING GREENVILLE SOUTH CAROLINA	TITLE: MONITOR WELLS EXCEEDING PRGs LANDFILL 10 (LF) SITE FORT LEE, VIRGINIA
REVISED BY R. MURRAY	DATE 04/24/01		
APPROVED BY A. SAPYTA	DATE 04/24/01		DWG. NO. FIGURE 2-1 REV. 1

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TABLE 2-2
CONTAMINANT CONTRIBUTIONS TO ECOLOGICAL HAZARD
LF SITE FEASIBILITY STUDY
FORT LEE, VIRGINIA

Contaminant	Exposure Concentration (mg/kg)	Shrew			Groundhog		
		Surface Soil HQ	Surface Water HQ	Total HQ	Surface Soil HQ	Surface Water HQ	Total HQ
Surface Soil and Surface Water							
Aroclor 1260	4.2E-02	1.51	--	1.51	--	--	--
Iron	9.41E+03	24.5	4.57	29	14.1	1.01	15.2
Subsurface Soil and Surface Water							
Iron	2.24E+04	58.2	4.57	62.8	33.7	1.01	34.7

Notes:

-- Hazard Quotient (HQ) less than 0.1.

Only contaminants with an HQ greater than 0.1 for one or more species were identified.

Only species with a total Hazard Index (HI) greater than 1.0 were identified.

exposure pathways to soil and surface water as well as the transport of contaminants in surface soil through rainwater.

Under normal conditions, groundwater does not recharge to surface water at the LF Site. The closest area of recharge occurs at the Blackwater Swamp which is approximately 3900 feet from the LF Site boundary. Fate and transport modeling completed as part of the RI (Fluor Daniel, 1999) concluded that contaminant migration would take thousands of years to reach Blackwater Swamp and the contaminant concentrations would be insignificant.

2.3 Selection of Applicable or Relevant and Appropriate Requirements

CERCLA requires that remedial actions meet the ARARs of Federal and State environmental standards, requirements, criteria or limitations. The selection of Federal and State ARARs is outlined in Appendix B. ARARs are listed as three types: chemical-specific (Table B-1), location-specific (Table B-2) and action-specific (Table B-3). No location-specific ARARs were identified. The chemical-specific and action-specific ARARs are dependent on the remedial action selected for the site as outlined in the following discussion.

The USEPA MCLs, USEPA Region III RBCs and USEPA SSLs would be defined as chemical-specific ARARs unless the future pathway for exposure to groundwater is eliminated.

The Criteria for Classification of Solid Waste Disposal Facilities and Practices were determined to be action-specific ARARs for the site. Requirements under this regulation could be addressed through compliance with the closure requirements under the Virginia Solid Waste Regulations. Although not promulgated until after closure of Landfill 10, the closure requirements under the Virginia Solid Waste Regulations were determined to be relevant and appropriate for the site. Specific requirements include two (2) feet of cover and proper grading to promote drainage across the site.

If additional cover is added to comply with closure requirement under the Virginia Solid Waste Regulations, the following would be identified as action-specific ARARs:

- Virginia Air Pollution Control Act – Reasonable precautions would be required to control visible emissions and dust during soil handling activities.

- Stormwater Management Act – Criteria would be applicable for controlling nonpoint pollution, localized flooding and stream channel erosion.
- Erosion and Sediment Control Law – Standards would be applicable for controlling erosion, sediment deposition and runoff.
- Occupational Safety and Health Standards – Standards would apply to workers engaged in construction work or construction-related activities.

Prior to initiation of the remedial action, the submittal of plans would be required to demonstrate that the remedial action would be in compliance with the action-specific ARARs.

2.4 Remedial Action Objectives

The recommendations from the RI were combined with the ARARs (see Appendix B) to develop the following remedial action objectives:

- Protect human health under potential future land use scenarios.
- Protect environmental habitat.
- Bring landfilled portions of the site into compliance with closure requirements under the Virginia Solid Waste Management Regulations [9 VAC 20-8-260E(1)].

The ecological and human health risk assessments indicated that there are no significant risks associated with media at the LF Site based on the current or predicted future land use. However, a minor human health risk would potentially exist under a future residential land use.

The Virginia Solid Waste Management Regulations were determined to be relevant and appropriate for the site but not applicable since the regulations were not in force over the life of the landfill. The post-RI field investigation determined that cover has been placed over portions of the landfill; however, additional cover would be required over the majority of the landfill to meet the two (2) feet statutory requirement. In addition, the site would need to be graded to promote proper drainage.

3.0 IDENTIFICATION AND SCREENING OF TECHNOLOGIES

3.1 General Response Actions

The remedial action objectives can be achieved through implementation of appropriate general response actions. General response actions refer to general implementation measures which will satisfy the remedial action objectives. The following general response actions have been generated from the USEPA guidance document for conducting RI/FS under CERCLA (USEPA, 1988).

No Action – The "No Action General Response Action, as mandated by the USEPA includes no new measures to address the media of concern. According to the requirements of the National Oil and Hazardous Substance Contingency Plan (NCP), 40 CFR 300.68, the No Action alternative was evaluated against all other alternatives.

Institutional Controls – This category includes options which would prevent or minimize contact with contaminants but would not address the volume, toxicity or migration of contaminants from the site.

Containment – This category includes technologies designed to reduce the migration of contaminants.

Removal/Collection – This category includes systems which extract groundwater.

Treatment – This category includes both in-situ and ex-situ treatment options.

Disposal – This category includes disposal options for groundwater after extraction and treatment.

3.2 Identification and Screening of Technologies

The purpose of this section is to identify and screen appropriate technologies (and specific processes within the technology type) for assembly into remedial alternatives that address contamination at the LF Site.

As previously discussed, the purpose of this FS is to evaluate mitigation of the potential risks and ensure compliance with ARARs (see Appendix B).

Descriptions of each of the remedial technologies/processes identified for the general response actions are presented in Table 3-1. This table evaluates the technical applicability of the identified technologies. At least one applicable technology was identified for each of the six (6) general response actions.

The specific processes considered applicable based on the initial screening were further evaluated (Table 3-2) based on the following factors:

- Effectiveness – Success of the process option in similar conditions; potential effectiveness under site conditions; ability to achieve the Remedial Objectives; and treatability studies required to verify application.
- Implementability – Probability of success at the site; time requirements; and conditions that may impede the implementation at the site; and
- Cost – Relative capital and operating cost – low, moderate, or high.

Although physical/chemical treatment was identified as a potentially applicable technology, the elevated background concentrations of the primary COCs (iron and manganese) would significantly impact the effectiveness and the implementability of this technology. A multi-stage treatment process which would be required to reduce the metal concentration would be cost prohibitive. It was, therefore, eliminated from further consideration. Since no other treatment alternatives were identified as appropriate, collection and discharge technologies were determined not to be applicable. The technologies remaining after screening were assembled into remedial alternatives.

TABLE 3-1
SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS
LF SITE FEASIBILITY STUDY
FORT LEE, VIRGINIA

General Response Action	Technology	Process Option	Description	Screening Comments
No Action			Site would be abandoned. Existing cover would be allowed to deteriorate.	Required for consideration by NCP
Institutional Controls	Monitoring	Groundwater Monitoring	A groundwater monitoring program would be established to validate the results of the fate and transport analysis.	Potentially applicable
	Restrictions on Groundwater Use	Use Institutional Controls to restrict future land use and/or prohibit groundwater use	Groundwater use would be prohibited and/or the future use of the site would be restricted to nonresidential	Potentially applicable
Collection	Extraction	Extraction wells	Series of wells to extract contaminated groundwater	Potentially applicable
	Subsurface drains	Interceptor trenches	Perforated pipe in trenches backfilled with porous media to collect groundwater	Potentially applicable
Containment	Surface Controls	Soil Cover	Additional soil to achieve 2 foot of cover over landfill and regrading to promote drainage across the site.	Potentially applicable
		Composite Barrier Cap	System consists of a barrier zone comprised of synthetic membrane, asphalt, or portland cement concrete pavement placed over a prepared subgrade (shaped and compacted). The barrier zone is overlain by a drainage zone to prevent ponding over the barrier zone. A vegetative zone is place upon the drainage zone to promote vegetative growth to control erosion and to protect the barrier zone.	Potentially applicable
Treatment	Biological	Aerobic/Anaerobic	Degradation of organics using microorganisms.	Not applicable to inorganics found in groundwater

TABLE 3-1 (Continued)
SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS
LF SITE FEASIBILITY STUDY
FORT LEE, VIRGINIA

General Response Action	Technology	Process Option	Description	Screening Comments
Treatment (cont'd)	Physical/chemical	Precipitation	Reduction of contaminant solubility through alteration of chemical equilibrium.	Potentially applicable to inorganics. Not applicable to organics
		Stripping	Transfer of contaminants to air within a packed column.	Not applicable to inorganics found in groundwater
		Carbon absorption	Absorption of contaminants onto activated carbon.	Not applicable to inorganics found in groundwater
		Reverse osmosis	Separating contaminants from water by using high pressure to force water through a membrane.	Not recommended since iron and/or organics may foul membrane
		Ion exchange	Ions are exchanged between resin and water in a resin bed.	Not recommended since organics may foul resin
	Thermal destruction	Combustion	Combustion is used to destroy contaminants.	Not applicable to inorganics found in groundwater
	Offsite	Publically Owned Treatment Works (POTW)	Extracted groundwater sent to a POTW for treatment.	Potentially applicable
	In situ	Bioreclamation	Bacteria and nutrients are injected into groundwater to degrade contaminants	Not applicable to inorganics found in groundwater
		Aeration	Air is injected into groundwater to remove contaminants through stripping	Not applicable to inorganics found in groundwater
		Permeable treatment beds	Downgradient trenches are filled with carbon to remove contaminants from the groundwater	Not applicable to inorganics found in groundwater
		Chemical reaction	Oxidizers are injected into the groundwater to degrade contaminants	Not applicable to inorganics found in groundwater
Discharge	Onsite	Local stream	Extracted water discharged to onsite stream	Potentially applicable
	Offsite	POTW	Extracted water discharged to local POTW	Potentially applicable

TABLE 3-2
EVALUATION OF PROCESS OPTIONS
LF SITE FEASIBILITY STUDY
FORT LEE, VIRGINIA

General Response Action	Technology	Process Option	Effectiveness	Implementability	Relative Cost	Retained?
No Action		Monitoring	Does not bring site into compliance with Virginia Solid Waste Regulations. Does not eliminate potential for risk from future residential exposure to groundwater.	Readily Implemented	None	Yes
Institutional Controls	Monitoring	Groundwater Monitoring	Required to verify conclusions from groundwater modeling as presented in the FS Does not bring site into compliance with Virginia Solid Waste Regulations Does not eliminate potential for risk from future residential exposure to groundwater.	Readily implemented using existing wells.	Negligible capital, low O&M	Yes
	Restrictions on Groundwater Use	Use institutional controls to restrict future land use and/or prohibit groundwater use	Eliminates risk from residential exposure to groundwater. Does not bring site into compliance with Virginia Solid Waste Regulations	Readily Implemented	Negligible Cost	Yes
Collection	Extraction	Extraction wells	Effective in extracting groundwater for subsequent treatment	Readily Implemented	Moderate capital, low O&M	No[1]

TABLE 3-2 (Continued)
EVALUATION OF PROCESS OPTIONS
LF SITE FEASIBILITY STUDY
FORT LEE, VIRGINIA

General Response Action	Technology	Process Option	Effectiveness	Implementability	Relative Cost	Retained?
Collection (cont'd)	Subsurface Drains	Interceptor trenches	Effective in intercepting downgradient flow for subsequent treatment	Contaminant concentrations exceeding PRGs not limited to a single area of the site collection would therefore be complex	High capital, low O&M	No(1)
Containment	Surface Controls	Soil Cover	Effective Meets relevant and Appropriate Requirements of Virginia Solid Waste Regulations.	Readily Implemented	Low capital, low O&M	Yes
		Composite Barrier Cap	Effective Meets relevant and Appropriate Requirements of Virginia Solid Waste Regulations.	Readily implemented with proper surface preparation. Design of cap may be complex	High capital, low O&M	No
Treatment	Physical/chemical treatment	Precipitation	Effective only for inorganic contaminants.	Various metals present may require a multiple stage treatment process. Based on background levels of iron and manganese, PRGs could not be met unless groundwater at the site was isolated.	High capital, high O&M	No
Discharge	Onsite discharge	Local stream	Effective for disposal of treated groundwater	Permit required	High capital, low O&M	No(1)
	Offsite discharge	POTW	Effective for disposal of treated groundwater	Permit required	High capital, low O&M	No(1)

(1) Collection and discharge options eliminated since no treatment options were retained.

4.0 DEVELOPMENT OF REMEDIAL ALTERNATIVES

The primary purpose of alternative development was to assemble a range of distinct remedial alternatives that individually or in combination would remediate or control contaminated media at the site in a manner that will provide adequate protection of human health and the environment and comply with ARARs. Remedial technologies that passed the technology screening phase were assembled into alternatives that met the remedial action objectives. A limited number of alternatives were developed for this FS since the site was determined not to present a significant risk to human health or the environment under the current or predicted future land use.

The technologies retained through the screening process were combined to form the following four (4) remedial alternatives:

- **Alternative 1: No Action**
  - Groundwater Monitoring
- **Alternative 2: Institutional Controls**
  - Groundwater Monitoring
  - Institutional Controls to Prohibit Groundwater Use
- **Alternative 3: Institutional Controls and Additional Cover and Regrading Over Portions of the Site Not Meeting Closure Requirements**
  - Groundwater Monitoring
  - Institutional Controls to Prohibit Groundwater Use and Restrict Future Land Use
  - Partial Soil Cover
- **Alternative 4: Institutional Controls and Cover and Regrading Over the Site**
  - Groundwater Monitoring
  - Institutional Controls to Prohibit Groundwater Use and Restrict Future Land Use
  - Soil Cover

5.0 DETAILED ANALYSIS OF ALTERNATIVES

In this section the remedial alternatives developed for addressing contamination at the LF Site were examined with respect to the requirements stipulated in CERCLA, and factors described in the USEPA guidance document entitled *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (USEPA, 1988). The nine (9) criteria from the guidance document are:

Overall protection of human health and the environment – how the alternative achieves and maintains protection of human health and the environment.

Compliance with ARARs – how the alternative complies with ARARs identified in Appendix B of this report.

Long-term effectiveness and permanence – the long-term effectiveness of the alternative in maintaining protection of human health and the environment.

Reduction of mobility, toxicity, and volume – the anticipated performance of the specific treatment technologies which are part of the alternative.

Short-term effectiveness – the effectiveness in protecting human health and the environment during implementation of the alternative.

Implementability – technical and administrative feasibility and availability of required goods and services for the alternative.

Cost – capital and operation and maintenance costs for the alternative.

State acceptance – the state's apparent preferences or concerns.

Community acceptance – the community's apparent preferences or concerns.

This FS uses the first seven (7) criteria in the alternative evaluation process. The first two (2) criteria must be met for an alternative to be considered. The next five (5) criteria are used to weigh major trade-offs among alternatives. The final two (2) criteria will be evaluated during preparation of the Proposed Plan for the site.

5.1 Alternative 1: No Action

5.1.1 Description

Under this alternative the site would be abandoned and the existing cover would be allowed to deteriorate. The no action alternative includes no new measures to address media of concern. This alternative was required by the NCP as a basis for comparing remedial alternatives. Groundwater monitoring would be conducted; however, to verify the modeling results presented in the RI Report (Fluor Daniel 1999).

5.1.2 Technical Criteria Assessment

Overall Protection of Human Health and the Environment

The baseline risk assessment for the LF Site identified a minor potential for risks to human health based on residential exposure to groundwater. Although an unlikely scenario, it is feasible that onsite groundwater could be used in the future for residential use in the absence of institutional controls. No significant risks to ecological receptors were identified.

Compliance with ARARs

Although the groundwater monitoring program would be used to demonstrate landfill compliance in terms of contaminant release into groundwater, this alternative would not be in compliance with the closure requirements of the Virginia Solid Waste Management Regulations. The remaining action-specific ARARs, as identified in Appendix B, would not be applicable to this alternative. Groundwater concentrations would not be in compliance with the MCLs or the USEPA Region III RBCs and soil concentrations would not meet the USEPA SSLs. These criteria were defined as chemical-specific ARARs (see Appendix B) since the future use of groundwater would not be restricted.

Long-term Effectiveness and Permanence

The no action alternative would not address potential future land use and potential risk from residential exposure to groundwater.

Reduction in Mobility, Toxicity, or Volume

This option would not reduce the mobility, toxicity, or volume of the contamination identified at the site.

Short Term Effectiveness

Under the current land use, the site does not present a significant risk; however, the no action alternative would not address compliance with ARARs.

Implementability

Existing groundwater monitoring wells would be used for the groundwater monitoring program.

Cost

Table 5-1 presents a summary of the cost estimate for this alternative. This alternative would involve no remedial actions and therefore the cost would be limited to the groundwater monitoring to verify the fate and transport results presented in the RI Report. The cost of groundwater monitoring would include monitoring of four (4) existing wells which would be sampled and analyzed annually. The assumptions used in estimating the cost of groundwater monitoring are listed in Appendix C. Annual cost of sampling and analysis was estimated at $21,000. Monitoring was assumed to last 10 years. The total present worth cost of Alternative 1 was estimated at $225,000.

5.2 Alternative 2: Institutional Controls

5.2.1 Description

This alternative includes institutional controls to prohibit groundwater use and to limit the future land use. It also includes a long-term groundwater monitoring program which would be more comprehensive than the monitoring included under Alternative 1.

5.2.2 Technical Criteria Assessment

Overall Protection of Human Health and the Environment

The baseline risk assessment for the LF Site identified a minor potential for risks to human health based on residential exposure to groundwater. Although an unlikely scenario, it is feasible that onsite groundwater could be used in the future for residential use in the absence of institutional controls. In this alternative, institutional controls to prohibit groundwater use and to limit the future land use would be used to insure that there would not be a complete exposure scenario for future land use. No significant risks to ecological receptors were identified.

Compliance with ARARs

Although the groundwater monitoring program would be used to demonstrate landfill compliance in terms of contaminant release into groundwater, this alternative would not be in compliance with the closure requirements of the Virginia Solid Waste Management Regulations. The remaining action-specific ARARs, as identified in Appendix B, would not

TABLE 5-1
SUMMARY COST ESTIMATE – ALTERNATIVE NO. 1
LF SITE
FEASIBILITY STUDY
FORT LEE, VIRGINIA

Capital Costs	
Direct	
Sampling Plan	$12,000
Total Direct Costs	**$12,000**
Indirect	
Project Management (10%)	$1,200
Total Indirect Costs	**$1,200**
Total Capital Costs	**$13,200**
Contingency (15%)	**$1,980**
Annual Costs	
Groundwater Sampling/Reporting	$6,000
Analysis (*4 wells, annually*)	$15,000
Total Annual Costs (10 years)	**$210,000**
TOTAL COST ALTERNATIVE NO. 1	**$225,180**

Note: See Appendix C for additional cost breakdown.

be applicable to this alternative. Chemical-specific ARARs identified in Appendix B would not apply since the future use of groundwater would be eliminated.

Long-term Effectiveness and Permanence

Institutional controls prohibiting groundwater use and limiting the future land use would be expected to be effective over the long-term in preventing a complete residential exposure scenario.

Reduction in Mobility, Toxicity, or Volume

This option would not reduce the mobility, toxicity, or volume of the contamination identified at the site.

Short Term Effectiveness

Under the current land use, the site would not present a significant risk; however, this alternative would not address compliance with ARARs.

Implementability

Institutional controls to prohibit groundwater use and to limit the future land use can be executed in a relatively short period of time.

Existing groundwater monitoring wells would be used for the groundwater monitoring program.

Cost

Table 5-2 presents a summary of the cost estimate for this alternative. This alternative would involve no remedial actions and, therefore, the cost is limited to a 10-year groundwater monitoring program. The assumptions used in estimating the cost of the monitoring program are outlined in Appendix C. The cost of groundwater monitoring would include the monitoring of eight (8) existing wells quarterly for two (2) years. Four (4) of these wells would continue to be monitored semi-annually for the next two (2) years and then annually for six (6) years. Annual cost of sampling and analysis was estimated at $168,000 per year for the first two (2) years, $42,000 per year for the next two (2) years and $21,000 per year for the remaining six (6) years. The total present worth cost of Alternative 2 was estimated at $550,000.

TABLE 5-2
SUMMARY COST ESTIMATE – ALTERNATIVE NO. 2
LF SITE
FEASIBILITY STUDY
FORT LEE, VIRGINIA

Capital Costs	
Direct	
Sampling Plan	$12,000
Total Direct Costs	**$12,000**
Indirect	
Project Management (10%)	$1,200
Total Indirect Costs	**$1,200**
Total Capital Costs	**$13,200**
Contingency (15%)	**$1,980**
Annual Costs	
Years 1 and 2 Groundwater Sampling/Reporting	$48,000
Analytical (*8 wells, quarterly, 2 years*)	$120,000
Years 3 and 4 Groundwater Sampling/Reporting	$12,000
Analytical (*4 wells, semi-annual, 2 years*)	$30,000
Years 5 through 10 Groundwater Sampling/Reporting	$6,000
Analytical (*4 wells, annual, 6 years*)	$15,000
Total Annual Costs (10 years)	**$546,000**
TOTAL COST ALTERNATIVE NO. 2	**$549,300**

Note: See Appendix C for additional cost breakdown.

5.3 Alternative 3: Institutional Controls and Additional Cover and Regrading Over Portions of the Site Not Meeting Closure Requirements

5.3.1 Description

Under this alternative, trees would be removed from the areas of the landfill requiring additional cover. Soil would be added to achieve a two (2) foot cover and the area would be regraded to promote drainage then reseeded. This alternative would require additional fieldwork to determine the extent of the landfill requiring additional cover based on a requirement of a two (2) foot cover. This alternative also includes institutional controls to prohibit groundwater use and to limit the future land use and groundwater monitoring to verify the previous modeling results.

5.3.2 Technical Criteria Assessment

Overall Protection of Human Health and the Environment

The baseline risk assessment for the LF Site identified a minor potential for risks to human health based on residential exposure to groundwater. Although an unlikely scenario, it is feasible that onsite groundwater could be used in the future for residential use in the absence of institutional controls. In this alternative, institutional controls to prohibit groundwater use and to limit the future land use would be used to insure that there would not be a complete exposure scenario for future land use. No significant risks to ecological receptors were identified; however, this alternative would impact the existing habitat since the area is currently heavily vegetated. This impact would be temporal, but would be a different type of re-established habitat.

Compliance with ARARs

This alternative would comply with relevant and appropriate closure requirements for cover under the Virginia Solid Waste Management Regulations; however, it may be difficult to promote drainage across the site without regrading other areas of the site. Construction activities must be completed in a manner to comply with the action-specific ARARs identified in Appendix B including: fugitive (dust) emission standards, stormwater and erosion control requirements and worker

safety standards. Chemical-specific ARARs identified in Appendix B would not apply since the future use of groundwater would be eliminated.

Long-term Effectiveness and Permanence

Institutional controls prohibiting groundwater use and limiting the future land use would be expected to be effective over the long-term in preventing a complete residential exposure scenario. Maintenance would be required to ensure the long-term effectiveness of the soil cover.

Reduction in Mobility, Toxicity or Volume

The additional cover would reduce mobility by minimizing infiltration of rainwater but would not reduce the toxicity or volume of the contamination identified at the site.

Short Term Effectiveness

This alternative would comply with relevant and appropriate closure requirements of the Virginia Solid Waste Management Regulations; however, it would temporarily disrupt the existing habitat.

Implementability

Existing groundwater monitoring wells would be used for the groundwater monitoring program. The additional soil cover would be readily implemented. Regrading to promote drainage across the site may be difficult if cover material would only be added to portions of the site and the remainder is left with the existing vegetation.

Cost

Table 5-3 presents a summary of the cost estimate for this alternative. Costs were based upon the assumption that approximately two-thirds of the site would require additional soil to achieve a two (2) foot cover over the entire site. Calculations for determining the cost associated with the cover material and regrading of the site are included in Appendix C. Total costs, including contingency, were estimated to be $950,000. Groundwater monitoring would remain as outlined in Alternative 2. The total present worth cost for Alternative 3 was estimated to be $1,500,000.

TABLE 5-3
SUMMARY COST ESTIMATE – ALTERNATIVE NO. 3
LF SITE
FEASIBILITY STUDY
FORT LEE, VIRGINIA

Capital Costs		
Direct		
	Soil Characterization	$1,500
	Survey	$15,000
	Construction Costs including Borrow Material	$623,000
	Sampling Plans	$12,000
Total Direct Costs		**$651,500**
Indirect		
	Construction Oversight	$44,000
	Engineering (10%)	$65,000
	Project Management (10%)	$65,000
Total Indirect Costs		**$174,000**
Total Capital Costs		**$825,500**
Contingency (15%)		**$123,825**
Annual Costs		
	Years 1 and 2 Groundwater Sampling/Reporting	$48,000
	Analytical (*8 wells, quarterly*)	$120,000
	Years 3 and 4 Groundwater Sampling/Reporting	$12,000
	Analytical (*4 wells, semi-annual*)	$30,000
	Years 5 through 10 Groundwater Sampling/Reporting	$6,000
	Analytical (*4 wells, annual*)	$15,000
Total Annual Costs (10 years)		**$546,000**
TOTAL COST ALTERNATIVE NO. 3		**$1,495,325**

Note: See Appendix C for additional cost breakdown.

5.4 Alternative 4: Institutional Controls and Cover and Regrading over the Entire Site

5.4.1 Description

Under this alternative the entire landfill area would be recovered, regraded and reseeded. This alternative also includes institutional controls to prohibit groundwater use and to limit the future land use and groundwater monitoring to verify the previous modeling results.

5.4.2 Technical Criteria Assessment

Overall Protection of Human Health and the Environment

The baseline risk assessment for the LF Site identified a minor potential for risks to human health based on residential exposure to groundwater. Although an unlikely scenario, it is feasible that onsite groundwater could be used in the future for residential use in the absence of institutional controls. In this alternative, institutional controls to prohibit groundwater use and to limit the future land use would be used to insure that there would not be a complete exposure scenario for future land use. No significant risks to ecological receptors were identified; however, this alternative would significantly impact the existing habitat since the area is currently heavily vegetated. This impact would be temporal, but would be a different type of re-established habitat.

Compliance with ARARs

This alternative would comply with relevant and appropriate closure requirements of the Virginia Solid Waste Management Regulations. Construction activities must be completed in a manner to comply with the action-specific ARARs identified in Appendix B including: fugitive (dust) emission standards, stormwater and erosion control requirements and worker safety standards. Chemical-specific ARARs identified in Appendix B would not apply since the future use of groundwater would be eliminated.

Long-term Effectiveness and Permanence

Institutional controls prohibiting groundwater use and limiting the future land use would be expected to be effective over the long-term in

preventing a complete residential exposure scenario. Maintenance would be required to ensure the long-term effectiveness of the soil cover.

Reduction in Mobility, Toxicity or Volume

This option would reduce mobility by minimizing infiltration but would not reduce the toxicity or volume of the contamination at the site.

Short Term Effectiveness

This alternative would comply with relevant and appropriate closure requirements of the Virginia Solid Waste Management Regulations; however, it would temporarily disrupt the existing ecological habitat.

Implementability

Existing groundwater monitoring wells would be used for the groundwater monitoring program. The soil cover and regrading of the site would be readily implemented.

Cost

Table 5-4 presents a summary of the cost estimate for this alternative. Costs were based upon the addition of soil to ensure a two (2) foot cover over the entire site. Figure C-1 in Appendix C illustrates the boundary of the LF Site. Calculations for determining the cost associated with the cover material and regrading of the site are included in Appendix C. Total costs, including contingency, were estimated to be $1,380,000. Groundwater monitoring would remain as outlined in Alternative 2. The total present worth cost of Alternative 4 was estimated to be $1,900,000.

TABLE 5-4
SUMMARY COST ESTIMATE – ALTERNATIVE NO. 4
LF SITE
FEASIBILITY STUDY
FORT LEE, VIRGINIA

Capital Costs		
Direct		
	Survey	$15,000
	Construction Costs including Borrow Material	$937,000
	Sampling Plans	$12,000
Total Direct Costs		**$964,000**
Indirect		
	Construction Oversight	$44,000
	Engineering (10%)	$96,000
	Project Management (10%)	$96,000
Total Indirect Costs		**$236,000**
Total Capital Costs		**$1,200,000**
Contingency (15%)		**$180,000**
Annual Costs		
	Years 1 and 2 Groundwater Sampling/Reporting	$48,000
	Analytical (*8 wells, quarterly*)	$120,000
	Years 3 and 4 Groundwater Sampling/Reporting	$12,000
	Analytical (*4 wells, semi-annual*)	$30,000
	Years 5 through 10 Groundwater Sampling/Reporting	$6,000
	Analytical (*4 wells, annual*)	$15,000
Total Annual Costs (10 years)		**$546,000**
TOTAL COST ALTERNATIVE NO. 4		**$1,926,000**

Note: See Appendix C for additional cost breakdown.

6.0 COMPARATIVE ANALYSIS OF ALTERNATIVES

This section reviews the advantages and disadvantages of the remedial alternatives relative to one another. This analysis is based on the criteria discussed in the detailed analysis of alternatives.

6.1 Overall Protection of Human Health and the Environment

The site does not present a risk to human health or the environment under the current use scenario. A slight human health risk was identified for a future onsite residential scenario. Alternatives 2, 3 and 4 would protect human health by eliminating the potential for future residential exposure to groundwater. Alternative 1 would not limit future use of the site and would, therefore, not protect against future risk.

No significant ecological risk was identified. Alternatives 3 and 4 would, however, affect the habitat since existing vegetation would be removed. The effect would be less severe for Alternative 3 since only a portion of the site would be affected. In either case, this would be a temporal effect since new vegetation would be re-established as part of the action.

6.2 Compliance with ARARs

Alternative 1 would not comply with chemical-specific ARARs identified in Appendix B. Chemical-specific ARARs would not be defined for the remaining alternatives since institutional controls would be used to eliminate the pathway for future exposure to groundwater.

Alternatives 3 and 4 would address the relevant and appropriate closure requirements for cover under the Virginia Solid Waste Regulations; however, Alternative 3 would not promote drainage across the site since only a portion of the site would be regraded. Alternatives 1 and 2 would not address the closure requirements of this ARAR.

Alternatives 3 and 4 would have to be designed to comply with the action-specific ARARs identified in Appendix B.

6.3 Long-term Effectiveness and Permanence

Alternatives 2, 3 and 4 would address human health risks over the long-term through institutional controls to prohibit groundwater use and to limit the future

land use to eliminate the exposure pathway. Alternative 1 would not include provisions to limit the potential for future risk. Alternatives 2 and 3 would require minimal maintenance to ensure long-term compliance with ARARs.

6.4 Reduction of Mobility, Toxicity, and Volume

Alternatives 3 and 4 would reduce the mobility of contaminants by improving surface runoff and reducing infiltration of rainwater. None of the alternatives would address the toxicity or volume of waste.

6.5 Short-term Effectiveness

None of the alternatives would expose remedial workers or the local community to a significant risk from exposure to onsite contaminants during remedial activities.

6.6 Implementability

All of the alternatives would be readily implemented.

6.7 Cost

The costs of Alternatives 1 and 2 were limited to groundwater monitoring. The monitoring program for Alternative 2 was more comprehensive based on recommendations from VaDEQ on other Fort Lee sites, therefore, the total present worth cost of Alternative 2, ($550,000) was significantly higher than the total present worth cost of Alternative 1 ($225,000). Alternatives 3 and 4 both included the cost of the more comprehensive groundwater monitoring program. Alternative 3 included a cost of approximately $950,000 for landfill cover for a portion of the site. Alternative 4 included a cost of approximately $1,380,000 for landfill cover over the entire site. The total present worth costs for Alternatives 3 and 4 were $1,500,000 and $1,900,000, respectively.

7.0 REFERENCES

Fluor Daniel. 1999. Remedial Investigation Report for Landfill 10 Site, Fort Lee, Virginia.

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United States Environmental Protection Agency (USEPA). 1996. Soil Screening Guidance: User s Guide, Second Edition. 9355.4-23. Washington, D.C.

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United States Environmental Protection Agency (USEPA). 1988. Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA. Interim Final. EPA/540/G-89/004. October, 1998.

APPENDIX A

COVER STUDY BORING LOGS

SOIL BORING LOG

HOLE NO. HA-01

1. COMPANY NAME: Fluor Daniel	2. DRILLING SUBCONTRACTOR: None
SHEET 1 OF 1 SHEETS	
3. PROJECT: LF Site Soil Cover Study	4. LOCATION: South of Road
5. SURFACE ELEVATION	6. DATE/TIME STARTED: 9/17/00 / 0940
7. DATE/TIME STOPPED: 9/17/00 / 0951	
8. TOTAL DEPTH OF HOLE: 48"	9. OTHER WATER LEVEL AND ELAPSED TIME AFTER DRILLING COMPLETED

10. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	11. SIGNATURE OF INSPECTOR
Backfilled	Soil Cutting			

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
	3"	Humus Layer					
	10"	Coal Ash and Slag Material					
	1	Tan-Gray Clayey Silty SAND					
	2						
	3						
	4	**Terminated at 48 In.**					
	5						

FORM F01-0004 | PROJECT | HOLE NO.

SOIL BORING LOG

HOLE NO. HA-02

1. COMPANY NAME: Fluor Daniel	2. DRILLING SUBCONTRACTOR: None
SHEET 1 OF 1 SHEETS	
3. PROJECT: LF Site Soil Cover Study	4. LOCATION: South of Road
5. SURFACE ELEVATION	6. DATE/TIME STARTED: 9/17/00 / 0955
7. DATE/TIME STOPPED: 9/17/00 / 1012	
8. TOTAL DEPTH OF HOLE: 30"	9. OTHER WATER LEVEL AND ELAPSED TIME AFTER DRILLING COMPLETED

10. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	11. SIGNATURE OF INSPECTOR
Backfilled	Soil Cutting			

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
	3"	Coal Ash					
	1	Tan-Gray Clayey Silty SAND					
	2						
	30"	**Terminated at 30 In.**					
	3						
	4						
	5						

FORM F01-0004 | PROJECT | HOLE NO.

SOIL BORING LOG

HOLE NO. HA-03

1. COMPANY NAME: Fluor Daniel	2. DRILLING SUBCONTRACTOR: None	SHEET 1 OF 1 SHEETS
3. PROJECT: LF Site Soil Cover Study	4. LOCATION: South of Road	
5. SURFACE ELEVATION	6. DATE/TIME STARTED: 9/17/00 / 1017	7. DATE/TIME STOPPED: 9/17/00 / 1030
8. TOTAL DEPTH OF HOLE: 24"	9. OTHER WATER LEVEL AND ELAPSED TIME AFTER DRILLING COMPLETED	

10. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	11. SIGNATURE OF INSPECTOR
Backfilled	Soil Cutting			

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
	2"	Dark Brown Clayey SAND					
	1	Tan-Gray Clayey Silty SAND					
	22"	Glass and Trash					
	2	**Terminated at 24 In.**					
	3						
	4						
	5						

FORM F01-0004 | PROJECT | HOLE NO.

SOIL BORING LOG

HOLE NO. HA-04

1. COMPANY NAME: Fluor Daniel	2. DRILLING SUBCONTRACTOR: None
	SHEET 1 OF 1 SHEETS
3. PROJECT: LF Site Soil Cover Study	4. LOCATION: South of Road
5. SURFACE ELEVATION	6. DATE/TIME STARTED: 9/17/00 / 1035
	7. DATE/TIME STOPPED: 9/17/00 / 1046
8. TOTAL DEPTH OF HOLE: 36"	9. OTHER WATER LEVEL AND ELAPSED TIME AFTER DRILLING COMPLETED

10. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	11. SIGNATURE OF INSPECTOR
Backfilled	Soil Cutting			

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
		Coal Ash					
	8"						
	1	Orange Clayey Silty SAND to Sandy CLAY					
	2	Metal Debris and Trash					
	30"	Tan-Orange Silty Sandy CLAY					
	3	**Terminated at 36 In.**					
	4						
	5						

FORM F01-0004	PROJECT	HOLE NO.

SOIL BORING LOG

HOLE NO. HA-05

1. COMPANY NAME: Fluor Daniel	2. DRILLING SUBCONTRACTOR: None
SHEET 1 OF 1 SHEETS	
3. PROJECT: LF Site Soil Cover Study	4. LOCATION: South Side of Road
5. SURFACE ELEVATION	6. DATE/TIME STARTED: 9/17/00 / 1050
7. DATE/TIME STOPPED: 9/17/00 / 1058	
8. TOTAL DEPTH OF HOLE: 36"	9. OTHER WATER LEVEL AND ELAPSED TIME AFTER DRILLING COMPLETED

10. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	11. SIGNATURE OF INSPECTOR
Backfilled	Soil Cutting			

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
	0	Gray ASH					
	1						
	14"	Orange Sandy CLAY					
	18"	Dark Gray Black ASH					
		Tan-Orange Clayey Silty SAND					
	2						
		Mixture of SAND and ASH					
	30"	Trash and Glass					
	3	**Terminated at 36 In.**					
	4						
	5						

FORM F01-0004 | PROJECT | HOLE NO.

SOIL BORING LOG

HOLE NO. HA-06

1. COMPANY NAME: Fluor Daniel	2. DRILLING SUBCONTRACTOR: None	SHEET 1 OF 1 SHEETS
3. PROJECT: LF Site Soil Cover Study	4. LOCATION: South of Road	
5. SURFACE ELEVATION	6. DATE/TIME STARTED: 9/17/00 / 1058	7. DATE/TIME STOPPED: 9/17/00 / 1107
8. TOTAL DEPTH OF HOLE: 30"	9. OTHER WATER LEVEL AND ELAPSED TIME AFTER DRILLING COMPLETED	

10. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	11. SIGNATURE OF INSPECTOR
Backfilled	Soil Cutting			

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
		Dark Gray Silty SAND with some ASH					
	6"	ASH					
	1	Tan-Orange Sand CLAY Mixed with Ash					
	22"	White and Brown Mixture of Loose Gravel					
	2	Trash and Paper					
		Terminated at 30 In.					
	3						
	4						
	5						

FORM F01-0004 | PROJECT | HOLE NO.

SOIL BORING LOG

HOLE NO. HA-07

1. COMPANY NAME: Fluor Daniel	2. DRILLING SUBCONTRACTOR: None	SHEET 1 OF 1 SHEETS
3. PROJECT: LF Site Soil Cover Study	4. LOCATION: South of Road	
5. SURFACE ELEVATION	6. DATE/TIME STARTED: 9/17/00 / 1110	7. DATE/TIME STOPPED: 9/17/00 / 1120
8. TOTAL DEPTH OF HOLE: 36"	9. OTHER WATER LEVEL AND ELAPSED TIME AFTER DRILLING COMPLETED	

10. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	11. SIGNATURE OF INSPECTOR
Backfilled	Soil Cutting			

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
		Dark Gray Sandy Gravel and ASH					
	9"						
	1	Tan-Orange Silty Sandy CLAY					
	2						
		Tan-Orange Clayey Siilty SAND					
	30"						
		Metal Debris and Trash					
	32"						
		Tan-Orange Clayey SAND to Sandy CLAY					
	3	**Terminated at 36 In.**					
	4						
	5						

FORM F01-0004 | PROJECT | HOLE NO.

SOIL BORING LOG

HOLE NO. HA-08

1. COMPANY NAME: Fluor Daniel	2. DRILLING SUBCONTRACTOR: None	SHEET 1 OF 1 SHEETS
3. PROJECT: LF Site Soil Cover Study	4. LOCATION: South of Road	
5. SURFACE ELEVATION	6. DATE/TIME STARTED: 9/17/00 / 1124	7. DATE/TIME STOPPED: 9/17/00 / 1131
8. TOTAL DEPTH OF HOLE: 36"	9. OTHER WATER LEVEL AND ELAPSED TIME AFTER DRILLING COMPLETED	

10. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	11. SIGNATURE OF INSPECTOR
Backfilled	Soil Cutting			

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
	2"	Humus					
	1	Tan-Orange Clayey Silty SAND					
	20"	Tan-Gray Clayey SILT					
	2	Tan Fine SAND					
	3	**Terminated at 36 In.**					
	4						
	5						

FORM F01-0004 | PROJECT | HOLE NO.

SOIL BORING LOG

HOLE NO. HA-09

1. COMPANY NAME: Fluor Daniel	2. DRILLING SUBCONTRACTOR: None
3. PROJECT: LF Site Soil Cover Study	4. LOCATION: South of Road
5. SURFACE ELEVATION:	6. DATE/TIME STARTED: 9/17/00 / 1133
8. TOTAL DEPTH OF HOLE: 36"	9. OTHER WATER LEVEL AND ELAPSED TIME AFTER DRILLING COMPLETED

SHEET 1 OF 1 SHEETS

10. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	11. SIGNATURE OF INSPECTOR
Backfilled	Soil Cutting			

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
	0	Dark Brown Silt SAND					
	2"						
	1	Tan-Orange Silty Sandy CLAY					
	2						
	34"						
	3	ASH					
		Terminated at 36 In.					
	4						
	5						

FORM F01-0004 | PROJECT | HOLE NO.

SOIL BORING LOG

HOLE NO. HA-10

1. COMPANY NAME: Fluor Daniel	2. DRILLING SUBCONTRACTOR: None
SHEET 1 OF 1 SHEETS	
3. PROJECT: LF Site Soil Cover Study	4. LOCATION: North of Road
5. SURFACE ELEVATION	6. DATE/TIME STARTED: 9/17/00 / 1328
7. DATE/TIME STOPPED: 9/17/00 / 1334	
8. TOTAL DEPTH OF HOLE: 24"	9. OTHER WATER LEVEL AND ELAPSED TIME AFTER DRILLING COMPLETED

10. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	11. SIGNATURE OF INSPECTOR
Backfilled	Soil Cutting			

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
	1"	Humus					
	1	Tan-Gray Clayey Silty SAND					
	2	Ash and Slag Trash and Glass **Terminated at 24 In.**					
	3						
	4						
	5						

FORM F01-0004 | PROJECT | HOLE NO.

SOIL BORING LOG

HOLE NO. HA-11

1. COMPANY NAME: Fluor Daniel	2. DRILLING SUBCONTRACTOR: None	SHEET 1 OF 1 SHEETS
3. PROJECT: LF Site Soil Cover Study	4. LOCATION: North of Road	
5. SURFACE ELEVATION	6. DATE/TIME STARTED: 9/17/00 / 1335	7. DATE/TIME STOPPED: 9/17/00 / 1341
8. TOTAL DEPTH OF HOLE: 30"	9. OTHER WATER LEVEL AND ELAPSED TIME AFTER DRILLING COMPLETED	

10. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	11. SIGNATURE OF INSPECTOR
Backfilled	Soil Cutting			

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
	1"	Humus					
	1	Tan-Orange Clayey Silty SAND Mixed with ASH					
	18"						
	2	Glass Mixed with Soil and ASH					
		Terminated at 30 In.					
	3						
	4						
	5						

FORM F01-0004 | PROJECT | HOLE NO.

SOIL BORING LOG

HOLE NO. HA-12

1. COMPANY NAME: Fluor Daniel	2. DRILLING SUBCONTRACTOR: None
SHEET 1 OF 1 SHEETS	
3. PROJECT: LF Site Soil Cover Study	4. LOCATION: North of Road
5. SURFACE ELEVATION	6. DATE/TIME STARTED: 9/17/00 / 1344
7. DATE/TIME STOPPED: 9/17/00 / 1352	
8. TOTAL DEPTH OF HOLE: 36"	9. OTHER WATER LEVEL AND ELAPSED TIME AFTER DRILLING COMPLETED

10. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	11. SIGNATURE OF INSPECTOR
Backfilled	Soil Cutting			

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
	1"	Humus					
		Gray ASH					
	9"						
	1	Tan-Orange Clayey Silty SAND					
	2						
	30"						
		Tan Silty SAND					
	34"						
	3	Trash and Glass and ASH					
		Terminated at 36 In.					
	4						
	5						

FORM F01-0004 | PROJECT | HOLE NO.

SOIL BORING LOG

HOLE NO. HA-13

1. COMPANY NAME: Fluor Daniel	2. DRILLING SUBCONTRACTOR: None	SHEET 1 OF 1 SHEETS
3. PROJECT: LF Site Soil Cover Study	4. LOCATION: North of Road	
5. SURFACE ELEVATION	6. DATE/TIME STARTED: 9/17/00 / 1356	7. DATE/TIME STOPPED: 9/17/00 / 1401
8. TOTAL DEPTH OF HOLE: 30"	9. OTHER WATER LEVEL AND ELAPSED TIME AFTER DRILLING COMPLETED	

10. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	11. SIGNATURE OF INSPECTOR
Backfilled	Soil Cutting			

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
		Humas					
	9"						
	1	Tan-Orange Clayey Silty SAND					
	20"						
	2	Tan-Orange Sandy Silty CLAY					
	26"						
		Tash (Glass) Wood and Metal					
		Terminated at 30 In.					
	3						
	4						
	5						

FORM F01-0004 | PROJECT | HOLE NO.

SOIL BORING LOG

HOLE NO. HA-14

1. COMPANY NAME: Fluor Daniel	2. DRILLING SUBCONTRACTOR: None
3. PROJECT: LF Site Soil Cover Study	4. LOCATION: North of Road
5. SURFACE ELEVATION	6. DATE/TIME STARTED: 9/17/00 / 1403
8. TOTAL DEPTH OF HOLE: 18"	9. OTHER WATER LEVEL AND ELAPSED TIME AFTER DRILLING COMPLETED

SHEET 1 OF 1 SHEETS

7. DATE/TIME STOPPED: 9/17/00 / 1408

10. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	11. SIGNATURE OF INSPECTOR
Backfilled	Soil Cutting			

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
		Humus					
	6"	Tan-Orange Clayey Silty SAND					
	1	Trash and Glass with ASH					
		Terminated at 18 In.					
	2						
	3						
	4						
	5						

FORM F01-0004 | PROJECT | HOLE NO.

SOIL BORING LOG

HOLE NO. HA-15

1. COMPANY NAME: Fluor Daniel	2. DRILLING SUBCONTRACTOR: None
SHEET 1 OF 1 SHEETS	
3. PROJECT: LF Site Soil Cover Study	4. LOCATION: North of Road
5. SURFACE ELEVATION	6. DATE/TIME STARTED: 9/17/00 / 1410
7. DATE/TIME STOPPED: 9/17/00 / 1418	
8. TOTAL DEPTH OF HOLE: 36"	9. OTHER WATER LEVEL AND ELAPSED TIME AFTER DRILLING COMPLETED

10. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	11. SIGNATURE OF INSPECTOR
Backfilled	Soil Cutting			

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
	0	Humus					
	6"						
	1	Tan-Orange Clayey Silty SAND					
	2						
	30"						
		Tan-Orange Silty CLAY					
	3	**Terminated at 36 In.**					
	4						
	5						

FORM F01-0004 | PROJECT | HOLE NO.

SOIL BORING LOG

HOLE NO. HA-16

1. COMPANY NAME: Fluor Daniel	2. DRILLING SUBCONTRACTOR: None	SHEET 1 OF 1 SHEETS
3. PROJECT: LF Site Soil Cover Study	4. LOCATION: West End of Landfill	
5. SURFACE ELEVATION	6. DATE/TIME STARTED: 9/17/00 / 1450	7. DATE/TIME STOPPED: 9/17/00 / 1458
8. TOTAL DEPTH OF HOLE: 27"	9. OTHER WATER LEVEL AND ELAPSED TIME AFTER DRILLING COMPLETED	

10. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	11. SIGNATURE OF INSPECTOR
Backfilled	Soil Cutting			

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
	0	Dark Gray Black ASH					
	1	Tan-Orange Clayey Silty SAND					
	2	Auger Refusal - Metal					
	27"	**Terminated at 27 In.**					
	3						
	4						
	5						

FORM F01-0004 | PROJECT | HOLE NO.

SOIL BORING LOG

HOLE NO. HA-17

1. COMPANY NAME: Fluor Daniel	2. DRILLING SUBCONTRACTOR: None	SHEET 1 OF 1 SHEETS
3. PROJECT: LF Site Soil Cover Study	4. LOCATION: West End of Landfill	
5. SURFACE ELEVATION	6. DATE/TIME STARTED: 9/17/00 / 1500	7. DATE/TIME STOPPED: 9/17/00 / 1510
8. TOTAL DEPTH OF HOLE: 36"	9. OTHER WATER LEVEL AND ELAPSED TIME AFTER DRILLING COMPLETED	

10. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	11. SIGNATURE OF INSPECTOR
Backfilled	Soil Cutting			

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
	3"	Humus					
	1	Tan-Orange Sandy Silty CLAY					
	18"	Mixture Ash and Slag					
	2	Trash					
	30"	Tan-Orange Sandy Silty CLAY					
	3	**Terminated at 36 In.**					
	4						
	5						

FORM F01-0004 | PROJECT | HOLE NO.

SOIL BORING LOG

HOLE NO. HA-18

1. COMPANY NAME: Fluor Daniel	2. DRILLING SUBCONTRACTOR: None
SHEET 1 OF 1 SHEETS	
3. PROJECT: LF Site Soil Cover Study	4. LOCATION: North Side of Landfill
5. SURFACE ELEVATION:	6. DATE/TIME STARTED: 9/17/00 / 1512
7. DATE/TIME STOPPED: 9/17/00 / 1518	
8. TOTAL DEPTH OF HOLE: 36"	9. OTHER WATER LEVEL AND ELAPSED TIME AFTER DRILLING COMPLETED

10. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	11. SIGNATURE OF INSPECTOR
Backfilled	Soil Cutting			

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
	2"	Humus					
		Tan-Orange Clayey Silty SAND					
	1						
		Tan-Orange Sandy CLAY					
	2						
	30"						
		Trash					
	3	**Terminated at 36 In.**					
	4						
	5						

FORM F01-0004 | PROJECT | HOLE NO.

SOIL BORING LOG

HOLE NO. HA-19

1. COMPANY NAME: Fluor Daniel	2. DRILLING SUBCONTRACTOR: None	SHEET 1 OF 1 SHEETS
3. PROJECT: LF Site Soil Cover Study	4. LOCATION: North Side of Landfill	
5. SURFACE ELEVATION	6. DATE/TIME STARTED: 9/17/00 / 1521	7. DATE/TIME STOPPED: 9/17/00 / 1525
8. TOTAL DEPTH OF HOLE: 26"	9. OTHER WATER LEVEL AND ELAPSED TIME AFTER DRILLING COMPLETED	

10. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	11. SIGNATURE OF INSPECTOR
Backfilled	Soil Cutting			

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
	0	Humus					
	3"						
	1	Tan-Orange Clayey SAND					
	2	Metal Debris - Auger Refusal					
		Terminated at 26 In.					
	3						
	4						
	5						

FORM F01-0004 | PROJECT | HOLE NO.

SOIL BORING LOG

HOLE NO. HA-20

1. COMPANY NAME: Fluor Daniel	2. DRILLING SUBCONTRACTOR: None
SHEET 1 OF 1 SHEETS	
3. PROJECT: LF Site Soil Cover Study	4. LOCATION: North Side of Landfill
5. SURFACE ELEVATION	6. DATE/TIME STARTED: 9/17/00 / 1527
7. DATE/TIME STOPPED: 9/17/00 / 1545	
8. TOTAL DEPTH OF HOLE: 36"	9. OTHER WATER LEVEL AND ELAPSED TIME AFTER DRILLING COMPLETED

10. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	11. SIGNATURE OF INSPECTOR
Backfilled	Soil Cutting			

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
	2"	Humus					
		ASH (Gravelly) Slag					
	9"	Tan-Orange Sandy CLAY					
	1	Mixture of ASH and Soil					
	16"	ASH with Slag Gravel					
	2	Mixture of ASH and Soil					
	3	**Terminated at 36 In.**					
	4						
	5						

FORM F01-0004 | PROJECT | HOLE NO.

SOIL BORING LOG

HOLE NO. HA-21

1. COMPANY NAME: Fluor Daniel	2. DRILLING SUBCONTRACTOR: None
SHEET 1 OF 1 SHEETS	
3. PROJECT: LF Site Soil Cover Study	4. LOCATION: North Side of Landfill
5. SURFACE ELEVATION	6. DATE/TIME STARTED: 9/17/00 / 1548
7. DATE/TIME STOPPED: 9/17/00 / 1554	
8. TOTAL DEPTH OF HOLE: 36"	9. OTHER WATER LEVEL AND ELAPSED TIME AFTER DRILLING COMPLETED

10. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	11. SIGNATURE OF INSPECTOR
Backfilled	Soil Cutting			

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
	6"	Dark Gray ASH and Slag (Gravel)					
	1	Tan-Orange Sandy Silty Clay					
	18"						
	2	Mixture of ASH and Soil					
	30"						
	3	Metal Debris - Trash					
		Terminated at 36 In.					
	4						
	5						

FORM F01-0004 | PROJECT | HOLE NO.

SOIL BORING LOG

HOLE NO. HA-22

1. COMPANY NAME: Fluor Daniel	2. DRILLING SUBCONTRACTOR: None
3. PROJECT: LF Site Soil Cover Study	4. LOCATION: North Side of Landfill
5. SURFACE ELEVATION:	6. DATE/TIME STARTED: 9/17/00 / 1556
8. TOTAL DEPTH OF HOLE: 36"	9. OTHER WATER LEVEL AND ELAPSED TIME AFTER DRILLING COMPLETED

SHEET 1 OF 1 SHEETS

7. DATE/TIME STOPPED: 9/17/00 / 1601

10. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	11. SIGNATURE OF INSPECTOR
Backfilled	Soil Cutting			

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
	2"	Dark Gray-Black ASH and Slag (Gravelly)					
	9"						
	1						
		Tan-Orange Sandy Silty CLAY					
	2						
	3	Hit Metal at 26" - Auger Refusal					
		Terminated at 36 In.					
	4						
	5						

FORM F01-0004 | PROJECT | HOLE NO.

SOIL BORING LOG

HOLE NO. HA-23

1. COMPANY NAME: Fluor Daniel	2. DRILLING SUBCONTRACTOR: None
	SHEET 1 OF 1 SHEETS
3. PROJECT: LF Site Soil Cover Study	4. LOCATION: North Side of Landfill
5. SURFACE ELEVATION:	6. DATE/TIME STARTED: 9/17/00 / 1603
	7. DATE/TIME STOPPED: 9/17/00 / 1608
8. TOTAL DEPTH OF HOLE: 36"	9. OTHER WATER LEVEL AND ELAPSED TIME AFTER DRILLING COMPLETED

10. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	11. SIGNATURE OF INSPECTOR
Backfilled	Soil Cutting			

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
	2"	Humus					
	1	Tan-Orange Clayey Silty SAND					
	2						
	3	Auger Refusal - Metal					
		Terminated at 36 In.					
	4						
	5						

FORM F01-0004 | PROJECT | HOLE NO.

SOIL BORING LOG

HOLE NO. HA-24

1. COMPANY NAME: Fluor Daniel	2. DRILLING SUBCONTRACTOR: None
SHEET 1 OF 1 SHEETS	
3. PROJECT: LF Site Soil Cover Study	4. LOCATION: North Side of Landfill
5. SURFACE ELEVATION	6. DATE/TIME STARTED: 9/17/00 / 1610
7. DATE/TIME STOPPED: 9/17/00 / 1614	
8. TOTAL DEPTH OF HOLE: 36"	9. OTHER WATER LEVEL AND ELAPSED TIME AFTER DRILLING COMPLETED

10. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	11. SIGNATURE OF INSPECTOR
Backfilled	Soil Cutting			

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
		Humus					
	6"						
	1	Tan-Orange Sandy Silty CLAY					
	2	Tan Silty Fine SAND					
	33"						
		Trash and Wood					
	3	**Terminated at 36 In.**					
	4						
	5						

FORM F01-0004 | PROJECT | HOLE NO.

SOIL BORING LOG

HOLE NO. HA-25

1. COMPANY NAME: Fluor Daniel	2. DRILLING SUBCONTRACTOR: None
SHEET 1 OF 1 SHEETS	
3. PROJECT: LF Site Soil Cover Study	4. LOCATION: North Side of Landfill
5. SURFACE ELEVATION	6. DATE/TIME STARTED: 9/17/00 / 1616
7. DATE/TIME STOPPED: 9/17/00 / 1620	
8. TOTAL DEPTH OF HOLE: 26"	9. OTHER WATER LEVEL AND ELAPSED TIME AFTER DRILLING COMPLETED

10. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	11. SIGNATURE OF INSPECTOR
Backfilled	Soil Cutting			

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
	0	Dark Gray Clayey SILT					
	6"	ASH					
	9"	Tan-Orange Sandy Silty CLAY					
	1						
	2						
	26"	Trash - Auger Refusal					
		Terminated at 26 In.					
	3						
	4						
	5						

FORM F01-0004 | PROJECT | HOLE NO.

SOIL BORING LOG

HOLE NO. HA-26

1. COMPANY NAME: Fluor Daniel	2. DRILLING SUBCONTRACTOR: None	SHEET 1 OF 1 SHEETS
3. PROJECT: LF Site Soil Cover Study	4. LOCATION: North Side of Landfill	
5. SURFACE ELEVATION	6. DATE/TIME STARTED: 9/17/00 / 1621	7. DATE/TIME STOPPED: 9/17/00 / 1625
8. TOTAL DEPTH OF HOLE: 18"	9. OTHER WATER LEVEL AND ELAPSED TIME AFTER DRILLING COMPLETED	

10. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	11. SIGNATURE OF INSPECTOR
Backfilled	Soil Cutting			

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
		Brown Clayey SILT					
	9"						
	1	Tan-Orange Sandy CLAY					
	16"	Trash and Glass					
		Terminated at 18 In.					
	2						
	3						
	4						
	5						

FORM F01-0004 | PROJECT | HOLE NO.

SOIL BORING LOG

HOLE NO. HA-27

1. COMPANY NAME: Fluor Daniel	2. DRILLING SUBCONTRACTOR: None
	SHEET 1 OF 1 SHEETS
3. PROJECT: LF Site Soil Cover Study	4. LOCATION: North of Landfill
5. SURFACE ELEVATION	6. DATE/TIME STARTED: 9/17/00 / 1627
	7. DATE/TIME STOPPED: 9/17/00 / 1635
8. TOTAL DEPTH OF HOLE: 36"	9. OTHER WATER LEVEL AND ELAPSED TIME AFTER DRILLING COMPLETED

10. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	11. SIGNATURE OF INSPECTOR
Backfilled	Soil Cutting			

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
		Tan-Brown Silt with ASH					
	6"	Tan CLAY					
	9"						
	1	Tan Clayey Silty SAND					
	18"						
	2	Orange to Red Sandy SILT					
	30"						
		Tan Silty SAND					
	3	**Terminated at 36 In.**					
	4						
	5						

FORM F01-0004 | PROJECT | HOLE NO.

APPENDIX B

APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

The definitions of ARARs are:

Applicable Requirements – Under the National Oil and Hazardous Substances Contingency Plan (NCP), cleanup standards, standards of control and other substantive environmental protection requirements, criteria, or limitations promulgated under Federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site (40 CFR Part 300.5).

Relevant and Appropriate Requirements – Under the NCP, cleanup standards, standards of control and other substantive environmental protection requirements, criteria, or limitations promulgated under Federal or State law that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site (40 CFR Part 300.5).

To Be Considered – USEPA has also created another category of requirements known as TBCs which include non-promulgated criteria, advisories and guidance issued by Federal or State governments.

ARARs are classified into three (3) broad categories, and will be presented based upon these categories:

Chemical-specific ARARs are usually health- or risk-based numerical values or methodologies used to determine acceptable concentrations of chemicals that may be found in or discharged to the environment (e.g., MCLs that establish safe levels in drinking water). Chemical-specific ARARs govern the extent of site cleanup.

Location-specific ARARs restrict actions or contaminant concentrations in certain environmentally-sensitive areas. Examples of areas regulated under various Federal laws include floodplains, wetlands, and locations where protected species or historically significant cultural resources are present. Location-specific ARARs govern the development or use of naturally- or culturally- sensitive site features.

Action-specific ARARs are usually technically- or activity-based requirements or limitations on actions or conditions involving remedial activities.

TABLE B-1
CHEMICAL-SPECIFIC ARARS
LF SITE

ARAR/TBC	Requirement	Prerequisite	Citation	ARAR Determination
		FEDERAL		
Safe Drinking Water Act - Maximum Contaminant Levels (MCLs)	Enforceable standards that take into consideration human health effects, available treatment technologies and cost of treatment.	Apply to systems for the provision of piped water for human consumption with at least 15 service connections or serving at least 25 persons.	40 CFR 141	Potentially relevant and appropriate. Groundwater is currently not used as a source of drinking water; however, if future land use is not restricted it could potentially be used. If groundwater can be used for tap water it must meet the Drinking Water Standards.
Quality Criteria for Water	Non-enforceable, health-based criteria used to establish surface water quality standards for the protection of human health and aquatic life	Discharge to Surface Water	USEPA 440/5-86-001 (1986)	Not an ARAR. Proposed remedial activities do not involve a discharge to surface water.
USEPA Region III Risk-Based Concentrations (RBCs)	RBCs provide risk-based screening levels for soil and groundwater based on residential and industrial use	RBCs are used for screening human health risk under specific land use scenarios	USEPA 2000	To be considered. Based on a site-specific risk assessment, contaminant concentrations detected at the site would not present a risk to human health based on current land use; however, if future land use is not restricted it could present a risk.
USEPA Region III Soil Screening Levels (SSLs)	SSLs are screening levels which indicate potential risks for the soil to groundwater or soil to air pathways	SSLs are used only for screening and are not applicable as cleanup goals	USEPA 2000	To be considered. A fate and transport analysis indicated that the potential migration of contaminants would not present a risk to human health based on current land use; however, if future land use is not restricted it could present a risk.
Soil/Surface water/ Sediment - Biological Technical Assistance Guidance (BTAG)	BTAG values are screening levels which indicate potential risks to ecological receptors	BTAG values are used only for screening and are not applicable as cleanup goals	USEPA 1996	Not an ARAR. Based on a site-specific risk assessment, environmental risk was determined to be insignificant.

TABLE B-1 (Continued)
CHEMICAL-SPECIFIC ARARS
LF SITE

ARAR/TBC	Requirement	Prerequisite	Citation	ARAR Determination
STATE				
State Water Control Law, Code of Virginia 62.1-44.2 to 44.34:38				
Water Quality Standards	Enforceable standards that shall apply to all surface waters	Discharge to surface water	9 VAC 25-260-5 to 550	Not an ARAR. Proposed remedial activities do not involve a discharge to surface water.
Virginia Pollutant Discharge Elimination (VPDES) Permit Regulation	Site-specific discharge limits	Discharge to surface water	9 VAC 25-31-10 to 940	Not an ARAR. Proposed remedial activities do not involve a discharge to surface water.
Virginia Pollutant Abatement (VPA) Permit Regulation	Site-specific discharge limits	Discharge adjacent to surface water	9 VAC 25-32-10 to 300	Not an ARAR. Proposed remedial activities do not involve a discharge adjacent to surface water.
Environmental Health Services, Code of Virginia 32.1-163 to 248.1				
Waterworks Regulations	MCLs or if MCL not available, other health-based standard for groundwater.	Applicable to potential drinking water sources	12 VAC 5-590-10 to 1280	Potentially applicable. Groundwater is currently not used as a source of drinking water; however, if future land use is not restricted it could potentially be used. If groundwater can be used for tap water it must meet the Drinking Water Standards.
Virginia Waste Management Act, Code of Virginia 10.1-1400 to 1457				
Hazardous Waste Regulations	Action levels for contaminants released from solid waste management units	Action levels provide guidance in the absence of a risk assessment	9 VAC 20-80-220	Not an ARAR. Clean-up standards were evaluated through a risk assessment.

TABLE B-2
LOCATION-SPECIFIC ARARS
LF SITE

ARAR/TBC	Requirement	Prerequisite	Citation	ARAR Determination
FEDERAL				
National Archaeological and Historic Preservation Act, 16 USC 469				
Preservation of historical or archaeological data	Historical or archaeological data must be preserved	Alteration of terrain threatening historical or archaeological data	36 CFR 65	Not an ARAR. The area of the site has previously been disturbed. No historical or archaeological data would be disturbed due to activities associated with the site.
Federal National Historic Preservation Act, Section 106, 16 USC 470				
Preservation of historic and cultural properties - National Register of Historic Places (NRHP)	Remedial actions are required to take into account the effects of remedial activities on any historic properties included on or eligible for inclusion on the NRHP	Inclusion or eligible for inclusion on NRHP	36 CFR 800	Not an ARAR. The area of the site has previously been disturbed. There are no historic properties on the site.
Historic Sites, Buildings, and Antiquities Act, 16 USC 461 to 467				
Preservation of landmarks, historical and archaeological sites - National Registry of Natural Landmarks	Prior to remedial activities, the existence and location of landmarks on the National Registry of Natural Landmarks must be considered	Site contains landmarks on the National Registry of Natural Landmarks	40 CFR 6.301(a)	Not an ARAR. The area of the site has previously been disturbed. No known landmarks are present on the site
Endangered Species Act of 1973, 16USC 1531, 16 USC 1536(a)				
Protection of endangered and threatened species of fish, wildlife and plants	Remedial actions must not jeopardize threatened or endangered species or result in destruction of their critical habitats	Presence of threatened or endangered species	50 CFR 81, 225, 402	Not an ARAR. The site is not critical habitat for threatened or endangered species.

TABLE B-2 (Continued)
LOCATION-SPECIFIC ARARS
LF SITE

ARAR/TBC	Requirement	Prerequisite	Citation	ARAR Determination
Migratory Bird Treaty Act of 1972, 16 USC 703				
Protection of migratory birds	Protects almost all species of native birds in the US from unregulated taking which can include poisoning at hazardous waste sites	Presence of migratory birds	16 USC 703	Not an ARAR. Proposed remedial activities would not result in the taking of migratory birds.
Wilderness Act, 16 USC 1131, et seq.				
Protection of federally owned wilderness area	Federally-owned wilderness areas must be maintained in an unimpacted condition	Federally-owned wilderness area	50 CFR 35.1 et seq.	Not an ARAR. The site is not part of a Federally-owned wilderness area.
National Wildlife Refuge System, 16 USC 668				
Protection of national wildlife refuge	Restricts activities within a National Wildlife Refuge	National Wildlife Refuge	50 CFR 27	Not an ARAR. The site is not part of a National Wildlife Refuge.
Fish & Wildlife Coordination Act, Fish & Wildlife Improvement Act of 1978 and Fish & Wildlife Conservation Act of 1980, 16 USC 661, 662, 742(a), 2901				
Protection of fish and wildlife	The U.S. Fish and Wildlife Service, National Marine Fisheries Service and related State agencies must be consulted before a body of water, including wetlands, is modified	Water-related projects which may impact fish and wildlife	50 CFR 83	Not an ARAR. Proposed remedial activities would not modify a body of water or associated wetlands.
Procedures for Implementing the Requirements of the Council of Environmental Quality on the National Environmental Policy Act and Executive Order 11990, Protection of Wetlands				
Protection of wetlands	Adverse impacts associated with the destruction or loss of wetlands and new construction in wetlands should be avoided if a practical alternative exists	Destruction of wetlands or construction in wetlands	40 CFR 6, Appendix A 40 CFR 6.302(a)	Not an ARAR. Proposed remedial activities would not result in the loss of wetlands or construction within a wetland.

TABLE B-2 (Continued)
LOCATION-SPECIFIC ARARS
LF SITE

ARAR/TBC	Requirement	Prerequisite	Citation	ARAR Determination
Clean Water Act, Section 404				
Protection of wetlands	Disposal of dredged or fill material may be prohibited in a defined area	Discharges of dredged or fill material into waters of the United States	40 CFR 23.10 40 CFR 231 (231.1, 231.2, 231.7, 231.8)	Not an ARAR. Proposed remedial activities do not include dredge and fill.
Wild and Scenic Rivers Act, 16 USC 1271 et seq.				
Protection of wild and scenic rivers	Minimize direct and adverse effects on the free-flowing, scenic, and natural values of a river within or being considered for inclusion in the National Wild and Scenic Rivers System	Wild, scenic or recreational rivers within or being considered for inclusion in the National Wild and Scenic Rivers System	40 CFR 6.302(e)	Not an ARAR. Site is not located near a wild, scenic or recreational river.
Coastal Zone Management Act, 16 USC 1456(c), Section 307(c), 16 USC 1451 et seq.				
Protection of coastal zone	Remedial activities must be consistent with State coastal zone management programs	Site located in coastal zone	15 CFR 930 15 CFR 923.45	Not an ARAR. Site is not located within a coastal zone.
Coastal Barrier Resources Act, 16 USC 3504				
Protection of coastal zone	Prohibits new federal expenditure within the Coastal Barrier Resource System	Activity within the Coastal Barrier Resource System	40 CFR 6.302(d)	Not an ARAR. Site is not located on a coastal barrier.
Navigation and Navigable Waters				
Protection of navigable waters	Establishes regulations pertaining to activities that affect the navigation of the waters of the United States	Activities affecting navigable waters	33 CFR 320 to 329	Not an ARAR. Site is not located near navigable waters.

TABLE B-2 (Continued)
LOCATION-SPECIFIC ARARS
LF SITE

ARAR/TBC	Requirement	Prerequisite	Citation	ARAR Determination
Magnuson Fishery Conservation and Management Act, 16 USC 1801 et seq.				
Protection of fisheries	Provides for conservation and management of specified fisheries within specified fishery conservation zones	Presence of managed fisheries in federal waters	16 USC 1801 et seq.	Not an ARAR. Site is not located near managed fisheries.
Solid Wastes: Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities				
Hazardous waste siting criteria - Faults	New treatment, storage or disposal of hazardous waste is prohibited within 200 feet of a fault displaced in Holocene time	Facility located near a fault	40 CFR 264.18(a)	Not an ARAR. Proposed remedial activities do not call for construction of a hazardous waste facility.
Hazardous waste siting criteria - Floodplain	A hazardous waste facility within a 100 year floodplain must be designed, constructed, operated and maintained to avoid washout	Facility located within 100 year floodplain	40 CFR 264.18(b)	Not an ARAR. Proposed remedial activities do not call for construction of a hazardous waste facility.
Hazardous waste siting criteria - Salt dome formations, salt bed formations, underground mines and caves	Placement of non-containerized or bulk liquid hazardous waste within a salt dome formation, underground mine or cave is prohibited	On-site placement of hazardous waste	40 CFR 264.18(c)	Not an ARAR. There are no salt dome formations, underground mines or caves on the site.
Protection of Floodplains, Executive Order 11988				
Protection of floodplains	Potential effects of adverse impacts to floodplains associated with direct and indirect development of a floodplain must be evaluated and minimized	Development of a floodplain	40 CFR 6.302(b), Appendix A	Not an ARAR. Proposed remedial activities will not result in the development of a floodplain.

TABLE B-2 (Continued)
LOCATION-SPECIFIC ARARS
LF SITE

ARAR/TBC	Requirement	Prerequisite	Citation	ARAR Determination
STATE				
Virginia Natural Area Preserves Act, Code of Virginia 10.1-209 to 217				
Protection of natural areas	Restricts certain uses of dedicated natural areas	Department of Conservation and Recreation must have accepted dedication of a portion of the site as a natural area preserve	Code of Virginia 10.1-209 to 217	Not an ARAR. No portion of the site has been dedicated as a natural area preserve.
General Provisions Relating to Marine Resources Commission, Code of Virginia 28.2-1300 to 1320				
Wetlands Mitigation Compensation Policy	Must comply with provisions of zoning ordinance or statutory provisions of the law	Wetland zoning ordinance by local government	4 VAC 20-390-10 to 50	Not an ARAR. No tidal wetlands are associated with the site.
Chesapeake Bay Preservation Act, Code of Virginia 10.1-2100 to 2116				
Chesapeake Bay Preservation Area Designation and Management Regulations	Certain locally designated tidal and nontidal wetlands, as well as other sensitive land areas are subject to limitations regarding land use, development or redevelopment	Disturbance of certain locally designated tidal and nontidal wetlands and other sensitive land area	9 VAC 10-20-10 to 280	Not an ARAR. The site is not within an area designated as a Resource Protection Area or a Resource Management Area under the Chesapeake Bay Preservation Act.
State Water Control Law, Code of Virginia 62.1-44.2 to 44.34:38				
Virginia Water Protection Permit Regulation Virginia Wetlands Mitigation Policy	All state waters including wetlands are subject to set criteria and standards for water quality. No person shall dredge, fill or discharge any pollutant into, or adjacent to, surface waters, or otherwise alter the physical, chemical or biological properties of surface waters, except as authorized pursuant to a permit	Discharge into waters of the United States	9 VAC 25-31-10 to 940 9 VAC 25-32-10 to 300 9 VAC 25-210-10 to 260 9 VAC 25-260-5 to 550	Not an ARAR. Proposed remedial activities do not include dredge and fill.

TABLE B-2 (Continued)
LOCATION-SPECIFIC ARARS
LF SITE

ARAR/TBC	Requirement	Prerequisite	Citation	ARAR Determination
Virginia Endangered Species Act, Code of Virginia 29.1-563 to 570				
Definitions and Miscellaneous in General	The taking, transportation, processing, sale or offer for sale within the Commonwealth of any threatened or endangered species published by the United States Secretary of the Interior is prohibited, except as provided by this Act	Determination of effect upon endangered or threatened species or its habitat	4 VAC 15-20-130 to 140	Not an ARAR. Proposed remedial activities will not involve the taking, transportation, processing, sale or offer for sale of any threatened or endangered species.
Virginia Endangered Plant and Insect Species Act, Code of Virginia 3.1-1020 to 1030				
Rules and Regulations for the Enforcement of the Endangered Plant and Insect Species Act	The agency may make regulations to declare species to be threatened or endangered and may establish programs for their preservation	Determination of effect upon endangered or threatened species or its habitat	2 VAC 5.320-10	Not an ARAR. There are no endangered or threatened plant or animal species at the site.
Virginia Historic Resource Law, Virginia Antiquities Act, Code of Virginia 10.1-2200 to 2214 and 10.1-2300 to 2306				
Protection of historic properties	Requires that a reasonable and good faith effort be made to identify and evaluate historic properties, to assess the project's effects when historic properties are found, and to offer the Virginia Department of Historic Resources an opportunity to comment on the affected property when it is either listed or eligible for listing on the NRHP	Site contains historic properties	17 VAC 10-20-10 to 230	Not an ARAR. The area of the site has previously been disturbed. There are no historic properties on the site.

TABLE B-2 (Continued)
LOCATION-SPECIFIC ARARS
LF SITE

ARAR/TBC	Requirement	Prerequisite	Citation	ARAR Determination
Protection of human remains	A permit must be obtained prior to any field investigation involving the removal of human remains or associated artifacts	Activities involving the removal of human remains	17 VAC 5-20-10 to 80	Not an ARAR. The area of the site has previously been disturbed. There are no human burial locations at the site.
Virginia Waste Management Act, Code of Virginia 10.1-1400 to 1457				
Hazardous Waste Facility Siting Criteria	Hazardous waste treatment, storage and disposal facilities should not be placed in certain specific locations of the state	Placement of hazardous waste treatment, storage and disposal facility	9 VAC 20-50-20 to 100	Not an ARAR. Proposed remedial activities will not involve the placement of a hazardous waste treatment, storage and disposal facility at the site.

TABLE B-3
ACTION-SPECIFIC ARARS
LF SITE

ARAR/TBC	Requirement	Prerequisite	Citation	ARAR Determination
FEDERAL				
Toxic Substances Control Act (TSCA), 15 USC 2601 to 2692				
Remediation, release and disposal of polychlorinated biphenyls (PCBs)	Requirements governing the remediation, release, and disposal of PCBs	Remediation, release and disposal of PCBs	40 CFR 761	Not an ARAR. PCBs are not contaminants of concern at the site.
Resource Conservation and Recovery Act (RCRA), 42 USC 6901 et seq.				
Regulations governing hazardous waste generation - Identification	Waste generator shall determine if the excavated soil is hazardous	Excavated soil is determined to be a hazardous waste	40 CFR 262.11 40 CFR 262.10(a)	Not an ARAR. Proposed remedial activities will not include the generation of hazardous waste. Excavation is not planned.
Regulations governing hazardous waste generation – Accumulation	Generator may accumulate waste onsite for 90 days or less or must comply with requirements for operating a storage facility	Excavated soil is determined to be a hazardous waste	40 CFR 262.34	Not an ARAR. Proposed remedial activities will not include the generation of hazardous waste. Excavation is not planned.
Regulations governing hazardous waste generation - Recordkeeping	Generator must keep records	Excavated soil is determined to be a hazardous waste	40 CFR 262.40	Not an ARAR. Proposed remedial activities will not include the generation of hazardous waste. Excavation is not planned.
Regulations governing hazardous waste generation - Excavation	Movement of excavated soils to new location and placement in or on land will trigger land disposal restrictions for the soils determined to be hazardous waste.	Excavated soil determined to be a hazardous waste subject to land disposal restrictions	40 CFR 268.40	Not an ARAR. Proposed remedial activities will not include the generation of hazardous waste. Excavation is not planned.

TABLE B-3 (Continued)
ACTION-SPECIFIC ARARS
LF SITE

ARAR/TBC	Requirement	Prerequisite	Citation	ARAR Determination
Regulations governing hazardous waste generation - Clean closure	Removal or decontamination of all waste residues and management of them as hazardous waste	Contaminated soil returned to land	40 CFR 264.111 40 CFR 264.228	Not an ARAR. Clean closure is not part of the remedial action objectives.
Regulations governing hazardous waste generation - Placement of waste in land disposal unit	Attain land disposal treatment standards before putting waste into landfill in order to comply with land disposal restrictions.	Placement of RCRA hazardous waste in a landfill	40 CFR 268.40	Not an ARAR. Activities associated with the site will not include the generation of hazardous waste. Excavation is not planned.
Clean Water Act (CWA), 33 USC 1251 et seq.				
Requirements for discharge to surface water	Treatment standards, Best Management Practices, Monitoring Requirements	Discharge to waters of the United States	40 CFR 403 40 CFR 122	Not an ARAR. Activities associated with the site will not result in a point source discharge of water.
Clean Air Act (CAA), 40 USC 7401 et seq.				
Standards for air emissions	Sources of air pollutants are subject to standards for criteria pollutants and hazardous air pollutants	Source of air emissions	40 CFR 50, 61	Not an ARAR. Activities associated with the site will not result in the discharge of air pollutants.
US Department of Transportation, 49 USC 1802 et seq.				
Regulations governing hazardous materials transportation	Specific requirements for marking, labeling and placarding for transport of hazardous waste	Transport of hazardous waste	40 CFR 172.300 through 40 CFR 172.304	Not an ARAR. Activities associated with the site do not include transport of hazardous materials offsite.
Criteria for Classification of Solid Waste Disposal Facilities and Practices				
Regulations governing solid waste disposal	Criteria for solid waste disposal facilities to prevent adverse effects on health or the environment	Solid waste disposal	40 CFR 257	Applicable. The site is a solid waste disposal area and must comply with the closure requirements. Will be addressed through compliance with the Virginia Solid Waste Regulations.

TABLE B-3 (Continued)
ACTION-SPECIFIC ARARS
LF SITE

ARAR/TBC	Requirement	Prerequisite	Citation	ARAR Determination
Occupational Safety and Health Administration (OSHA)				
Standards for protection of hazardous waste workers	Requirements for hazardous waste workers such as training, personal protective equipment and clothing must be met	Hazardous waste work	29 CFR 1904 29 CFR 1910 29 CFR 1926	Not an ARAR. Activities associated with the site will not involve hazardous waste workers.
STATE				
Virginia Air Pollution Control Board, Code of Virginia 10.1-1300 to 1326				
Ambient Air Quality Standards	Air emissions must not cause an exceedance of ambient air quality standards	Action that will affect ambient air quality	9 VAC 5-30-10 to 80	Not an ARAR. Activities associated with the site will not cause significant air emissions and, therefore, will not affect the ambient air quality.
Standards of Performance for Visible Emissions and Fugitive Dust/Emissions	Reasonable precautions must be taken to prevent particulate matter from becoming airborne during excavation and other soil handling activities	Activities creating visible emissions or fugitive dust	9 VAC 5-50-60 to 120	Applicable to soil handling activities producing dust. Procedures will be followed to minimize dust generation.
Standards of Performance for Toxic pollutants	Criteria for control of toxic pollutants	Activities creating emissions of toxic pollutants	9 VAC 5-50-160 to 230	Not an ARAR. Activities associated with the site will not cause the emission of toxic pollutants.
Environmental Protection Agency National Emission Standards for Hazardous Air Pollutants	Criteria for control of hazardous air pollutants	Activities creating emissions of hazardous air pollutants	9 VAC 5-60-60 to 80	Not an ARAR. Activities associated with the site will not cause the emission of hazardous air pollutants.
Virginia Waste Management Act, Code of Virginia 10.1-1400 to 1457				
Hazardous Waste Regulations	Provides for the control of hazardous wastes that are generated within, or transported to Virginia for the purposes of storage, treatment or disposal	Generation of hazardous waste	9 VAC 20-60-10 to 1505	Not an ARAR. Activities associated with the site will not include the generation of hazardous waste since soil will not be excavated.

TABLE B-3 (Continued)
ACTION-SPECIFIC ARARS
LF SITE

ARAR/TBC	Requirement	Prerequisite	Citation	ARAR Determination
Solid Waste Management Regulations	Criteria for management of soil waste	Management of solid wastes	9 VAC 20-80-10 to 790 [9 VAC 20-80-260E(1)]	Applicable. The site is a solid waste disposal area and must comply with the closure requirements of the Virginia Solid Waste Regulations.
Regulations Governing Transportation of Hazardous Materials	Regulates the transportation of hazardous materials	Transportation of hazardous materials	9 VAC 20-110-10 to 130	Not an ARAR. Activities associated with the site do not include the transportation of hazardous materials.
Rules and Regulations Governing the Transportation of Hazardous Materials through Bridge-Tunnel Facilities, Code of Virginia 33.1-12				
Regulations Governing Transportation of Hazardous Materials	Regulates the transportation of hazardous materials in Virginia	Transportation of hazardous materials in Virginia	24 VAC 30-61-10 to 40	Not an ARAR. Activities associated with the site do not include the transportation of hazardous materials.
State Water Control Law, Code of Virginia 62.1-44.2 to 44.34:28				
Virginia Pollutant Discharge Elimination (VPDES) Permit Regulation	Criteria for discharge to surface waters	Discharge to surface water	9 VAC25-31-10 to 940 9 VAC 25-32-10 to 300 9 VAC 25-210-10 to 260	Not an ARAR. Activities associated with the site do not include a discharge to surface water.
Stormwater Management Act, Code of Virginia 10.1-603.1 to 603.15				
Stormwater Management Regulations	Minimum acceptable criteria to control nonpoint pollution, localized flooding and stream channel erosion	Applies to development projects that disturb more than 1 acre of land area	4 VAC 3-20-10 to 251	Potentially applicable. Activities associated with the site may include disturbing more than one acre of land. Stormwater controls will be required.
Erosion and Sediment Control Law, Code of Virginia 10.1-560 to 571				
Erosion and Sediment Control Regulations	Minimum standards for the control of soil erosion, sediment deposition, and runoff and requires that an erosion and sediment control plan be prepared and submitted for activities that disturb the land	Applies to development projects disturbing more than 1 acre of land with the potential for soil erosion, sediment deposition or runoff	4 VAC 50-30-10 to 110	Potentially applicable. Activities associated with the site may include disturbing more than one acre of land. Erosion controls will be required.

TABLE B-3 (Continued)
ACTION-SPECIFIC ARARS
LF SITE

ARAR/TBC	Requirement	Prerequisite	Citation	ARAR Determination
Occupational Safety and Health Standards, Code of Virginia 40.1-22				
Standards for protection of workers	The occupational safety or health standards shall apply to all employers and employees engaged in either construction work or construction related activities	Construction work	16 VAC 25-60-130 16 VAC 25-170-20	Potentially applicable. Activities associated with the site may involve construction activities. Controls will be required to protect workers.

APPENDIX C

CALCULATIONS FOR REMEDIAL COSTS

ORDER OF MAGNITUDE COST ESTIMATE FOR GROUNDWATER MONITORING

- Alternative 1

SAMPLING PLAN

$12,000

SAMPLING/ANALYSIS/REPORTING

Minimal sampling to verify groundwater modeling
4 wells, annually, 10 years
Full scan - $1500/well
Cost breakdown – sampling/reporting 2.5 x analytical

- Alternatives 2, 3 and 4

SAMPLING PLAN

$12,000

SAMPLING/ANALYSIS/REPORTING

Long-term monitoring program – 10 years
8 wells, quarterly, 2 years
4 wells, semi-annually, 2 years
4 wells, annually, 6 years
Full scan - $1500/well
Cost breakdown – sampling/reporting 2.5 x analytical

ORDER OF MAGNITUDE COST ESTIMATE FOR SOIL COVER - Alternative 3

SOIL CHARACTERIZATION

2 Field Techs, 20 hours each

SOIL COVER

Unit Costs:	clear/grub	$6775/acre
	borrow material	$8.10/cubic yard
	haul	$7.85/cubic yard
	spread	$1.39/cubic yard
	compact	$0.20/cubic yard
	seed	$50/million sq feet

Total Clear and Grub Area = 7 acres
2 foot Cover,
Volume = 21000 cubic yard fill
50% allowance for fissures/low areas
Total Volume = 150% x 21000 cubic yard = 32000 cubic yard
Site Manager, 60 days, 10 hours/day

Activity	Unit Cost	Unit	Quantity	Total
Soil Characterization	$38	hr	40	$1520
Clear and Grub	$6,775	acre	7	$47,425
Borrow	$8.10	cy	32000	$259,200
Haul	$7.85	cy	32000	$251,200
Spread	$1.39	cy	32000	$44,480
Compact	$0.20	cy	32000	$6400
Seed	$50	MSF	290	$14,500
Survey				$15,000
			Construction Total	**$639,725**
Site Manager	$73.00	hr	600	$43,800
Project Manager	10%		$639,725	$63,973
Engineering/Administration	10%		$639,725	$63,973
			Subtotal	$811,471
Contingency	15%		$811,471	$121,721
			TOTAL	**$933,192**

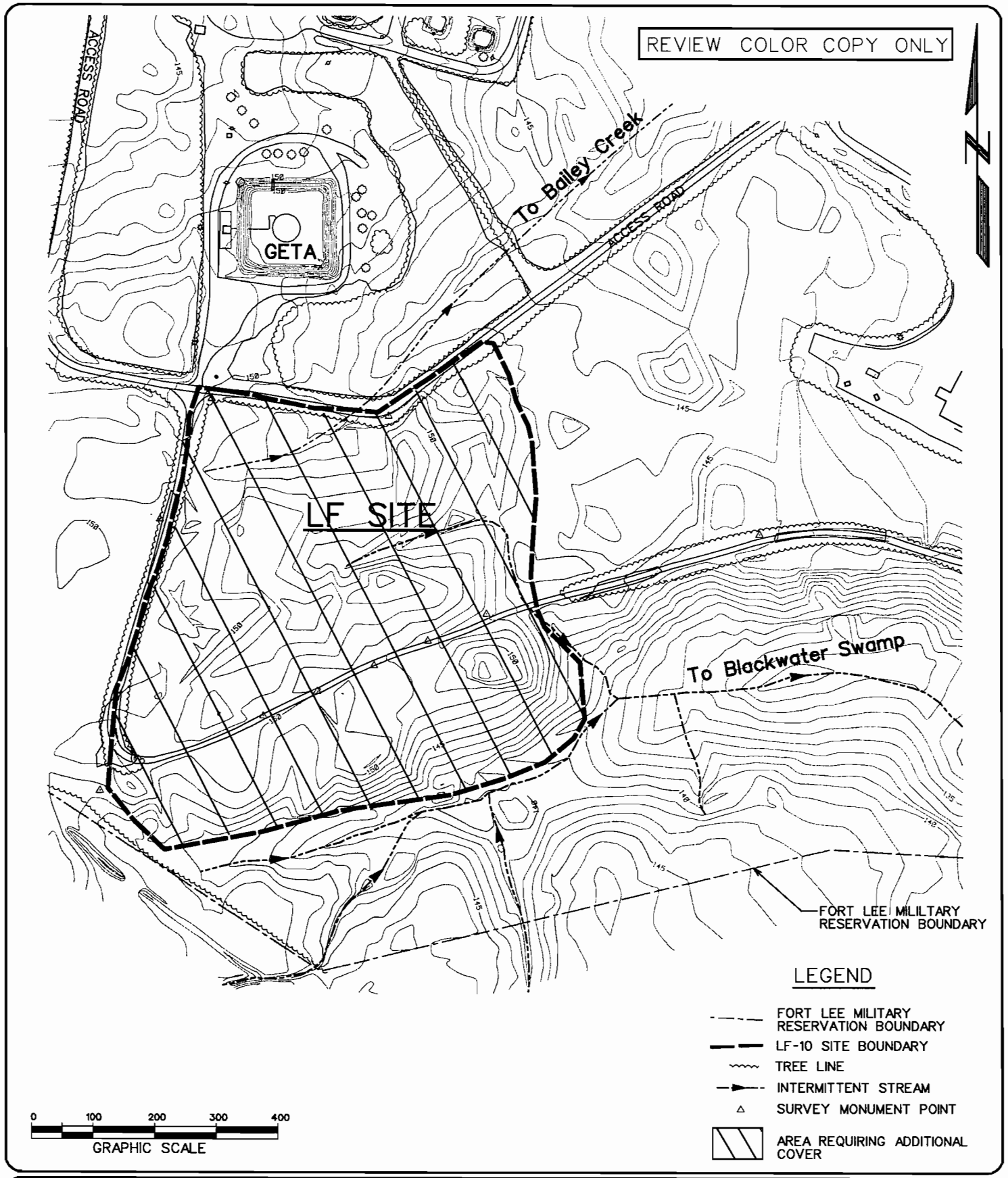
ORDER OF MAGNITUDE COST ESTIMATE FOR SOIL COVER - Alternative 4

SOIL COVER

Unit Costs:	clear/grub	$6775/acre
	borrow material	$8.10/cubic yard
	haul	$7.85/cubic yard
	spread	$1.39/cubic yard
	compact	$0.20/cubic yard
	seed	$50/million sq feet

Total Area = 10 acres = 435 MSF
Total Clear and Grub Area = 10 acres
2 foot Cover,
Volume = 32225 cubic yard fill
50% allowance for fissures/low areas
Total Volume = 150% x 32225 cubic yard = 48337 cubic yard
Site Manager, 60 days, 10 hrs/day

Activity	Unit Cost	Unit	Quantity	Total
Clear and Grub	$6,775.00	acre	10	$67,750
Borrow	$8.10	cy	48337	$391,530
Haul	$7.85	cy	48337	$379,445
Spread	$1.39	cy	48337	$67,188
Compact	$0.20	cy	48337	$9,667
Seed	$50.00	MSF	435	$21,750
Survey				$15,000
			Construction Total	**$952,330**
Site Manager	$73.00	hr	600	$43,800
Project Manager	10%		$952,330	$95,233
Engineering/Administration	10%		$952,330	$95,233
			Subtotal	**$1,186,596**
Contingency	15%		$1,168,596	$177,989
			TOTAL	**$1,364,585**



DRAWN BY JUDSON MITCHELL	DATE 8/10/99
REVISED BY	DATE
APPROVED BY ASHLEY SAPYTA	DATE 8/10/99

FLUOR DANIEL

ENGINEERING

GREENVILLE SOUTH CAROLINA

TITLE

SOIL COVER REQUIREMENTS
ALTERNATIVE 3
LANDFILL 10 (LF) SITE
FORT LEE, VIRGINIA

FIGURE NO. C-1	REV. 0

fig-c-2.dgn