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NWS EARLE
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FINAL DESIGN SUBMISSION REMEDIAL ACTION AT OPERABLE UNIT 1 (OU 1) SITE 4 AND SITE 5 VOLUME 1 OF 3 NWS EARLE NJ
11/1/1997
BROWN AND ROOT ENVIRONMENTAL

Final Design Submission
Remedial Action at
Operable Unit 1 (Sites 4 and 5)

Naval Weapons Station Earle
Colts Neck, New Jersey

Northern Division
Naval Facilities Engineering Command
Contract Number N62472-90-D-1298
Contract Task Order 0289

November 1997

Volume I of III

Brown & Root Environmental

A Division of Halliburton NUS Corporation

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November 7, 1997

Project Number 7602

Mr. Robert Marcolina
New Jersey Department of Environmental Protection
Bureau of Federal Case Management
401 East State Street, CN 028
Trenton, New Jersey 08625

Reference: CLEAN Contract No. N62472-90-D-1298
Contract Task Order 0289

Subject: Design Development Submission
OU-1 Cap Design
Naval Weapons Station Earle
Colts Neck, NJ
Contract Task Order (CTO) No. 0289

Dear Mr. Marcolina:

The following documents have been forwarded to you for review and comment:

1. Drawings (3 Copies)

2. Specifications (3 Copies)

3. Design Analysis Report (3 Copies)

Please review the attached documents and forward comments as appropriate. Comments are to be submitted to Northern Division, Code 05, by close of business Monday, December 8, 1997.

Facsimile transmission of review comments is encouraged. Northern Division, Code 05, facsimile number is (215) 897-6463.

Sincerely,

Michael J. Wierman, P.E.
Project Manager

Enclosure

c: Northern Division Code 182/JK (John Kolicius) (w/o enclosure)
Northern Division Code 402A/PB (Paul Briegel) (w/o enclosure)
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NWS Earle Code 096/GG (Greg Goepfert) (2 copies)
NWS Earle Code 09A/TD (Thomas Dunn) (2 copies)
Sharon Jaffess, EPA Region II (2 copies)
Arthur Holcomb, Foster Wheeler Env. Corp. (1 copy)

Design Analysis Report
for
Final Design Submission Remedial Action at Operable Unit 1 (Sites 4 and 5)

Naval Weapons Station Earle
Colts Neck, New Jersey

Northern Division
Naval Facilities Engineering Command
Contract Number N62472-90-D-1298
Contract Task Order 0289

November 1997

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DESIGN ANALYSIS REPORT
FOR
FINAL DESIGN SUBMISSION
REMEDIAL ACTION AT
OPERABLE UNIT 1 (SITES 4 AND 5)

NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

Submitted to:
Northern Division
Environmental Branch Code 18
Naval Facilities Engineering Command
10 Industrial Highway, Mail Stop #82
Lester, Pennsylvania 19113-2090

Submitted by:
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600 Clark Avenue, Suite 3
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CONTRACT NUMBER N62472-90-D-1298
CONTRACT TASK ORDER 0289

November 1997

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1.0 INTRODUCTION

1.1 PURPOSE AND SCOPE

The purpose of the Design Analysis Report (DAR) is to provide the basis of design for remedial actions at Operable Unit 1 (OU-1) at the Naval Weapons Station Earle (NWS Earle), in Colts Neck, New Jersey. This DAR was prepared by Brown and Root Environmental (B&R Environmental) under the Comprehensive Long-Term Environmental Action Navy (CLEAN) Program, Contract No. N62472-90-D-1298, Contract Task Order 0289.

1.2 BACKGROUND

NWS Earle is located in Monmouth County, New Jersey, approximately 47 miles south of New York City. Sites 4 and 5, which comprise OU-1, were historically used by the Navy for disposal of municipal and industrial wastes. After disposal activities at each of these sites were discontinued, each site was graded and revegetated.

A series of remedial investigations were conducted to determine the nature and extent of contamination at Sites 4 and 5. The results of these investigations concluded that groundwater in the vicinity of each site was impacted by metals and organic compounds. A feasibility study was later conducted for Sites 4 and 5 to determine potential remedial actions for the sites. The selected remedial action for Sites 4 and 5 were presented in the Proposed Plan for OU-1, dated March 1997. The Proposed Plan selected capping as the preferred remedial alternative, consistent with the EPA presumptive remedy for municipal landfills at military installations. The Record of Decision for OU-1, dated July 1997, selected capping as the remedial action for Sites 4 and 5. Proposed remedial actions at Sites 4 and 5 included the following components:

- Installation of a low permeability cap at each site to reduce rainwater infiltration and associated leachate generation, promote surface water drainage, and provide isolation of the waste materials from humans and the surrounding environment.

- Implementation of institutional controls to restrict future use of each site as well as impacted groundwater associated with each site.

- Implementation of long-term periodic monitoring to assess contaminant status and to determine when remedial action objectives are achieved.

The purpose of the DAR is to summarize and present the results of activities related to design of landfill caps for Sites 4 and 5. The Environmental Permits Report and the Erosion and Sediment Control Plan have also been prepared and are submitted under separate cover.

1.3 DESIGN ANALYSIS REPORT ORGANIZATION

The following highlights the information contained in each section of this Design Analysis Report.

- Section 1.0 provides an introduction and summary of the basis of design.
- Section 2.0 summarizes site characteristics, including site history, and surface/subsurface soil and hydrological characteristics, and remedial investigations of NWS Earle.
- Section 3.0 summarizes site characteristics including a site history, and surface/subsurface soil and hydrological characteristics, and remedial investigations at Site 4.
- Section 4.0 summarizes site characteristics including a site history, and surface/subsurface soil and hydrological characteristics, and remedial investigations at Site 5.
- Section 5.0 summarizes the results of the Pre-Design Investigation.
- Section 6.0 summarizes design requirements for the remedial action.

2.0 NWS EARLE

2.1 BACKGROUND

NWS Earle is located in Monmouth County, New Jersey, approximately 47 miles south of New York City. The station consists of two areas, the 10,248-acre Main Base (Mainside area), located inland, and the 706-acre Waterfront area (Figure 2-1). The two areas are connected by a Navy-controlled right-of-way.

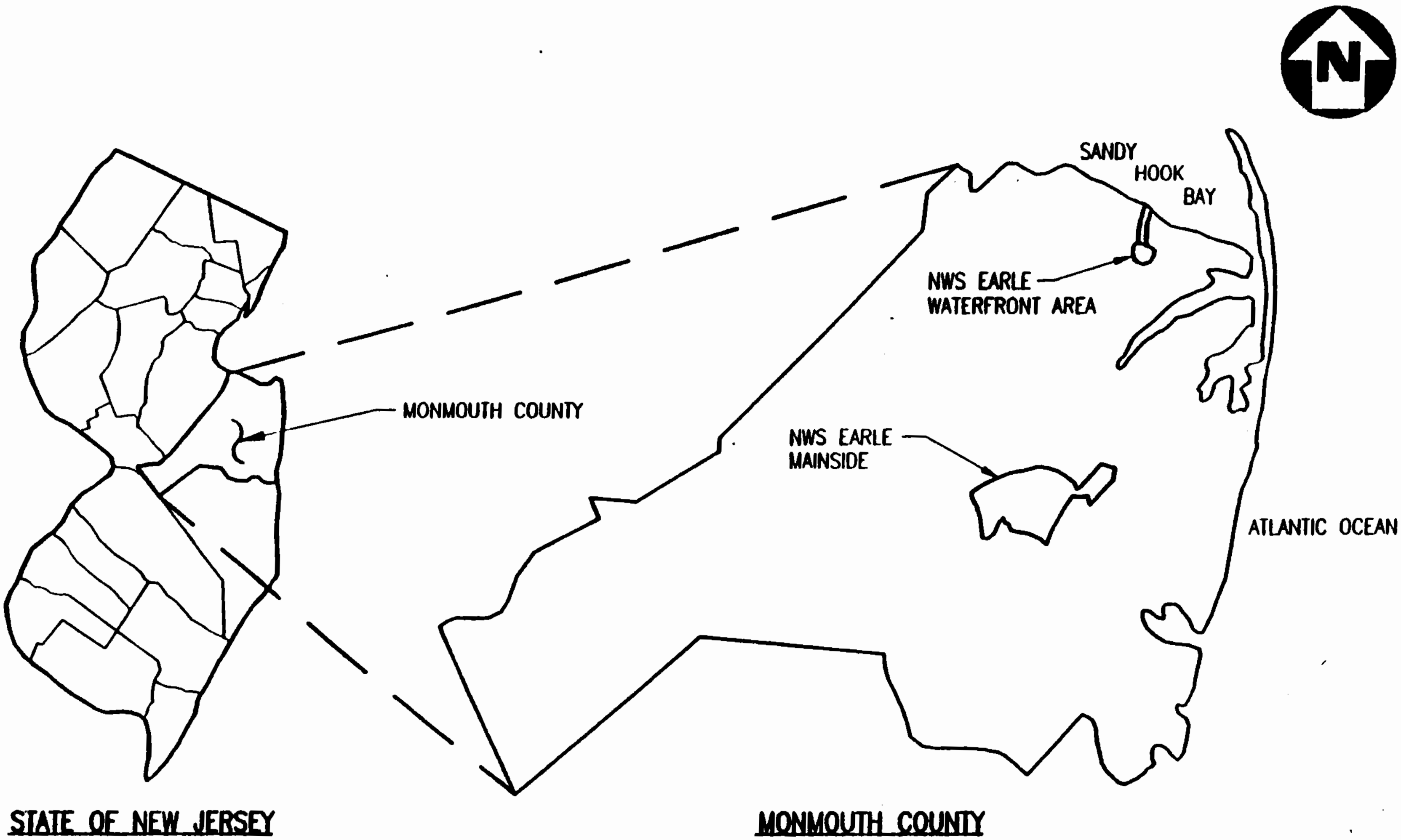
The facility was commissioned in 1943, and its primary mission is to supply ammunition to the naval fleet. An estimated 2,500 people either work or live at the NWS Earle station.

The Mainside area is located approximately 10 miles inland from the Atlantic Ocean at Sandy Hook Bay in Colts Neck Township, which has a population of approximately 6,500 people. The surrounding area includes agricultural land, vacant land, and low-density housing. The Mainside area consists of a large, undeveloped portion associated with ordnance operations, production, and storage; this portion is encumbered by explosive safety quantity distance arcs. Other land use in the Mainside area consists of residences, offices, workshops, warehouses, recreational space, open space, and undeveloped land. The Waterfront area is located adjacent to Sandy Hook Bay in Middletown Township, which has a population of approximately 68,200 people. The Mainside and Waterfront areas are connected by a narrow strip of land which serves as a government-controlled right of way containing a road and railroad.

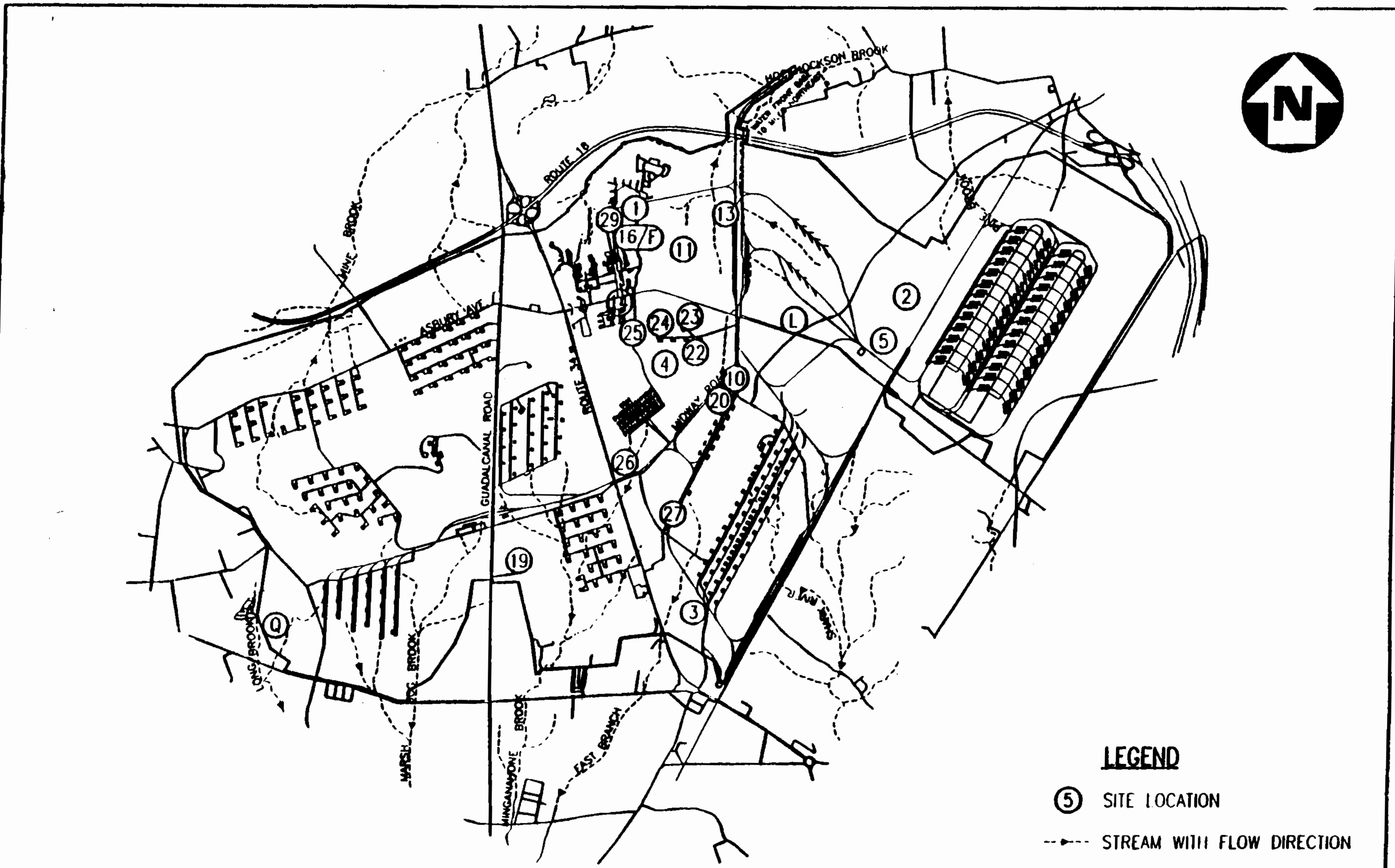
Operable Unit 1 (OU-1) consists of two former landfills located in the Mainside area (Figure 2-2): the landfill west of "D" group (Site 4) and the landfill west of the Army barricades (Site 5). The OU-1 sites were grouped together based on similarities of waste volumes, types of contaminants, and the potential for contaminants to migrate to human and/or environmental receptors.

2.2 SUMMARY OF SITE CHARACTERISTICS

NWS Earle is located in the coastal lowlands of Monmouth County, New Jersey, within the Atlantic Coastal Plain Physiographic Province. The Mainside area, which includes OU-1, lies in the outer Coastal Plain, approximately 10 miles inland from the Atlantic Ocean. The Mainside area is relatively flat, with elevations ranging from approximately 100 to 300 feet above mean sea level (MSL). The most significant topographic relief within the Mainside area is Hominy Hills, a northeast-southwest-trending group of low hills located near the center of the station.



DRAWN BY MRM DATE 1/7/97	Brown & Root Environmental	CONTRACT NO.	OWNER NO.
CHECKED BY RET DATE 1/7/97	REGIONAL SITE MAP	APPROVED BY	DATE
COST/SCHED.-AREA	NAVAL WEAPONS STATION EARLE	APPROVED BY	DATE
SCALE NOT TO SCALE	COLTS NECK, NEW JERSEY	DRAWING NO. FIGURE 2-1	REV.



0 5,000 10,000
SCALE IN FEET

DRAWN BY	DATE	Brown & Root Environmental	CONTRACT NO.	OWNER NO.
MRM	1/7/97	MAINSIDE SITE LOCATIONS	APPROVED BY	DATE
CHECKED BY	DATE	NAVAL WEAPONS STATION EARLE	APPROVED BY	DATE
RET	1/7/97	COLTS NECK, NEW JERSEY		
COST/SCHED.-AREA			DRAWING NO. FIGURE 2-2	REV
SCALE 1" = 5000'				

The rivers and streams draining NWS Earle ultimately discharge to the Atlantic Ocean, which is approximately 9 or 10 miles east of the Mainside area. The headwaters and drainage basins of three major Coastal Plain rivers (Swimming, Manasquan, and Shark) originate on the Mainside area. The northern half of the Mainside is in the drainage basin of the Swimming River, and tributaries include Mine Brook, Hockhockson Brook, and Pine Brook. The southwestern portion of the Mainside drains to the Manasquan River via either Marsh Bog Brook or Mingamahone Brook. The southeastern corner of the Mainside drains to the Shark River. Both the Swimming River and the Shark River supply water to reservoirs used for public water supplies.

NWS Earle is situated in the Coastal Plain Physiographic Province of New Jersey. The New Jersey Coastal Plain is a seaward-dipping wedge of unconsolidated Cretaceous to Quaternary sediments that were deposited on a pre-Cretaceous basement-bedrock complex. The Coastal Plain sediments are primarily composed of clay, silt, sand, and gravel and were deposited in continental, coastal, and marine environments. The sediments generally strike northeast-southwest and dip to the southeast at a rate of 10 to 60 feet per mile. The approximate thickness of these sediments beneath NWS Earle is 900 feet. The pre-Cretaceous complex consists mainly of PreCambrian and lower Paleozoic crystalline rocks and metamorphic schists and gneisses. The Cretaceous to Miocene Coastal Plain Formations are either exposed at the surface or subcrop in a banded pattern that roughly parallels the shoreline. The outcrop pattern is caused by the erosion truncation of the dipping sedimentary wedge. Where these formations are not exposed, they are covered by essentially flat-lying post-Miocene surficial deposits.

Groundwater classification areas were established in New Jersey under New Jersey Department of Environmental Projection (NJDEP) Water Technical Programs Groundwater Quality Standards in New Jersey Administrative Code (N.J.A.C.) 7:9-6. The Mainside area is located in the Class II-A: Groundwater Supporting Potable Water Supply area. Class II-A includes those areas where groundwater is an existing source of potable water with conventional water supply treatment or is a potential source of potable water. In the Mainside area, in general, the deeper aquifers are used for public water supplies and the shallower aquifers are used for domestic supplies.

OU-1 is situated in the recharge area of the Kirkwood-Cohansey aquifer system. The Kirkwood-Cohansey aquifer system is a source of water in Monmouth County and is composed of the generally unconfined sediments of the Cohansey Sand and Kirkwood Formation. The Kirkwood-Cohansey aquifer system has been reported in previous investigations as being used for residential wells in the Mainside area. Along the coast, this aquifer system is underlain by thick diatomaceous clay beds of the Kirkwood Formation.

All facilities located in the Mainside Administration area are connected to a public water supply (New Jersey American Water Company). Water for the public supply network comes from surface water intakes, reservoirs, and deep wells. No public water supply wells or surface water intakes are located on the NWS Earle facility. A combination of private wells and public water supply from the New Jersey American Water Company serves businesses and residences in areas surrounding the Mainside facilities. There are a number of private wells located within a 1-mile radius of NWS Earle and several within the NWS Earle boundaries. The majority of these wells are used for potable supplies; previous testing for drinking water parameters indicates these wells have not been adversely impacted.

There is a rich diversity of ecological systems and habitats at NWS Earle. Knieskern's beaked-rush (Rynchospora knieskernii), a sedge species, has been seen on the station, and the swamp pink (Helonias bullata), may be present; both of these species are on the federal and state endangered species lists. An osprey has visited Mainside and may nest in another area at NWS Earle. The Mingamahone Brook supports bog turtles downstream of the Mainside area and provides an appropriate habitat for them at the Mainside area.

2.3 SUMMARY OF REMEDIAL INVESTIGATIONS

Potential hazardous substance releases at NWS Earle were addressed in an Initial Assessment Study (IAS) in 1982, a Site Inspection Study (SI) in 1986, and a Phase I Remedial Investigation (RI) in 1993. These were preliminary investigations to determine the number of sources, compile histories of waste-handling and disposal practices at the sites, and acquire data on the types of contaminants present and potential human health and/or environmental receptors. The RI at Sites 4 and 5 included the installation and sampling of monitoring wells, collection of surface water and sediment samples, and excavation of test pits to observe wastes and sample subsurface soils.

In 1990, NWS Earle was placed on the National Priorities List (NPL), which is a list of sites where uncontrolled hazardous substance releases may potentially present serious threats to human health and the environment. The sites at NWS Earle were then addressed by Phase II RI activities to determine the nature and extent of contamination at these sites. Activities included installation and sampling of groundwater monitoring wells, surface water and sediment sampling, and surface and subsurface soil sampling. The Phase II RI was initiated in 1995 and completed in July 1996, when the final Phase II RI report was released.

The results of the RI were used as the basis for performing a feasibility study (FS) of potential remedial alternatives. The Navy and EPA, in consultation with NJDEP, developed the proposed remedial action plan (Proposed Plan). The Proposed Plan, dated March 1997, selected capping as the preferred remedial alternative for OU-1. A Record of Decision (ROD), dated July 1997, was later issued for OU-1 and included capping as the final remedial action for Sites 4 and 5.

3.0 SITE 4 - LANDFILL WEST OF "D" GROUP

3.1 SITE DESCRIPTION

Site 4 is a 5-acre landfill that received approximately 10,200 tons of mixed domestic and industrial wastes from 1943 until the late 1960s. Disposed materials include metal scrap, construction debris, pesticide and herbicide containers, paint residues, and rinsewaters. It has been reported that containers of paint, paint thinners, varnishes, shellacs, acids, alcohols, caustics, and asbestos may have been disposed. The landfilled materials are currently covered by a thin layer of sandy soil.

Figure 3-1 depicts the location of Site 4 as well as other features such as monitoring wells and sampling locations. Figure 3-1 depicts the approximate boundary of the landfill, based on review of aerial photographs and other historical information.

An eight inch water line parallels the dirt road to the east of Site 4. An six inch lateral extends from this water line into the Site 4 landfill area. Historic drawings indicate that this lateral line serviced a fire hydrant located in Site 4. The historical drawings also indicate an elevation of the fire hydrant well above present ground surface elevation of the landfill. It is unlikely that this line is in service. The exact location of the lateral water line is not known although part of the line is exposed east of the landfill.

3.2 GEOLOGY

Regional mapping places Site 4 within the outcrop area of the Cohansey Sand. The Cohansey Sand ranges between 0 and 30 feet in thickness and the soil borings are no more than 35 feet deep. The lithology of the sediments encountered in the on-site borings generally agrees with the published description of the Cohansey Sand. The thickness of the sediments penetrated in the on-site borings indicates the Cohansey Sand may have a regional thickness of greater than 30 feet. In general, the borings encountered alternating beds of light-colored, silty, fine- to coarse-grained sand with varying amounts of gravel. A 0.5-foot reddish-yellow clay seam was penetrated in one of the borings

3.3 SOILS

The soils covering Site 4 are mapped as PT or Pits, sand and gravel, according to the April 1989 Soil Survey of Monmouth County, New Jersey. This unit consists of areas that have been excavated for sand and gravel. Typically, these areas consist of sandy material and differing amounts of gravel and

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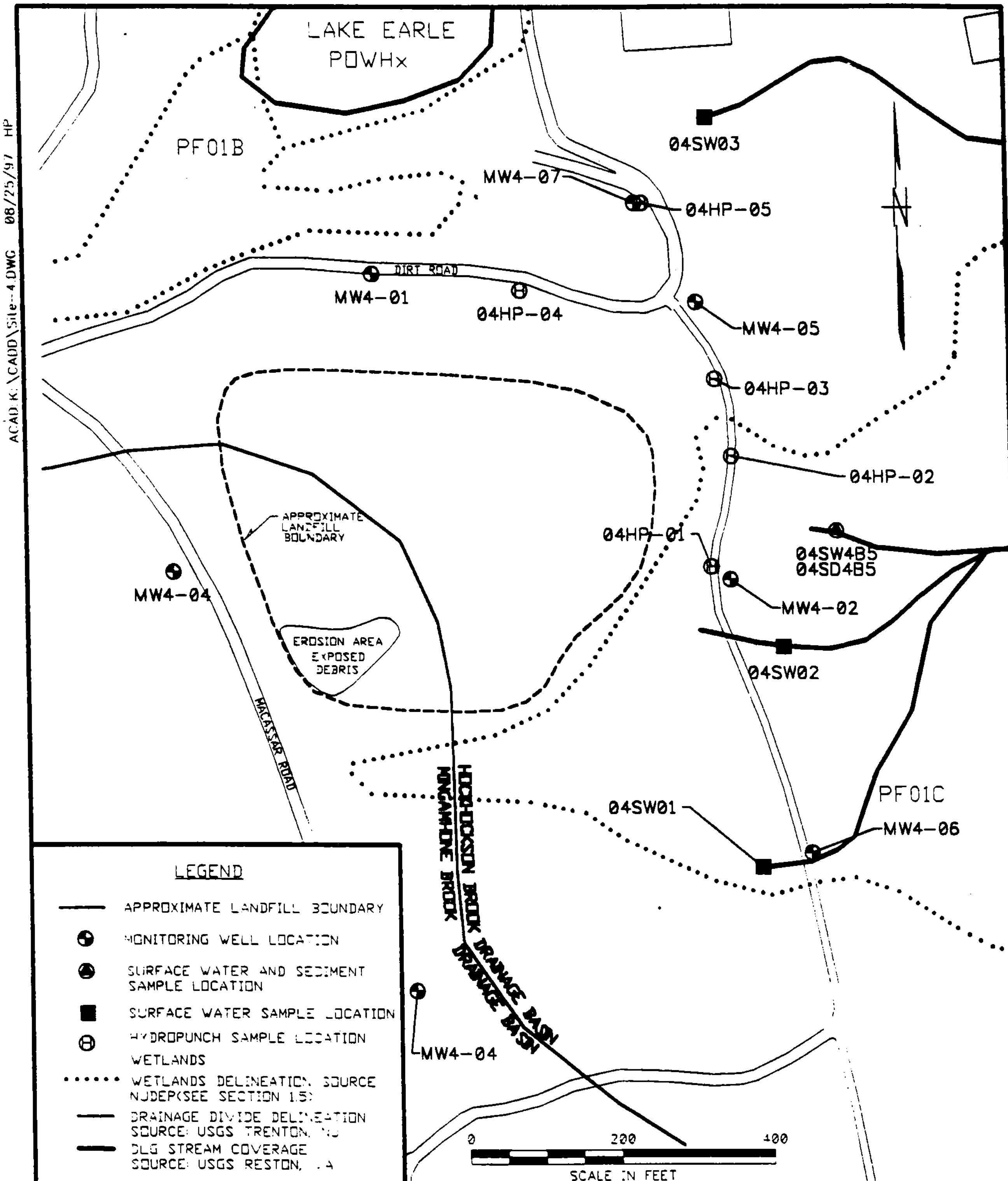


DRAWN BY HJP / DATE 8/25/97	Brown & Root Environmental	CONTRACT NO. 7602	OWNER NO.
CHECKED BY / DATE	SITE 4 LANDFILL WEST OF "D" GROUP NAVAL WEAPONS STATION EARLE COLTS NECK, NEW JERSEY	APPROVED BY / DATE	
COST/SCHED-AREA		APPROVED BY / DATE	
SCALE AS NOTED		DRAWING NO. FIGURE 3-1	REV. 0

fragments of iron-cemented sandstone. A few abandoned pits, such as the one at Site 4, have been used as landfills or dumps. The properties and characteristics of this map unit differ greatly from place to place.

Boring logs, completed during field activities at the site, indicate that the surface and shallow subsurface soil is comprised of silty, fine-grained sand with some clay. The soil's consistency is generally loose to medium dense and the soil is orange-brown to gray-brown in color.

The soil covering areas south and west of Site 4 belong to the Atsion and Lakewood series (USDA, 1989). Atsion series soils, mapped as Atsion sand, are nearly level, poorly drained soil in depressional areas and on broad flats. These soils formed in acid, sandy, Coastal Plain sediments. Permeability of the Atsion sand is moderately rapid or rapid in the subsoil and rapid in the substratum. The available water capacity is low. Runoff is very slow and erosion is a slight hazard. Most areas with this soil are wooded. Common species of trees include pitch pine, black gum, and red maple. The surface layer of the Atsion series is approximately 8 inches thick. The layer contains 2 inches of partly decomposed organic material and roots and 6 inches of black sand. The subsurface soil is grayish brown sand 14 inches thick. These soil characteristics generally correspond to the soil encountered during boring activities at Site 4.

The Lakewood series consists of excessively drained soils on uplands. These soils were also formed in acid, sandy, Coastal Plain sediments. The mapping unit identified within the Lakewood series adjacent to Site 4 is the Lakewood sand, 5 to 10 percent slopes (USDA, 1989). Permeability of this sand is rapid in the subsoil and moderate to rapid in the substratum. The available water capacity is low and runoff is slow. The water erosion hazard is moderate, but the wind erosion hazard is severe. Most areas with this soil are wooded. Common species of trees found in Lakewood sand include pitch pine, shortleaf pine, chestnut oak, black oak, and Virginia pine. The surface layer is 4 inches thick. The uppermost inch is dark, brown, matted, decomposed organic material, and below that is light brownish gray sand 10 inches thick. The subsurface soil of the Lakewood series is light brownish gray sand 10 inches thick. These soil characteristics generally correspond to the soil encountered during boring activities at Site 4.

The areas north and east of Site 4 are classified as Udorthents (UA). This unit consists of areas of soils that have been altered by excavating or filling. Udorthents consist of well drained to somewhat poorly drained soils that have no horizonation. These soils formed in stratified or graded, sandy or loamy fill material that has as much as 35 percent gravel by volume. Slope ranges from 0 to 3 percent.

3.4 HYDROGEOLOGY

OU-1 is situated in the recharge area of the Kirkwood-Cohansey aquifer system. The Kirkwood-Cohansey aquifer system is a source of water in Monmouth County and is composed of the generally unconfined sediments of the Cohansey Sand and Kirkwood Formation. The Kirkwood-Cohansey aquifer system has been reported in previous investigations as being used for residential wells in the Mainside area. Along the coast, this aquifer system is underlain by thick diatomaceous clay beds of the Kirkwood Formation.

Groundwater in the Cohansey aquifer beneath the site occurs under unconfined conditions. Static-water-level measurements and water-table elevations were recorded in August and October 1995. Groundwater contour maps are presented in Figure 3-2 (August 1995) and Figure 3-3 (October 1995). The direction of shallow groundwater flow in the aquifer is toward the east and east-southeast. There does not appear to be a significant seasonal variation in groundwater flow direction. The hydraulic conductivity calculated for MW4-04 is 4.48×10^{-4} cm/sec (1.27 ft/day).

3.5 SURFACE WATER HYDROLOGY

Site 4 is covered with a pine tree plantation, open space dominated by tall grass, and some bare areas. Site 4 is surrounded by woodlands. The ground surface slopes downward to the southeast from approximately 170 feet above mean sea level (MSL) near MW4-01 to approximately 150 feet above MSL at MW4-06. A broad, low-lying wetland extends from the eastern portion of Site 4 beyond the unpaved boundary road. Surface water flow is to the east and east-southeast toward the wetland. The southern boundary of the landfill at Site 4 parallels a drainage course which discharges into the wetlands located along the southeast corner of the landfill.

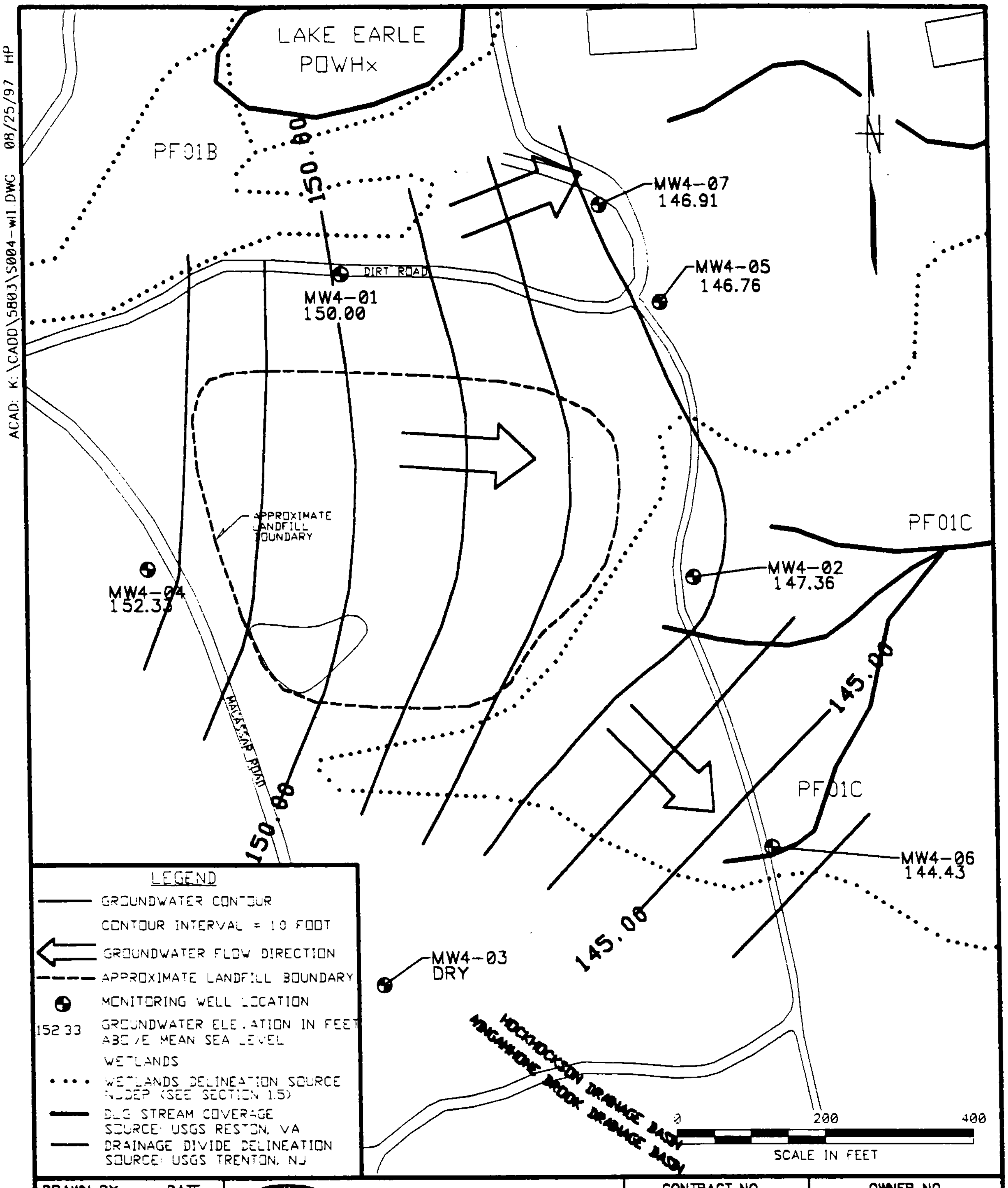
3.6 SUMMARY OF REMEDIAL INVESTIGATIONS

3.6.1 IAS and SI Results

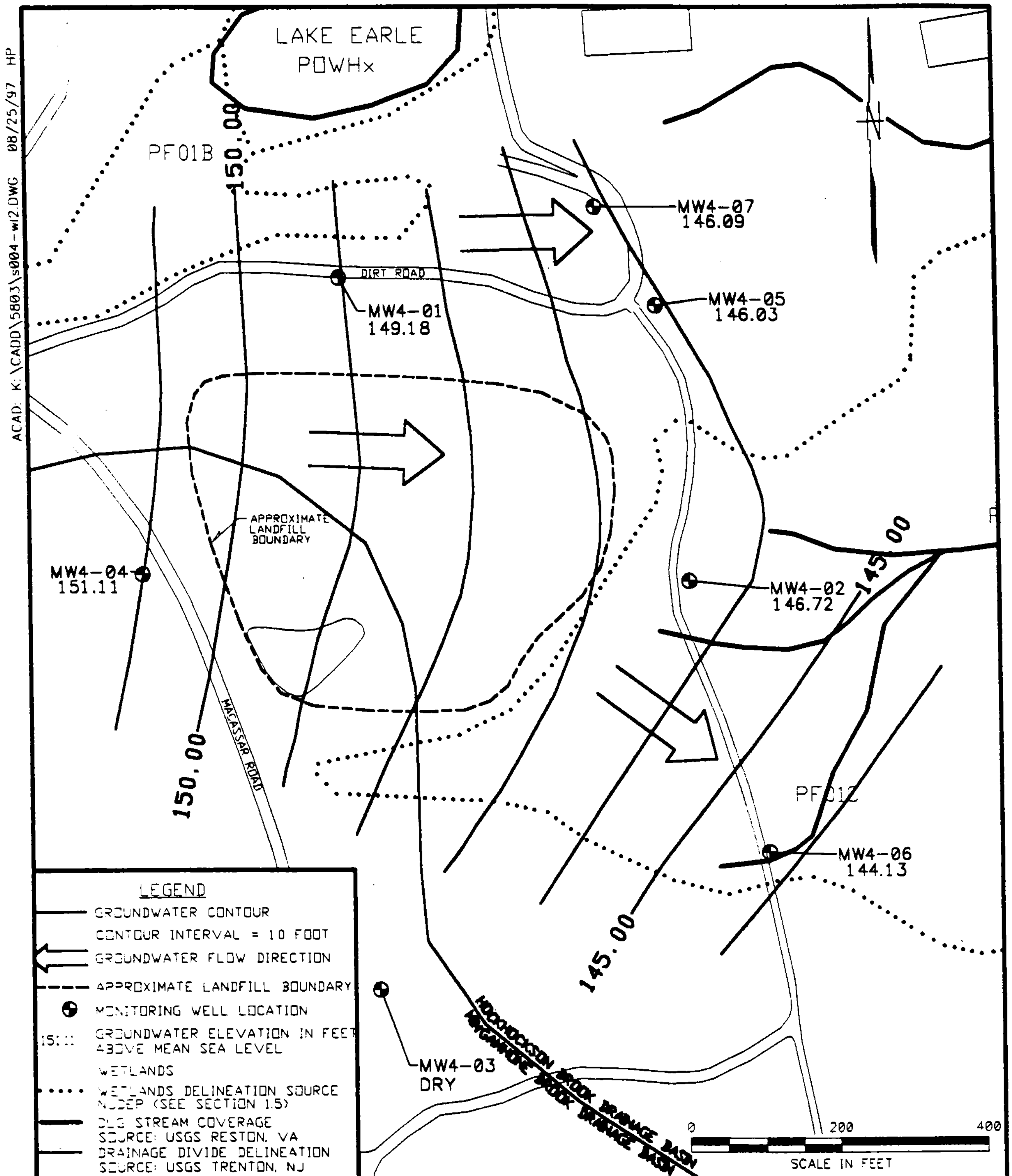
The IAS determined that hazardous materials were potentially present and could impact groundwater. The SI detected low levels of volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), polychlorinated biphenyl (PCB), and metals in sediment samples receiving drainage from the site.

3.6.2 Phase I Remedial Investigation

During the Phase I RI, the laboratory results of groundwater samples detected VOCs, and subsurface soil samples detected elevated levels of a single pesticide and total petroleum hydrocarbons (TPH). Six test pits were excavated to characterize the waste materials in the landfill. The waste consisted primarily of metal



DRAWN BY HJP	DATE 8/25/97	Brown & Root Environmental	CONTRACT NO. 7602	OWNER NO.
CHECKED BY	DATE	GROUNDWATER CONTOURS MAP AUGUST 7, 1995 SITE 4 – LANDFILL WEST OF "D" GROUP NAVAL WEAPONS STATION EARLE COLTS NECK, NEW JERSEY	APPROVED BY	DATE
COST/SCHED-AREA			APPROVED BY	DATE
SCALE AS NOTED			DRAWING NO. FIGURE 3-2	REV. 0



DRAWN BY HJP	DATE 08/25/97	Brown & Root Environmental	CONTRACT NO. 7602	OWNER NO.
CHECKED BY	DATE	GROUNDWATER CONTOUR MAP OCTOBER 17, 1995 SITE 4—LANDFILL WEST OF "D" GROUP NAVAL WEAPONS STATION EARLE COLTS NECK, NEW JERSEY	APPROVED BY	DATE
COST/SCHED-AREA			APPROVED BY	DATE
SCALE AS NOTED			DRAWING NO. FIGURE 3-3	REV. 0

scrap such as steel banding, pipes, and empty metal trash barrels. Lumber, concrete, brick, and other construction debris were also encountered. No anomalous organic vapor readings were detected in any of the test pits.

3.6.3 Phase II Remedial Investigation

Results of the Phase II RI showed the presence of VOCs, including 1,2-dichloroethene (1,2-DCE) and trichloroethene (TCE), vinyl chloride (VC), and elevated levels of metals, including aluminum, iron, lead, and manganese in groundwater. Elevated levels of metals, including aluminum, iron, lead, and manganese, and trace levels of pesticides, including aldrin and dieldrin, were detected in surface water samples. A single SVOC, nitrobenzene, was also detected at an elevated level (66.0 ug/kg) in a sediment sample. Table 3-1 summarizes the results of samples taken from groundwater compared to applicable standards.

3.6.4 Groundwater Modeling

Computer modeling estimated that Site 4 groundwater metals concentrations would gradually diminish over time, assuming a source control measure, such as capping, would be implemented to control vertical migration. The model estimated that metals concentrations at the nearest potential discharge point, a stream located approximately 400 feet downgradient of Site 4, would be well below either the state standard or background levels. The maximum distance from Site 4 where metals concentrations in groundwater would remain above applicable regulatory standards or background levels, was estimated to be 55 feet by the model. Surface water samples taken from the watershed downgradient of Site 4 currently show no concentration of compounds above background or regulatory standards.

3.6.5 Summary

In summary, results of investigations at Site 4 indicate that:

- Metals found in groundwater at concentrations above New Jersey regulatory standards were limited to aluminum, iron, and manganese. There is no promulgated federal regulatory standard for these common groundwater constituents.

- Metals concentration results may be biased high for groundwater samples collected at Site 4 because of high sample endpoint turbidity values in four of the six samples taken.

- Modeling estimated that metals in groundwater will migrate only very little, and concentrations will diminish slowly with time.

TABLE 3-1

SITE 4 GROUNDWATER
NWS EARLE, COLTS NECK , NEW JERSEY

	Maximum Exceedances	Frequency of Eceedance	ARARs and TBCs			Data Exceeding ARARs					
			Maximum Contamination Level (MCL) (ug/L)	Drinking Water Health Advisory (Lowest Criterion Shown)	NJDEP Groundwater Quality Standard (ug/L)	04GW01 1995 RI 7/25/95	04GW02 1995 RI 7/26/95	04GW04 1995 RI 7/25/95	04GW05 1995 RI 7/25/95	04GW06 1995 RI 7/25/95	04GW07 1995 RI 8/22/95
INORGANICS (µg/L)											
Aluminum	2690	5/6	-	-	200	1590 J	923 J	1490 J	2690 J	578 J	
Iron	20900	4/6	-	-	300	554	20900		7680	647	
Manganese	306	1/6	-	-	50		306				
VOLATILES (µg/L)											
Trichloroethene	55	1/6	5	-	1				55		
Vinyl chloride	3	1/6	2	10e	5		3				

J = Value is estimated because the concentration is below the laboratory contract quantitation limit or because of data validation control quality criteria.
e = The listed health advisory, long-term child, is equal to the most stringent of the EPA health advisories for this chemical.

TCE, found in one monitoring well at a concentration greater than the EPA and New Jersey standard, and its degradation products, found approximately at (VC) or below (1,2-DCE) the regulatory standard, indicate that contaminants leaching from the limited source area are degrading with time and are not widely spread.

4.0 SITE 5 - LANDFILL WEST OF ARMY BARRICADES

4.1 SITE DESCRIPTION

The Site 5 landfill received approximately 6,600 tons of mixed domestic and industrial wastes between 1968 and 1978 (Figure 4-1). The landfill covers an aerial extent of approximately 8 acres. Figure 4-1 depicts the approximate boundary of the landfill, based on review of aerial photographs and other historical information.

Wastes which were disposed of at Site 5 included paper, glass, plastics, construction debris, pesticide and herbicide containers, containers of paint, paint thinners, varnishes, shellacs, acids, alcohols, caustics, and small amounts of asbestos. The landfill materials are currently covered by a sand and vegetated soil layer ranging in depth from 1 to 3 feet. Approximately 2.5 acres of the site is used as a skeet shooting range.

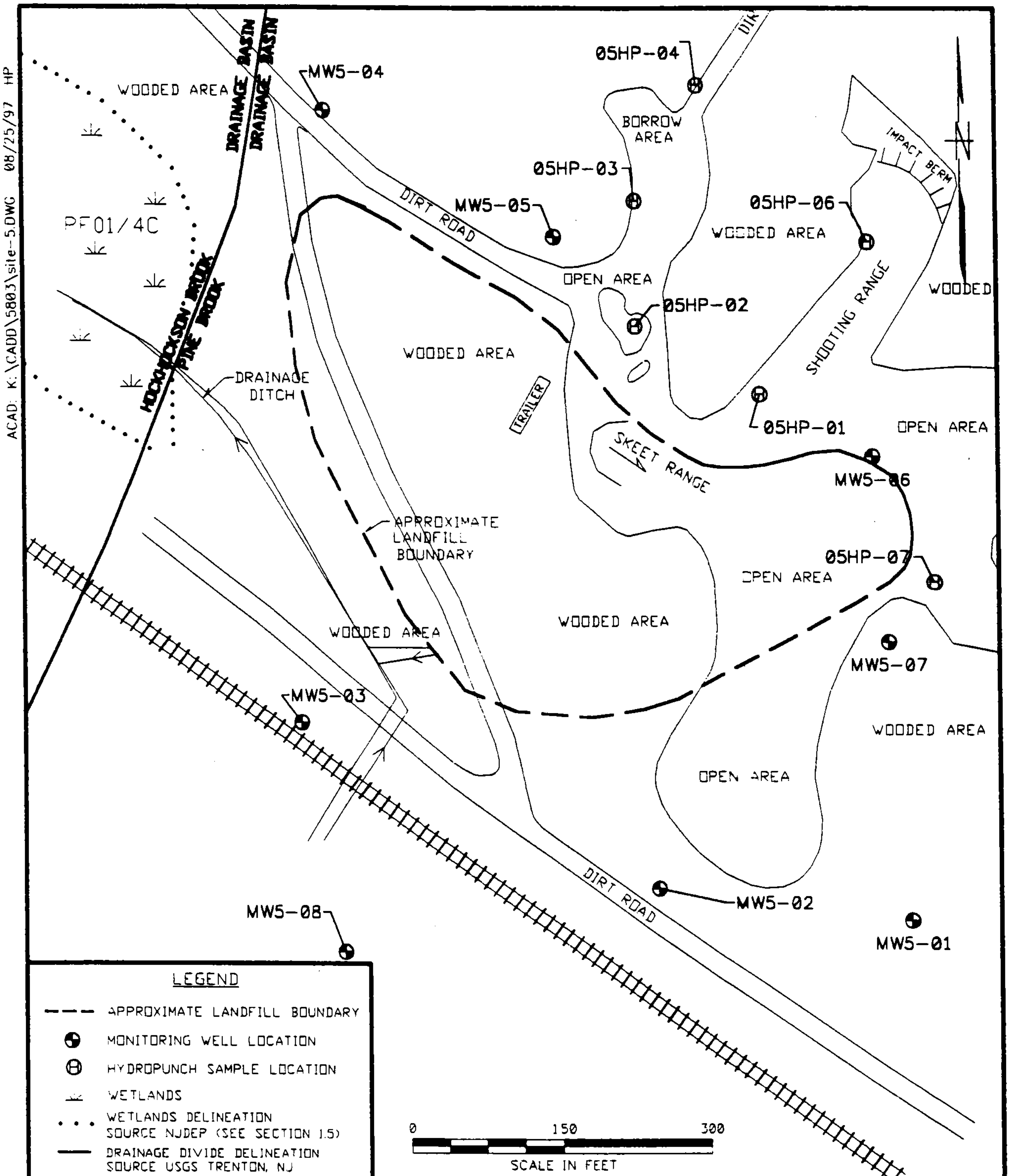
As shown on Figure 4-1 a trap/skeet shooting facility (Shooters Club) is located on top of the landfill at Site 5. The Shooters Club consists of concrete walkways to shooting stations, various small structures which house target throwing equipment, wooden light standards with the associated lights for night shooting, and other small ancillary items (gun racks, flagpole, etc.).

Also included at the facility is a clubhouse which consists of a mobile home ("Trailer" on Figure 4-1), approximately 60 feet by 12 feet and a wooden deck approximately the same size. Two large vaults are installed within the clubhouse and are used to store guns, ammunition, and related equipment used during shooting events. The clubhouse includes a sink and restroom facilities.

Electric service to the shooters club is provided by an underground electric line (100 Amp, single phase) which was trenched through the landfill and passes beneath the railroad tracks south west of the clubhouse. Underground electric lines run to the light poles and range equipment.

The clubhouse is also serviced by an underground telephone line which follow the main road into Site 5 (from the north west). The telephone line from the clubhouse extends to the explosive ordinance disposal (EOD) bunker, located to the north.

Potable water is supplied to the clubhouse by 5-gallon carboys from a local bottled water supplier. Water for non-potable uses is also available via a portable tank ('Water Buffalo") located adjacent to the clubhouse.



DRAWN BY HJP	DATE 08/25/97	Brown & Root Environmental	CONTRACT NO. 7602	OWNER NO.
CHECKED BY	DATE	SITE 5-LANDFILL WEST OF ARMY BARRICADES NAVAL WEAPONS STATION EARLE COLTS NECK, NEW JERSEY	APPROVED BY	DATE
COST/SCHED-AREA			APPROVED BY	DATE
SCALE AS NOTED			DRAWING NO. FIGURE 4-1	REV. 0

The clubhouse includes its own heating system, which is fired by propane. A propane storage tank is located adjacent to the clubhouse.

Wastewater from the clubhouse is treated by an existing on-lot septic system consisting of a septic tank and leach field.

A gravel parking area is located adjacent ot the clubhouse. Gravel and dirt roads are located within the landfill boundary, including the road to the trap/skeet range which turns and continues to the EOD bunker, and an access road crossing the landfill from the northwest to southeast .

Wetlands are located to the southwest of the landfill. No wetlands are located within the landfill.

Site 5 is located within the safety distance arc for the EOD range. When work is being performed at the EOD range (approximately 1,250 feet to the north), Site 5 must be vacated.

4.2 GEOLOGY

Regional mapping places Site 5 within the outcrop area of the Kirkwood Formation. The Kirkwood Formation ranges between 60 and 100 feet in thickness. The lithology of the soils encountered in the on-site borings (from previous remedial investigations) generally agrees with the published descriptions of the Kirkwood and Vincentown Formations. The on-site borings were no greater than 55 feet deep. Assuming a portion of the Kirkwood Formation was removed by erosion, it is possible that at least one of the soil borings penetrated the underlying Vincentown Formation. In general, the borings encountered brown and gray, very fine- to medium-grained sand and dark-colored silt (probably representative of the Kirkwood Formation) and olive and olive brown, slightly glauconitic, fine- to coarse-grained sand (probably representative of the Vincentown Formation). The Mainside area is located above the updip limit of the Piney Point, Shark River, and Manasquan Formations; therefore, the glauconitic sand is interpreted to be part of the Vincentown Formation.

4.3 SOILS

The soils covering Site 5 belong to 4 different series. The series include the Atsion, Keyport, Lakehurst, and Lakewood (USDA, 1989). Each series and the appropriate mapping unit that covers Site 5 are described in detail below.

Boring logs, completed during remedial investigation activities at the site, indicate that the surface and shallow subsurface soil is comprised of silty, fine-grained sand with some clay. The soil's consistency ranges from very loose to medium dense. The color of the surface and shallow subsurface soil varies between boring locations. Some soil is orange-brown to gray-brown in color, while others are dark brown to olive-brown.

Atsion series soils, mapped as Atsion sand, are nearly level, poorly drained soil in depressional areas and on broad flats. These soils formed in acid, sandy, Coastal Plain sediments. A minor portion of Site 5 is mapped as Atsion sand. Permeability of the sand is moderately rapid or rapid in the subsoil and rapid in the substratum. The available water capacity is low. Runoff is very slow and erosion is a slight hazard. Most of the areas of this soil are wooded. Common species of trees include pitch pine, black gum, and red maple. The surface layer of the Atsion series is approximately 8 inches thick. The layer contains 2 inches of partly decomposed organic material and roots and 6 inches of black sand. The subsurface soil is grayish brown sand 14 inches thick. These soil characteristics generally correspond to the soil encountered during boring activities at Site 5.

The Keyport series consists of moderately well drained soils on uplands. These soils formed in acid, clayey, Coastal Plain sediments. The mapping unit identified within the Keyport series at Site 5 is the Keyport sandy loam, 2 to 5 percent slopes (USDA, 1989). This unit covers a western portion of Site 5. It is a gently sloping, moderately well drained soil on low divides. Permeability of this soil is slow in the subsoil and the substratum. The available water capacity is high and runoff is medium. Erosion is a moderate hazard. The most common species of tree found in Keyport soil include yellow poplar, northern red oak, and American beech. Some areas of Keyport soil have pyritic clay in the substratum. If the clay is exposed during excavation and used as top soil, it will become extremely acid (pH about 2.5-3.0) and will not support vegetation. The surface soil is brown sandy loam 8 inches thick and the subsurface soil is yellowish brown silty clay loam 18 inches thick. These soil characteristics generally correspond to the soil encountered during boring activities at Site 5.

The Lakehurst series consists of moderately well drained and somewhat poorly drained soils on uplands. These soils were formed in acid, sandy Coastal Plain sediments. The mapping unit identified within the Lakehurst series at Site 5 is the Lakehurst sand, 0 to 2 percent slopes (USDA, 1989). This unit covers a limited portion of Site 5. It is a nearly level, moderately well drained and somewhat poorly drained soil in depressional areas and on low divides. Permeability of this sand is rapid in the subsoil and the substratum. The available water capacity is low and runoff is very slow. Water erosion hazard is slight, but wind erosion is a severe hazard. Most areas of this soil are woodland. The most common species of tree found in Lakehurst sand is the pitch pine. The surface layer is gray sand 4 inches thick. The subsurface layer is light gray sand 6 inches thick. These soil characteristics generally do not correspond to the soil encountered during boring activities at Site 5.

The Lakewood series consists of excessively drained soils on uplands. These soils were formed in acid, sandy, Coastal Plain sediments. The mapping unit identified within the Lakewood series at Site 5 is the Lakewood sand, 0 to 5 percent slopes (USDA, 1989). This unit covers a majority of Site 5. It is a nearly level and gently sloping, excessively drained soil on divides. Permeability of this sand is rapid in the subsoil and moderate to rapid in the substratum. The available water capacity is low and runoff is very slow. Water erosion hazard is slight, but wind erosion is a severe hazard. Common species of trees found in Lakewood sand include pitch pine, shortleaf pine, chestnut oak, black oak, and Virginia pine. The surface layer is 4 inches thick. The uppermost inch is dark brown, matted decomposed organic material, and below that it is dark grayish brown sand. The subsurface soil of the Lakewood series is light brownish gray sand 10 inches thick. These soil characteristics generally correspond to the soil encountered during boring activities at Site 5.

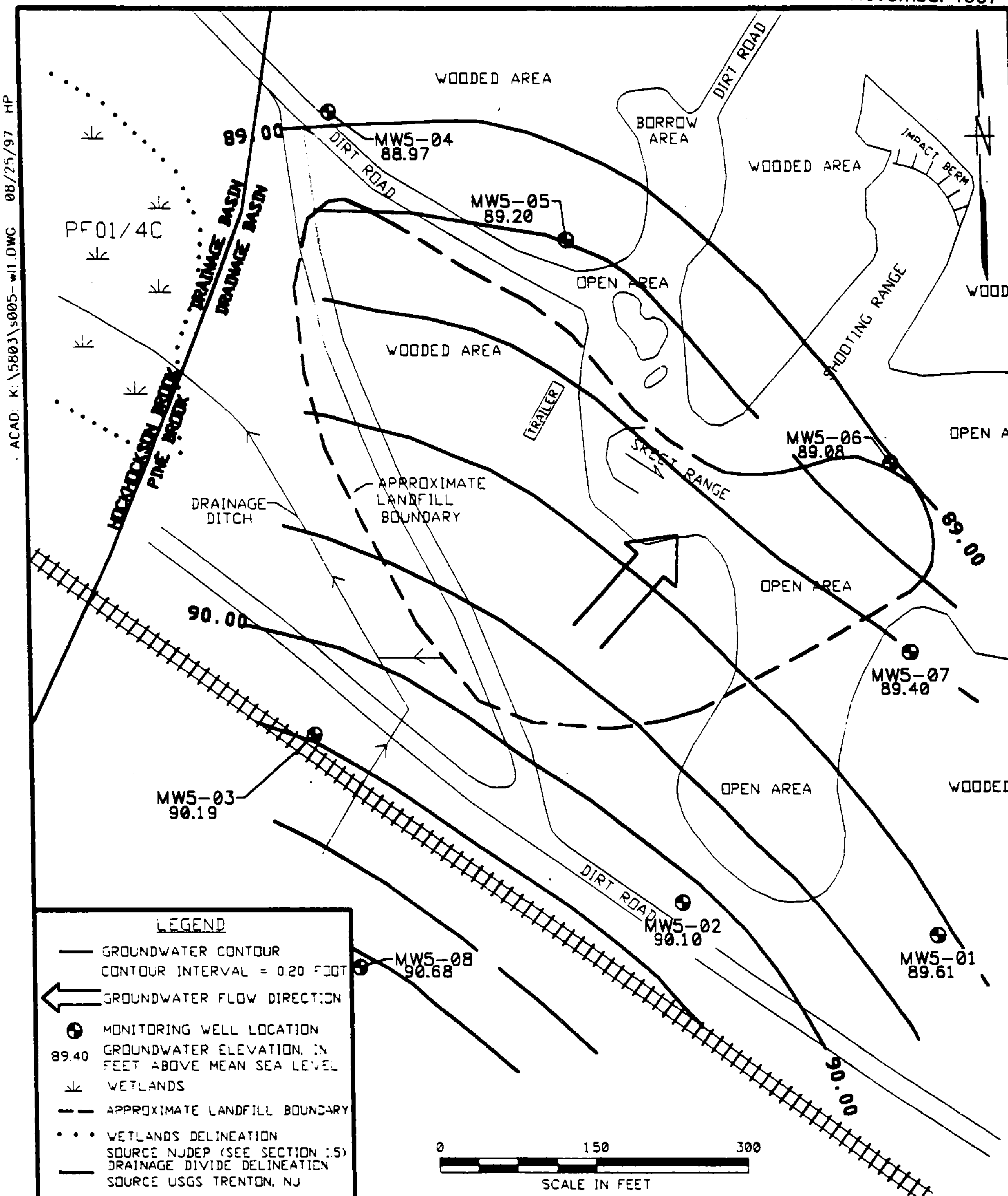
4.4 HYDROGEOLOGY

Based upon the boring log descriptions, well MW5-06 penetrated the Kirkwood Formation, wells MW5-02, MW5-03, MW5-05, MW5-07, and MW5-08 penetrated both the Kirkwood and Vincentown Formations, and wells MW5-01 and MW5-4 penetrated the Vincentown Formation.

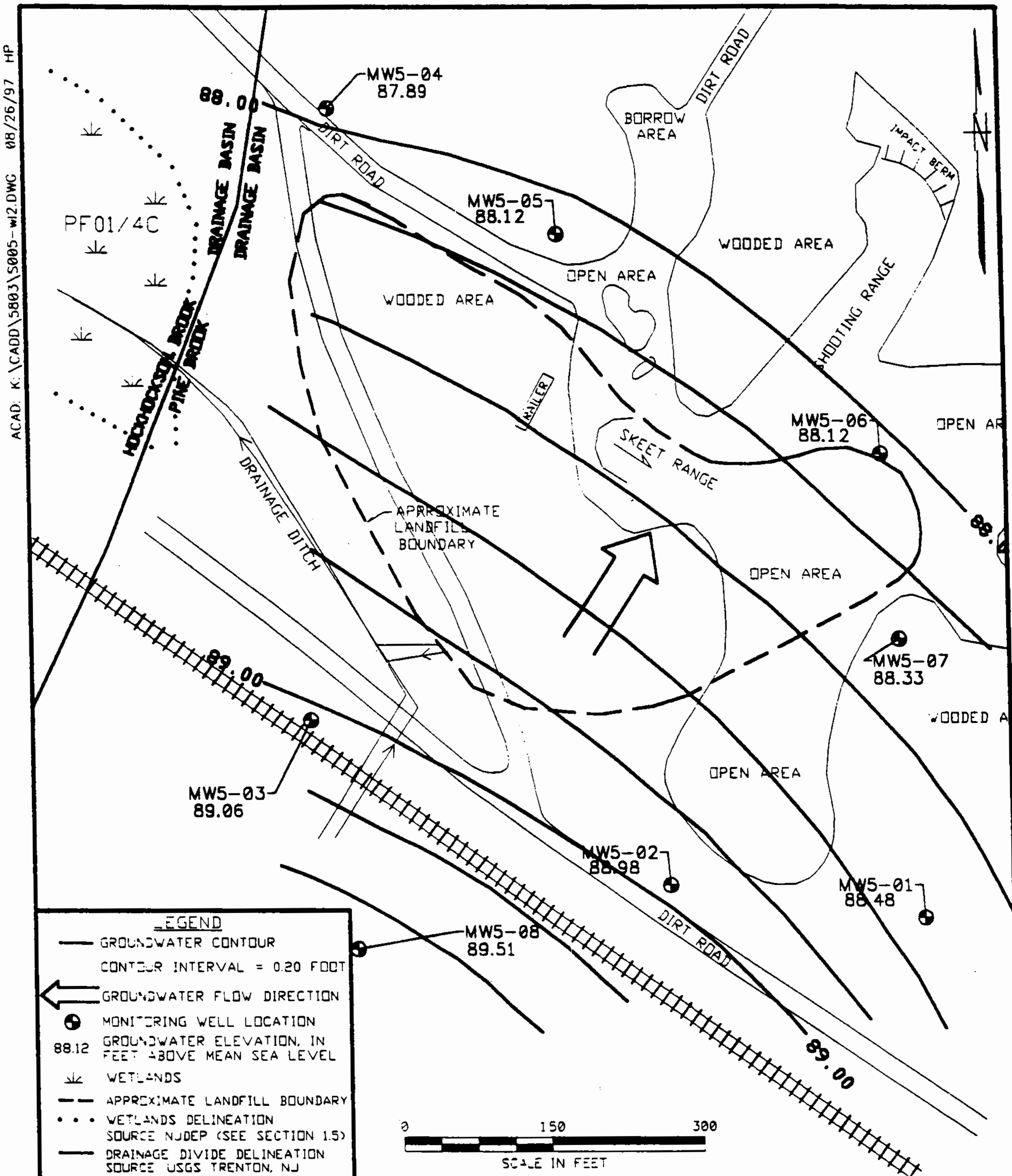
Groundwater in the Kirkwood and Vincentown aquifer beneath the site occurs under unconfined conditions and the formations are interpreted to be hydraulically interconnected. Groundwater contour maps are presented in Figure 4-2 (August 1995) and Figure 4-3 (October 1995). The direction of shallow groundwater flow in the aquifer is toward the northeast. There does not appear to be a significant seasonal variation in groundwater flow direction. The hydraulic conductivities calculated for MW5-02 (Kirkwood and Vincentown Formation), MW5-06 (Kirkwood Formation), and MW5-07 (Vincentown Formation) are 3.18×10^{-4} cm/sec (0.90 ft/day), 6.46×10^{-4} cm/sec (1.83 ft/day), and 2.08×10^{-4} cm/sec (0.59 ft/day), respectively.

4.5 SURFACE WATER HYDROLOGY

A small drainage ditch is located approximately 100 feet west of the dirt road that borders the western edge of the site, and water is present in the ditch only after periods of heavy rainfall. The closest surface water is a tributary of Hockhockson Brook, located approximately 1,000 feet east of Site 5. The site is located on the border of the Hockhockson Brook and Pine Brook watersheds. The topography of the site is flat, inhibiting off-site runoff; therefore, precipitation perches and infiltrates on the site. No surface seeps exist at the landfill.



DRAWN BY HJP DATE 08/25/97	Brown & Root Environmental	CONTRACT NO. 7602	OWNER NO.
CHECKED BY DATE	GROUNDWATER CONTOUR MAP AUGUST 7, 1995 SITE 5 LANDFILL WEST OF ARMY BARRICADES NAVAL WEAPONS STATION EARLE COLTS NECK, NEW JERSEY	APPROVED BY DATE	
COST/SCHED-AREA		APPROVED BY DATE	
SCALE AS NOTED		DRAWING NO. FIGURE 4-2	REV. 0



DRAWN BY HJP	DATE 08/26/97	Brown & Root Environmental	CONTRACT NO. 7602	OWNER NO.
CHECKED BY	DATE	GROUNDWATER CONTOUR MAP OCTOBER 17, 1995 SITE 5 – LANDFILL WEST OF ARMY BARRICADES NAVAL WEAPONS STATION EARLE COLTS NECK, NEW JERSEY	APPROVED BY	DATE
COST/SCHED-AREA			APPROVED BY	DATE
SCALE AS NOTED			DRAWING NO. FIGURE 4–3	REV. 0

4.6 SUMMARY OF REMEDIAL INVESTIGATIONS

4.6.1 IAS and SI Results

The IAS and SI concluded that a potential threat to groundwater existed at the site.

4.6.2 Phase I Remedial Investigation

The results of the Phase I RI showed metals and VOCs in subsurface soil and groundwater samples.

Four test pits were excavated to characterize the wastes that had been disposed at the landfill. A layer of trash, ranging in thickness from 6 to 13 feet, was encountered in all four test pits. The trash consisted of foam rubber, glass, paper, plastic, metal scrap materials, lumber, concrete, bricks, and other construction debris.

4.6.3 Phase II Remedial Investigation

The Phase II RI indicated the presence of metals (e.g., aluminum, arsenic, cadmium, cobalt, iron) and VOCs [1,2-dichloroethane (1,2-DCA), 1,2-DCE, TCE, benzene, ethylbenzene, xylene, vinyl chloride] in groundwater samples, generally confirming previous findings. Table 4-1 summarizes the results of samples taken from groundwater compared to applicable standards.

Metals found in groundwater at concentrations greater than regulatory guidelines included aluminum, cadmium, iron, manganese, nickel, and thallium. In the case of Site 5, of eight monitoring well samples collected, four met the sample collection endpoint turbidity goal and the other four had reasonably low endpoint turbidity values. Therefore, no probable general correlation exists between turbidity and groundwater samples metals concentrations above regulatory standards or background.

Organic compounds found in groundwater at levels above regulatory standards included 1,2-DCA, benzene, chloroform, and TCE. All four compounds were found at concentrations below the federal standard for human consumption for potable water supplies, but slightly above the New Jersey standard. TCE and benzene were each found in two monitoring wells downgradient of the landfill. Chloroform was found in one monitoring well upgradient of the landfill at a concentration above the New Jersey standard.

TABLE 4-1

SITE 5 GROUNDWATER
NWS EARLE, COLTS NECK , NEW JERSEY

			ARARs and TBCs			Data Exceeding ARARs					
	Maximum Exceedance	**Frequency of Eceedance**	**Maximum Contaminant Level (MCL) (ug/L)**	**Drinking Water Health Advisory (Lowest Criterion Shown)**	**NJDEP Groundwater Quality Standard (ug/L)**	**05GW01 1995 RI 7/21/95**	**05GW02 1995 RI 7/07/95**	**05GW04 1995 RI 7/21/95**	**05GW05 1995 RI 7/5/95**	**05GW06 1995 RI 7/13/95**	**05GW07 1995 RI 8/22/95**
Aluminum	42000	8/8	-	-	200	2150 J	4310	7870 J	2740	2600	497
Cadmium	8	2/8	5	5e	4					7	
Iron	59200	8/8	-	-	300	2670	453	1450 J	2310	59200J	331
Manganese	302	4/8	-	-	50		65		171	156	
Nickel	102	1/8	100	100a	100						
Thallium	6	3/8	2	0.4a	10	4	5		6 J		
1,2-dichloroethane	3	1/8	5	700e	2					3 J	
Benzene	3	2/8	5	200d	1					2 J	
Chloroform	22	1/8	100	100e	6	22					
Trichloroethene	4	2/8	5	-	1		3		55	4 J	

J = Value is estimated because the concentration is below the laboratory contract quantitation limit or because of data validation control quality criteria.
a = The listed health advisory criterion, lifetime adult, is equal to the most stringent of the EPA health advisories for this chemical.
d = The listed health advisory criterion, ten-day child, is equal to the most stringent of the EPA health advisories for this chemical.
e = The listed health advisory criterion, long-term child, is equal to the most stringent of the EPA health advisories for this chemical.

4.6.4 Groundwater Modeling

Computer modeling estimated that Site 5 groundwater metal concentrations would gradually diminish over a long period of time, assuming a source control measure, such as capping, would be implemented to control vertical migration. The model estimated that metals concentrations at the nearest potential discharge point, a stream located approximately 3,500 feet downgradient of Site 5, would be well below either the state standard or background levels. Surface water samples taken from the watershed downgradient of Site 5 currently show no concentrations of compounds above background or regulatory standards.

4.6.5 Summary

In summary, results of investigations at Site 5 indicate that:

- Metals concentrations in groundwater were found to be slightly higher than background or the corresponding New Jersey standard (generally at 1 or 1.5 times the corresponding background concentration).
- Modeling estimates that metals in groundwater will migrate only very little, and concentrations will diminish slowly with time
- Thallium found at low concentrations in groundwater upgradient of the landfill does not appear to be leaching from the landfill.
- Source control (e.g., covering the landfill) would inhibit infiltration of water through the landfill, preclude the leaching of additional metals and volatiles, and promote natural attenuation. Long-term monitoring would be required to evaluate the effectiveness of source control.
- The low levels of 1,2-DCA and TCE found in groundwater downgradient of the landfill are indicative of contaminants leaching from a limited source area that are degrading with time and are not widely spread.
- The low level of chloroform found in one upgradient monitoring well does not appear to be the result of a concentrated source in the area of the landfill.

After significant investigation over more than a decade, no concentrated source of VOCs has been found at Site 5. It is unlikely that a concentrated source of VOC contamination exists in the landfill material.

5.0 PRE-DESIGN INVESTIGATION

5.1 PRE-DESIGN INVESTIGATION ACTIVITIES

A pre-design investigation was completed to gather information required for the design effort. The pre-design investigation included the following components:

- Geotechnical Investigation
- Test Pit Investigation
- Wetlands Delineation
- Topographic Survey

A general description of the scope of work activities is provided in Sections 5.1.1 through 5.1.4. The results of the pre-design investigation at Sites 4 and 5 are included in Sections 5.2 and 5.3, respectively.

5.1.1 Geotechnical Investigation

Geotechnical investigations were performed at Sites 4 and 5 to verify the soil geotechnical characteristics and the depth of waste. The results of this investigation were used to estimate the stability of the regraded landfill and cover system as well as estimate landfill settlement due to the additional load of the cover materials.

A total of 8 geotechnical soil borings were completed at Sites 4 and 5. The borings were drilled using hollow stem auger techniques. The hollow stem augers had a minimum inside diameter of 4 inches.

Soil samples were collected continuously at each boring location using two-inch diameter split spoons samplers. Each split-spoon sampler was driven to the required depth with a rig-mounted hammer weighing 140 pounds and falling 30 inches. All samples obtained from the boreholes were screened with a photoionization detector (PID) immediately upon opening and the associated readings were recorded on the boring logs. Soil characteristics and geotechnical information from each split-spoon sample were also recorded on the boring logs.

At least one soil sample was selected from each soil boring location for geotechnical testing. Each soil sample was analyzed for soil classification (ASTM Method D 2488), particle size (ASTM Method D 422), moisture content (ASTM Method D 2216), and Atterburg Limits (ASTM Method D 4318).

Additional soil samples were collected when more than one stratigraphic layer was observed within a split spoon sample. The soil samples were placed into individual clear plastic bags following sample retrieval and field (visual) classification, and the bags sealed to reduce moisture loss. All soil samples were maintained on site until the appropriate samples were selected for laboratory testing. Soil samples that were not shipped from the site for laboratory testing were disposed of at the respective site.

The original work scope for the geotechnical testing included collection of one sample of fine grained soils from each site using a Shelby tube sampler These samples would be analyzed for triaxial compression testing (ASTM Method D 4767) and consolidation (ASTM D 2435). Since no fine grained cohesive material was encountered in any of the soil borings, neither triaxial compression or consolidation testing was performed.

Upon completion of each boring, the individual borings were backfilled with cement/bentonite (6 to 1 ratio, respectively) grout through the center of the augers with a tremie tube. Each boring was grouted from the bottom of the boring to the ground surface.

5.1.2 Test Pit Investigation

The limits of waste at Sites 4 and 5 were initially determined through examination of historical records and aerial photography (Figures 3-1 and 4-1). Test pit investigations were later performed at Sites 4 and 5 to confirm the actual limits of the waste.

Test pits were excavated along the boundary of each site to determine the limits of the disposal areas. All test pits were excavated using a rubber tire backhoe. The test pits were generally excavated perpendicular to the landfill boundary until the limit of landfilled material was encountered and visually identified. Logs were completed for each test pit and included the test pit number, location, and materials encountered.

Test pits were backfilled immediately after completion. Test pits were backfilled with the excavated material from the associated test pit.

5.1.3 Wetlands Delineation

Potential wetlands areas at Sites 4 and 5 were originally delineated using maps generated by the NJDEP which were based on aerial photography. During the pre-design activities, potential wetland areas at each site were field delineated to provide a more accurate determination of wetlands areas. The field delineation was performed by a certified wetlands specialist.

Wetland delineations at each site were performed in accordance with procedures outlined in the U.S. Army Corps of Engineers Wetland Delineation Manual (1987). All delineations included an onsite inspection of the vegetation, soils, and hydrogeology.

5.1.4 Topographic Survey

Topographic surveys were performed at each site to map the existing site topography and provide a basis for cut/fill calculations for cap installation. The topographic surveys were performed by a New Jersey licensed Land Surveyor.

The topographic maps were prepared on a scale of 1 inch = 50 feet and 1-foot contour interval. Planimetric features such as streams, pipes, roads, etc. were included for clarity.

5.2 PRE-DESIGN INVESTIGATION - SITE 4

5.2.1 Geotechnical Investigation

The geotechnical investigation at Site 4 was performed on June 17 and 18, 1997 and included completion of 3 geotechnical borings at locations indicated on Figure 5-1. A total of 5 geotechnical borings were originally planned for Site 4, but only 3 could be completed due to access problems. Five monitoring wells surround Site 4. The boring logs from the installation of the monitoring wells were also used in analyzing the subsurface conditions.

Boring logs for the 3 geotechnical borings are included in Appendix A. Appendix B includes boring and well installation logs which were completed during previous remedial investigations and are provided here for information purposes.

A total of 4 samples were submitted to Valley Forge Laboratories, Inc. for geotechnical analysis. Laboratory results of these samples are included in Appendix C. The laboratory results described the soil samples as non-plastic tan, poorly-graded sand with silt (SP-SM). Natural moisture contents ranged from 5.4 to 14.1 percent. Laboratory testing was performed using personal protective equipment (PPE) Level D.

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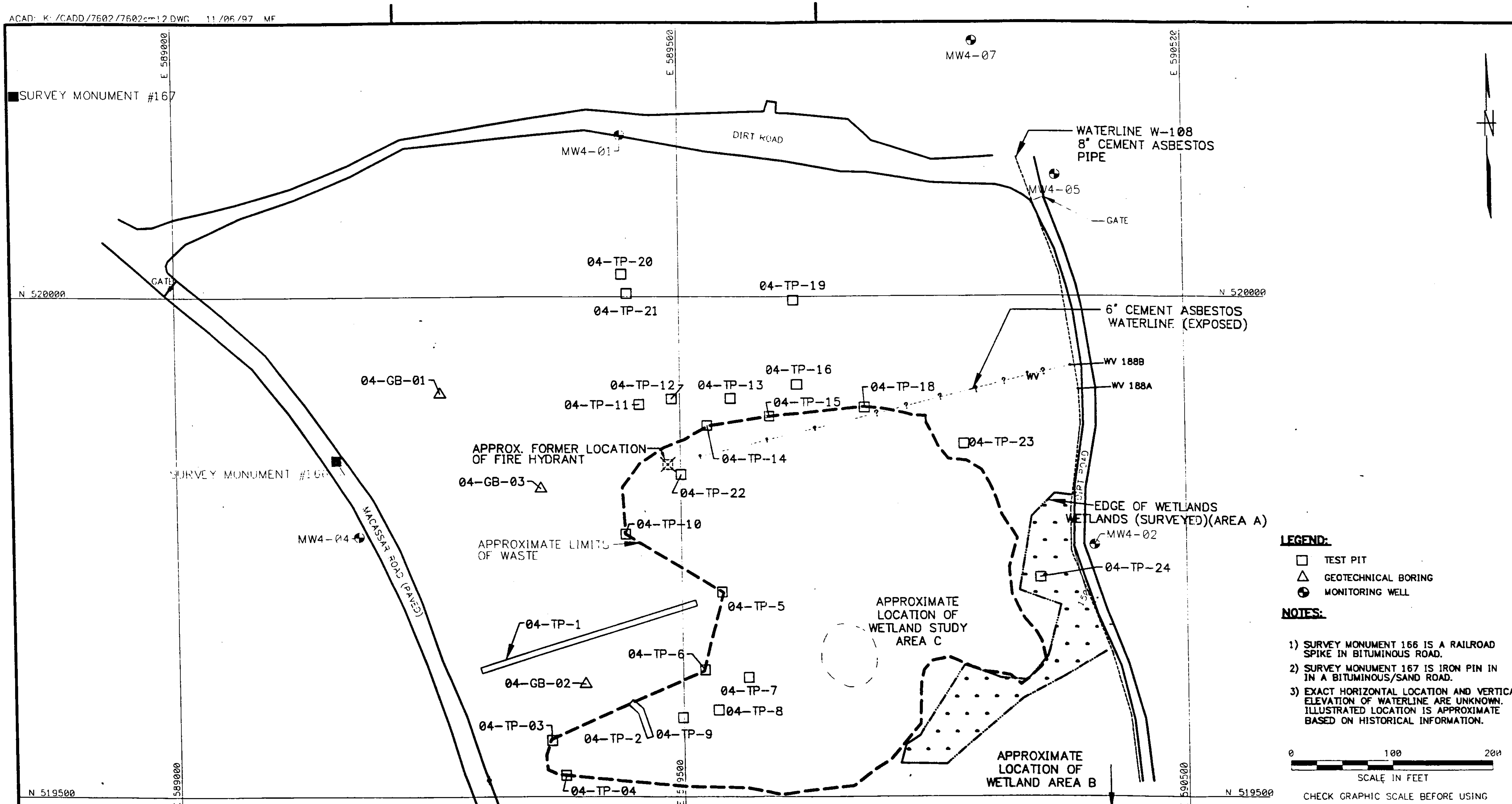

NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY TAD DATE 8/28/97
CHECKED BY DATE
COST/SCHED-AREA
SCALE AS NOTED

Brown & Root Environmental

SITE 4
PRE-DESIGN INVESTIGATION
EXISTING CONDITIONS PLAN
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

CONTRACT NO. 7602
OWNER NO.
APPROVED BY DATE
APPROVED BY DATE
DRAWING NO. FIGURE 5-1
REV. 0

FORM CADD NO. SDIV_BH.DGN - REV 0 - 02/11/97

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None of the three geotechnical borings were completed within the boundary of the landfill at Site 4 (Figure 5-1). Access problems restricted placement of borings. The results of the test pit investigation (Section 5.2.2) determined that the boundary of the landfill was somewhat different than was originally estimated. The test pit investigation for Site 4, which was completed after the geotechnical boring program was completed, determined that the western boundary of the landfill was further east than what was originally estimated.

5.2.2 Test Pit Investigation

The test pit investigation for Site 4 was completed on June 17, 18, and 19, 1997 and included excavation of a total of 24 test pits at Site 4. The locations of these test pits are included on Figure 5-1. The logs for each test pit are included in Appendix D.

The limits of the Site 4 landfill area along the southern edge were not delineated with test pits due to access problems with the backhoe. Therefore, the southern limit of the landfill was determined through a combination of visual observations, the results of other test pit work around Site 4, and interviews with NWS personnel who were knowledgeable about past landfill operations at both Sites 4 and 5.

After Site 4 was closed, the disturbed areas of the landfill were revegetated with pine trees. These pine trees were generally planted in rows and were much smaller than the surrounding woodland vegetation, which was generally composed of a combination of pines and hardwood trees. During the test pit investigation, this difference in tree growth across the site was used to determine the approximate boundary of the landfill and focus the test pit investigation.

Visual observations were also used to determine the limit of waste for the landfill. Along the eastern and southeastern edge of the landfill, waste materials were exposed in a "face" which extended as much as 10 to 15 feet above surrounding grade. Several test pits were excavated to the east and southeast of this "face" (access permitting) to confirm that no waste materials extended past the visible "face."

The southwest boundary of the landfill is bounded by a topographic ridge which extends approximately 20 feet above surrounding grade and is vegetated with older tree growth. A drainage ditch forms the boundary between the southwest edge of the landfill and this ridge. Test pit excavations and visual observations confirmed that the limit of waste extended to the northern edge of this drainage ditch. The south side of the ditch appeared to be undisturbed and was vegetated with larger hardwood trees and laurel. The bottom of the drainage ditch was assumed to be the limit of waste material along the southern side of Site 4.

A mix of waste materials was encountered in the test pits within the former landfill boundaries and was composed mainly of municipal/industrial waste materials. Ordnance-type materials were encountered at 04-TP-02 and consisted of various components such as shipping containers, detonator batteries, etc..

5.2.3 Wetlands Delineation

A total of three suspected wetlands areas were identified in the immediate area of Site 4 which could be impacted by site-related activities. These areas were identified as:

- Area A - Near the southeast corner of the landfill boundary
- Area B - South of Area A
- Area C - Within the landfill boundary

The locations of these areas are included on Figure 5-1. Of the three potential wetlands areas studied, Area A and Area B were the only areas which were confirmed as wetlands. Area C did not meet all of the requirements of a wetland. Area A is located near the southeast corner of the landfill and will likely be affected during installation of the cap and related appurtenances. Area B is located further south from Area A and will likely not be affected by construction activities. Appendix E provides additional information on the delineation of each area.

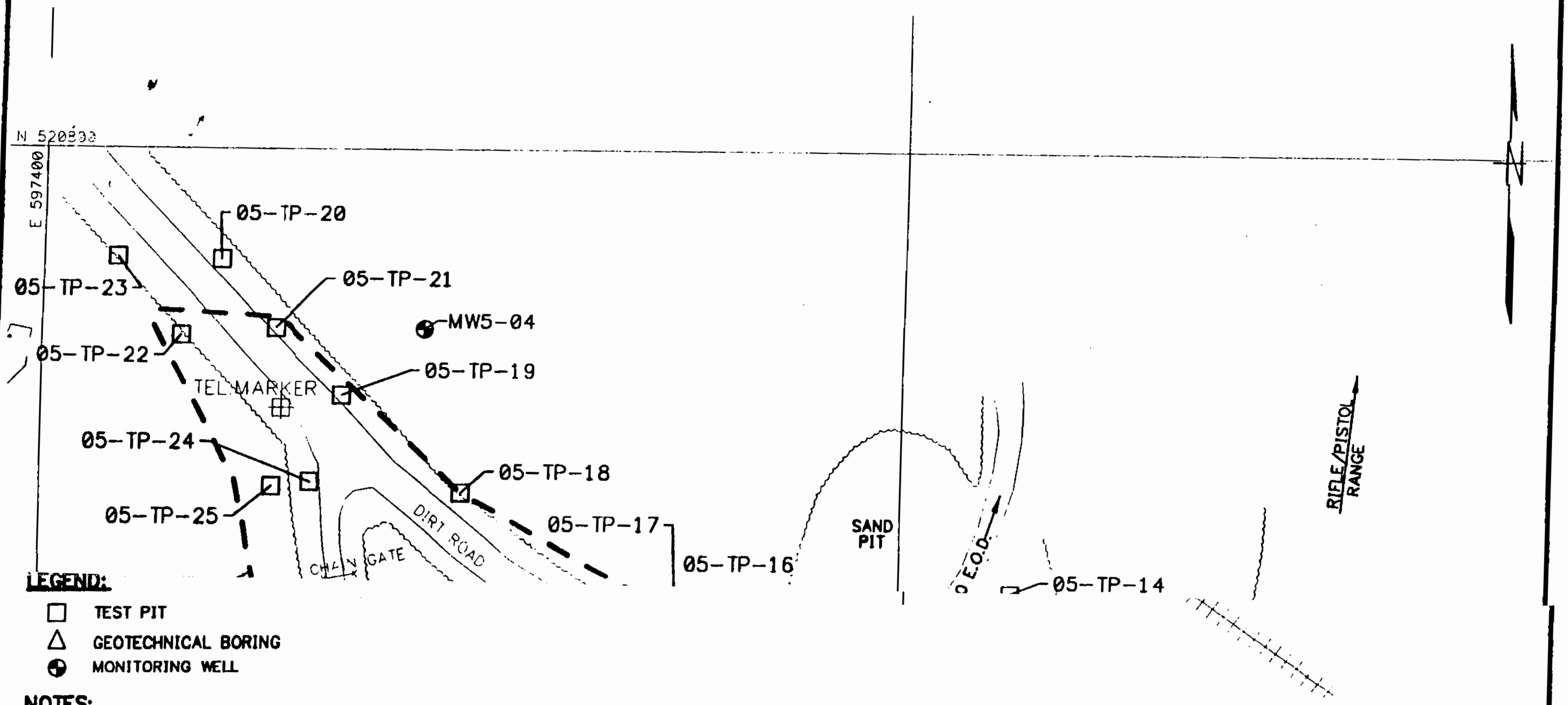
On Friday, October 3, 1997, the Navy and B&R Environmental personnel met with a representative of the NJDEP to review the boundaries for the individual wetlands areas. The boundaries have been revised to reflect the field confirmation by the NJDEP.

5.3 PRE-DESIGN INVESTIGATION - SITE 5

5.3.1 Geotechnical Investigation

The geotechnical investigation at Site 4 included completion of 5 geotechnical borings at locations indicated on Figure 5-2. Boring logs for the 5 geotechnical borings are included in Appendix F. Appendix G includes boring and well installation logs which were completed during previous remedial investigations and are provided here for information purposes.

A total of 4 samples were submitted to Valley Forge Laboratories, Inc. for geotechnical analysis. Laboratory results of these samples is included in Appendix H. The laboratory results described the soil samples as green clayey sand (SC), silty clayey sand (SM-SC), or poorly-graded sand with silt (SP-SM).



LEGEND:

- TEST PIT
- GEOTECHNICAL BORING
- MONITORING WELL

NOTES:

1) SITE 5 SURVEY MONUMENTS ARE LOCATED OUTSIDE THE BOUNDARIES PRESENTED ON THIS FIGURE.

0 100 200

SCALE IN FEET

CHECK GRAPHIC SCALE BEFORE USING

DRAWN BY / DATE: TAD 8/28/97	Brown & Root Environmental	CONTRACT NO. 7602	OWNER NO. 0289
CHECKED BY / DATE	SITE 5 PRE-DESIGN EXISTING CONDITIONS PLAN NAVAL WEAPONS STATION EARLE COLTS NECK, NEW JERSEY	APPROVED BY / DATE	
COST/SCHED-AREA		APPROVED BY / DATE	
SCALE: AS NOTED		DRAWING NO. FIGURE 5-2	REV. 0

FORM CADD NO. SOUTH_BV.DWG - REV 0 - 04/16/97

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Natural moisture contents ranged from 9 to 22.6 percent. Due to the presence of significant odors, laboratory testing of Site 5 soil samples was performed using personal protective equipment (PPE) Level C.

5.3.2 Test Pit Investigation

A total of 59 test pits were excavated to delineate the approximate limits of fill areas at Site 5. The locations of these test pits are included on Figure 5-2. The logs for each test pit are included in Appendix I. It should be noted that Test Pit 47 (05-TP-47) was never excavated and represents a skipped number in the test pit numbering sequence.

A mix of waste materials was encountered in the test pits within the former landfill boundaries and was composed mainly of municipal/industrial waste materials. Ordnance-type materials were encountered at 05-TP-29 and included three empty depth charges.

5.3.3 Wetlands Delineation

A total of three suspected wetlands areas were identified in the immediate area of Site 5 which could be impacted by site-related activities. These areas were identified as:

- Area A - Within the landfill boundary
- Area B - West of the landfill boundary
- Area C - West of Area B

The locations of these areas are included on Figure 5-2. Of the three potential wetlands areas studied, only Area B and Area C were confirmed as wetlands. These two wetlands are located to the west of the landfill boundary. Area B appears to be the only wetland which could potentially be affected by site remedial activities.

Area A (not identified as a wetland) is a small depression located near the south end of the landfill, within the landfill boundary and will likely be affected during installation of the cap and related appurtenances. Appendix E provides additional information on the delineation of each area.

On Friday, October 3, 1997, the Navy and B&R Environmental personnel met with a representative of the NJDEP to review the boundaries for the individual wetlands areas. The boundaries have been revised to reflect the field confirmation by the NJDEP.

The representative of the NJDEP felt that Area A was in fact a wetland, however, since this area lies completely within the boundary of the landfill, this area does not need to be restored or replaced.

6.0 DESIGN REQUIREMENTS

6.1 APPROACH

The proposed caps for Sites 4 and 5 are intended to provide a cover over waste materials disposed of at the respective sites. A brief summary of the approach to each site is provided.

6.1.1 Site 4

As indicated on Figure 5-1, the results of the test pit investigation indicated a somewhat irregular area for waste deposition. The limit of waste extends to the bottom of a relatively steep slope along the south east side of the landfill. At the bottom of the steep slope a wetland (Wetland Area A) has been identified. In order to minimize the surface area of the cap, and to improve the constructability of the landfill, two areas of waste material will be excavated and regraded under the cap. These areas include:

- The narrow area trending in an east-west direction at the southwest corner of the landfill. Based on the test pits which were excavated in this area, most of this area consists of a relatively thin layer of waste (1 to 2 feet) with deeper portions (5-6 feet) toward the main body of the landfill. In calculating the volume of waste to be removed from this area it was conservatively assumed that the waste thickness was a uniform 6 feet thick.

- A smaller protruding area near the southeast corner of the landfill, adjacent to Wetland Area A (Site 4). In order to calculate the volume of this excavation area it was assumed that the waste material does not extend deeper than the existing relatively flat natural grade at the bottom of the slope.

In addition to the areas of excavation, the existing limit of waste will be moved in two places. The regraded waste would be extended from the existing limit of waste to improve the constructability of the cap system on the west side of the landfill and along an indentation in the existing limit of waste along the south east corner. The filling of this indentation will impact a small portion of the wetland, however, the excavation of the waste area adjacent to this indentation will result in an area which could be established as new wetland.

The remainder of the landfill would be graded to establish uniform slopes in preparation for installation of the cap. With respect to the southeast corner of the landfill it was decided to hold the existing limit of waste over most of the slope for the regrading of the waste material. This will result in filling a strip of the wetlands with clean fill to allow for the termination of the cap components. The alternative to this would be to excavate back into the landfill slope to allow for the termination of the cap system outside of the wetlands. It was decided to limit the amount of waste excavation due to the presence of the steep slopes and difficulties that this could cause during construction.

The small protruding area of waste (adjacent to Wetland Area A) will be excavated and this material consolidated under the cap. The excavated area will be regraded, revegetated, and restored as additional wetlands. This additional area of wetlands will offset the area of wetlands lost due to cap installation.

6.1.2 Site 5

As indicated on Figure 5-2, the results of the test pit investigation indicated a somewhat irregular area of waste deposition. The existing topography at Site 5 was relatively flat, requiring excavation of waste materials near the perimeter of the landfill and movement of these materials toward the center of the site to create the required slope while balancing the cut/fill requirements. In some areas, the landfill boundaries are adjacent to hillsides, requiring excavation of wastes from specific areas to allow installation of the cap and related drainage swales along the perimeter.

In addition, the restoration of Site 5 includes the replacement of the trap/skeet range after the site is capped. The location and orientation of the trap/skeet range could not be changed without an extensive review and approval process by the Navy. Site approval from Naval Ordnance Center and Naval Facilities Engineering Command must be obtained based on the redesign of the trap/skeet range.

The surface of the trap/skeet range will be paved on the final cap surface to facilitate the removal of clay pigeons and lead shot. Due to the possibility of either the shot damaging the pavement or having shot ricochet off of the pavement, it was decided to configure the grades on the cap so that the shooting positions are located at a high point in the cap, with the surrounding grade sloping downhill from the shooting positions. To accommodate this design constraint, the high point of the landfill cap was placed as close as possible to the shooting positions while minimizing the amount of cut and fill.

6.2 MATERIAL/SOILS MANAGEMENT

Based on the results of soil analysis, test pit investigation, and the site survey performed during the pre-design investigation, the volumes of waste materials to be excavated and filled at each site were estimated. The estimates are based on the regrade surface and do not include imported materials for the cap components. The estimated volumes are as follows:

Location	Waste Volume To Be Excavated (CY)	Volume To Be Filled (CY)	Net Difference
Site 4	7,384	7,408	24 excess fill
Site 5	12,858	14,157	1299 excess fill
TOTAL	20,242	21,565	1323 excess fill

Cut/fill balances and excavated soil volumes reported for these designs are determined by a computer modeling software by forming Triangulated Irregular Networks or TINs between several 3-dimensional points located on each of the respective surfaces. Cut/fill balances and excavated volumes between to particular surfaces are thence calculated by summing the volumes calculated for tetrahedrons formed from adjacent triangles in the TIN. This method is considered to be more accurate than cross section, average end area, or grid methods.

6.3 COVER SYSTEM LIMITS

The proposed cover system is intended to cover the area at Sites 4 and 5 as delineated by the test pit investigation. The original limits of the waste material have been modified as described above. The final limits of waste will be covered by the cap system. The limits of the cap at each site have been established to minimize infiltration through subsurface soils, as well as to provide a vertical soil buffer between the waste and potential receptors.

The proposed landfill caps for Sites 4 and 5 will have footprints as shown on the design drawings. For Site 4, the cap footprint will occupy an area of 2.7 acres. The cap will maintain a minimum 4.0 percent slope to promote runoff of precipitation. The cap high point will have an elevation of 183 feet msl.

For Site 5, the cap footprint will occupy an area of 7.9 acres. The impermeable layer of the cap will maintain a minimum 3.5 percent slope to minimize hydraulic head on the cap. The final grade of the cap in the skeet range was adjusted to a flatter scope to provide a flat area for the skeet range shooting positions. This flat area was created by increasing the thickness of the select fill in the cover system. This allowed the low permeability layer to maintain a 3.5 percent slope and the final surface to be flatter. The cap high point will have an elevation of 120 feet msl. The proposed cap minimizes the capacity while maintaining the necessary footprint over the waste disposal areas.

6.4 FINAL COVER SYSTEM DESIGN

The proposed cap system for each landfill complies with the Resource Conservation and Recovery Act (RCRA) Subtitle D requirements as well as NJDEP requirements for closure of municipal landfills. The caps for each site will have similar configuration and will include the following components, in ascending order:

- A 12-inch-thick bedding/landfill gas management layer
- 40 mil very flexible polyethylene (VFPE) geomembrane
- Cushion fabric
- A 12-inch-thick layer of granular drainage material
- A nonwoven geotextile (filter)
- A 12-inch-thick select fill material (part of the vegetative layer)
- A 6-inch-thick topsoil layer (part of the vegetative layer)

VFPE is a generic term used by several manufacturers and researchers to describe a class of resins used to make geomembranes including LDPE (low density polyethylene), VLDPE (very low density polyethylene), and LLDPE (linear low density polyethylene).

6.4.1 Bedding/Gas Management Layer

The bedding/landfill gas management layer is included in the cap section to provide a suitable base on which to construct the other layers of the cap. The New Jersey regulations (NJAC 7:26-2A) require that a minimum of 6 inches of bedding (or a geotextile) be provided above and below the geomembrane layer . The bedding/landfill gas management layer will also serve as a gas management layer to collect gases which may be generated by the landfill and to direct the landfill gas to passive gas vents. A one foot thick layer was chosen to provide additional protection of the geomembrane and to provide adequate cover of the gas management piping.

6.4.2 VFPE Geomembrane/Cushion Fabric

Natural low permeability soils (compacted clay liner), geomembrane, and geosynthetic clay liners (GCL) were evaluated for use as the low permeability layer in the cap system. Due to the generally sandy soils in and around NWS Earle it was felt that a compacted clay liner would not be cost effective since a source of this material could be difficult to locate close to the station. In addition, a geomembrane or a GCL would be easier to construct that a compacted clay liner.

A geomembrane was chosen as the low permeability layer in the landfill caps at Sites 4 and 5 for NWS Earle over a Geosynthetic Clay Liner (GCL) following the evaluation of several design issues associated with GCLS including the following:

- Slope stability
- Differential settlement
- Thinning of the bentonite layer
- Installed cost

Any one of the above issues could be resolved through design modifications, increased cost, or by a willingness to accept a greater possibility of compromise of the low permeability layer, however, taken together it was felt that a geomembrane was a more suitable material in the landfill cap. Each of these issues is discussed in greater detail below.

Slope Stability

The interface between the GCL and the materials placed next to the GCL is a potential failure surface. The proposed cap configuration includes a cushion fabric placed on top of the GCL. The cushion fabric would be needed to protect the GCL from the granular drainage material. Preliminary calculations indicate that this interface will not result in an acceptable factor of safety. The need for the cushion fabric is described below regarding thinning of the GCL.

The cushion fabric would be a heavy non-woven geotextile. The cushion fabric helps protect the geomembrane from puncture from the overlying materials. Generally conservative literature values of interface friction angles are used in the initial slope stability analysis, then site specific tests are performed prior to construction with the actual materials to be used to confirm that the actually friction angles meet the design requirements. Literature values for friction angles between geotextiles are very limited. A value of 18° was obtained between two non-woven geotextiles from Trevira literature. CETCO Literature (manufacturers of Bentomat and Claymax products) lists an interface friction angle between the non-woven side of a bentomat GCL with a woven geotextile to be 12^0. Higher friction angles generally exist with non-woven versus woven geotextiles, so it is assumed that the non-woven side of the GCL would be placed against the cushion fabric. This interface would essentially be a non-woven geotextile to a non-woven geotextile interface.

A simplified infinite slope stability calculation gives a factor of safety against sliding of the cap components with the following equation:

FS = tan friction angle/ tan slope angle

This simplified equation does not account for pore water pressure on the geomembrane or GCL which would lower the factor of safety. A more detailed equation incorporating the pore water pressure is used in the final design calculations.

Based on the above equation, a 4:1 (horizontal to vertical) slope, and a 18° interface friction angle, the factor of safely against sliding is approximately 1.3. A factor of safety of 1.5 is generally considered acceptable for slope stability. This interface was judged to be unacceptable.

Differential Settlement

Landfill caps can be subjected to differential settlement caused by the decay and collapse of materials within the landfill. This has been described as the "rusted refrigerator" scenario (i.e., localized settlement caused by the collapse of refrigerator or similar material disposed of within the landfill). Based on research it appears that GCLs can withstand large distortions and tensile strain up to 10-15 % with out undergoing significant increases in hydraulic conductivity. However, if differential settlement occurs directly beneath a GCL seam (GCLs are seamed by overlapping the GCL and adding granular bentonite along the overlap) the amount of differential settlement the at the GCL can accommodate is limited by the amount of overlap. VFPE geomembrane have very good multiaxial strain characteristics which are superior to GCLs. Given this information it was felt that a VFPE geomembrane provides superior properties with respect to differential settlement as compared to the GCL.

Thinning of the GCL

The possibility exists for bentonite to thin in the GCL due to various loadings causing an increase in permeability of the GCL. The thinning can be caused by the subgrade or cover soil conditions.

The CETCO installation guidelines indicate that the subgrade should possess a particle size distribution such that at least 80 percent of the soil is finer than a #60 sieve (0.25 mm). The current cap design includes a sand bedding/gas management layer, however, it was felt that it would be difficult to locate a local supply of material which meets the GCL requirements and also provide adequate permeability for gas flow.

Finally, the CETCO installation guidelines suggest using only cover soils with a particle size ranging from fines to 1 inch diameter. Soils with minimal fines or a high concentration of aggregate larger than 1 inch should be assessed with a field scale test. The drainage layer to be placed above the low permeability layer would include minimal fines (D2 > 0.1 inch) based on New Jersey sanitary landfill regulations To avoid a very narrow gradation (which may be costly) but also to avoid large stones which could damage the GCL or geomembrane, the drainage material would be limited to 1 inch diameter. To protect the GCL from the granular drainage material it was decided to included a cushion fabric in the design. It was felt that a cushion fabric was also appropriate to protect a geomembrane.

Installed Cost

Vendors were contacted to estimate the installed cost of the low permeability layer in the cap systems. The following table summarizes the costs.

Material	Installed Cost (dollars/square foot)
GCL (non-woven /woven geotextiles)	$0.43-0.52 / sf
GCL (non-woven /non-woven geotextiles)	$0.48-0.57 / sf
40 mil smooth VFPE	$0.35-0.39 / sf
40 mil textured VFPE	$0.38-0.45 / sf

The geomembrane generally has a lower installed cost than the GCL.

Sites 4 and 5 are relatively remote and are located at least partly within explosive safety arcs, it was assumed that future development work at each site would be minimal. In addition, the waste materials at each site appear to be relatively stable, with little evidence of differential settlement. Therefore, long-term maintenance activities associated with the individual caps are assumed to be minimal.

Based on the potential disadvantages of both a GCL and a compacted clay liner, the geomembrane liner was chosen to be used in the cap systems. The N.J.A.C. 7:26-2A.7 requires a minimum 30 mil geomembrane to be used in a landfill cap. A 40 mil geomembrane was chosen because of its enhanced survivability during placement. An VFPE membrane was chosen because of its ability to withstand differential settlement compared to high density polyethylene (HDPE) material.

6.4.3 Granular Drainage Material

A granular drainage layer is placed above the cushion fabric protecting the geomembrane. The function of the drainage layer is to reduce the head which will develop on the geomembrane due to water infiltrating into the cap system. The New Jersey regulations require a 12-inch thick drainage layer above a geomembrane in a landfill cap. Based on the New Jersey sanitary landfill regulations, the drainage material must meet the following gradation:

$$D2 > 0.1 \text{ inch } (2.54 \text{ mm})$$
$$D85 > 4\ D15$$

Material meeting this gradation requirement would correspond to a clean graded aggregate.

6.4.4 Geotextile Filter/Vegetative Layer

Above the drainage layer a non-woven geotextile is included to separate the vegetative layer from the drainage layer. This will prevent the vegetative layer from clogging the drainage layer. The geotextile design is based on that anticipated cover material grain size, the required apparent opening size (AOS), and the permittivity of the geotextile. Above the drainage layer the vegetative layer consists of 12 inches of select fill material covered by 6 inches of topsoil. The select fill material will be materials similar existing soil at the sites such as silty sands. The Rutgers University Agricultural Extension and the USDA Natural Resources Conservation Service were contacted to determine if the vegetative layers possessed enough thickness to support grasses on the landfill cap (specifically hard fescue). The indication from these agencies was that the thickness of the vegetative support layer is adequate.

6.4.5 Landfill Grade

All of the referenced regulations require grading to promote run-off, to prevent run-on, and to accommodate settling. The state sanitary landfill regulations require that, after allowing for settlement, the top surface of a landfill cap be between 3 percent and 5 percent. To be conservative, a minimum slope of 3.5 percent slope was used as a design parameter to determine the regraded surface of the landfill. This provides for settlement, although the calculations indicate that settlement will be negligible. The New Jersey sanitary landfill regulations state that the maximum side slopes are 3 horizontal to 1 vertical. To be conservative and to ensure a stable cap system, a maximum slope of 4 horizontal to 1 vertical was considered when configuring the final cap surfaces. The proposed design promotes the run-off of precipitation.

Various geotechnical analyses, including slope stability and settlement, were performed to verify the adequacy of the proposed grading scenario. Based upon these analyses, it was concluded that:

- Soil loss from the cap surfaces do not exceed 2.0 tons/acre/year as required by the New Jersey sanitary landfill regulations.
- The proposed components of the cover system possess adequate interface friction to provide acceptable system stability.
- The proposed landfill configuration provides an adequate factor of safety against slope stability failure.
- Anticipated cap settlement will not reduce the minimum cap grade to less than 3.0 percent, as required by the regulations.

The geotechnical analyses are described in greater detail in Section 6.5 of this report.

Cross sections for each landfill cap have been provided on 100-foot intervals for this submittal.

6.5 GEOTECHNICAL ANALYSIS

Detailed geotechnical evaluations, including slope stability and settlement, were performed in conjunction with preparation of the remedial design for Sites 4 and 5. Site stratigraphy was inferred from the results of several test borings that were advanced through and adjacent to each site (performed in conjunction with the remedial design as well as during previous site investigations). The stratigraphy is generally described in Sections 3.0 (Site 4) and Section 4.0 (Site 5) of this report, and test boring logs are included as Appendices. In summary, the uppermost stratigraphic unit at Sites 4 and 5 is comprised primarily of sands. No fine-grained stratigraphic units were encountered during the geotechnical boring program, and therefore no undisturbed "Shelby Tube" samples were collected or analyzed. It was judged that, for the purposes of stability and settlement analyses, extensive geotechnical testing of the sand units was not required, and appropriate engineering properties could be inferred from visual classification and blow counts. Laboratory testing included:

- Soil classification
- Particle size
- Atterberg Limits
- Moisture content

Classification-type testing was used to verify continuity and consistency of the stratigraphic units as determined from visual characterization and blow counts. Results of the geotechnical testing are included in Appendix C and H of this report.

6.5.1 Stability Analysis

Detailed slope stability analyses were performed for both the Site 4 and Site 5 landfills, based upon the input data described above. The PCSTABL5 computer program, a two-dimensional limiting equilibrium slope stability method, was utilized to perform the analyses. Numerous iterations of the analyses were performed to identify the failure surface that would correspond to the lowest factor of safety.

Cross section input geometry for existing conditions was obtained from stratigraphic sections that were developed from the site test borings (these stratigraphic sections are included with the design calculations). The location of the groundwater table was inferred from the results of test borings and water level measurement within on-site monitoring wells. Engineering properties of soils were assigned based upon the laboratory testing described above. Materials to be consolidated within the landfill are anticipated to include waste metals and on-site soils that are excavated as part of the overall site remediation, as well as imported clean borrow materials; corresponding engineering properties of these materials were conservatively estimated based upon past experience.

The final grades of the remediated (closed) landfill were inferred from a site grading plan that was prepared during the earliest stages of closure design. It was anticipated that the closure design configuration (and grades) would change as the design approached completion. Therefore, a "worst case" design condition was utilized for the purposes of the stability analyses, assuming a maximum potential sideslope of 4H : 1V, and a maximum apex of the cap at an elevation of 183 feet msl for Site 4. The maximum apex of the cap at site 5 is and 120 msl. The evaluated section was cut along the portion of the cap with the greatest elevation drop.

The results of the stability analyses indicate that, for the worst case geometric conditions described above, the factor of safety is on the order of 2 for Site 4 and exceeds 2 for Site 5. The resultant factors of safety are judged to be acceptable and applicable to all slopes of less height or steepness. Slope stability calculations are included in Appendix J of this report.

In addition, specific stability calculations were performed to verify that the proposed materials of construction for the cover system will provide adequate interface friction to maintain system stability. An infinite slope analysis was performed for the various critical interfaces between cap materials, using interface friction values from published literature It was concluded that the minimum factor of safety exceeds 1.5 for both sites. Infinite slope stability analyses are also included in Appendix J of this report.

6.5.2 Settlement Analysis

Settlement analyses were performed for the landfills at Sites 4 and 5, based upon stratigraphic cross sections that were similar to those used for the slope stability analyses. The anticipated grades of the cover system were assumed based upon the final design configuration (e.g., the worst-case condition that was assumed for the slope stability analyses was not required for these calculations). Settlement within the sand layers is expected to be elastic, such that settlement would occur concurrently with placement of overlying backfill and the cover system. Therefore, it was judged that elastic settlement will not affect the final design grades of the landfill.

The results of the settlement analyses indicate that the proposed minimum grades are acceptable because, following consolidation settlement, the final grades will exceed the minimum slope requirement of 3.0 percent. Settlement calculations are included in Appendix J of this report.

6.6 EROSION, SEDIMENT, AND STORMWATER MANAGEMENT REQUIREMENTS

6.6.1 Erosion and Sediment Control

An erosion and sediment control plan (E&S Plan) has been prepared for this project and is submitted under separate cover. The plan was prepared in accordance with the State of New Jersey regulations as set forth in the Standards for Soil and Erosion Control in New Jersey 1987. Runoff quality during the remedial action will be addressed via temporary erosion and sediment control devices located around the perimeter of the disturbed area. Refer to the draft E&S Plan for detailed information regarding the planned controls as well as runoff calculations.

6.6.2 Stormwater Management

The final cover of the cap system at Site 4 will include topsoil and a vegetated layer. Because of the poor cover soil now present at Site 4 and relatively poor vegetation, the post construction runoff from the cap area will be less than the pre construction runoff. The pre and post construction runoff calculations for both Sites 4 and 5 are presented in Erosion and Sediment Control Plan submitted under a separate cover. The permanent surface water controls at Site 4 include perimeter ditches to control run-on and runoff from the cap system. The perimeter ditches are design to collect flow from the drainage layer in the cap system.

Because the post-construction runoff from Site 4 is less than the pre-construction runoff, permanent detention basins are not required. Temporary sediment basins will be required during construction.

It should be noted that runoff from the landfill area at Site 4 does not have a positive drainage outlet from the wetlands located at the base of the landfill (the wetlands are a low point with no outlet across the dirt road to the east of the site). Under the post construction conditions this situation is not changed so that water will continue to pond in the wetland area. It was felt that creating a positive drainage across this dirt road could potentially drain the wetland.

The final cover of the cap system at Site 5 will include top soil and grass vegetation. Portions of Site 5 will be paved for the trap/skeet range. The runoff for Site 5 will increase from pre-construction to post-construction conditions due primarily to the pavement installation at the trap/skeet range. Detention basins will be required for Site 5 to control the post-construction runoff to pre-construction levels. Perimeter ditches similar to Site 4 will also be constructed at Site 5 to control run-on and run-off and to collect water from the drainage layer in the cap system.

6.7 TRAP/SKEET RANGE REQUIREMENTS

The existing trap/skeet range will be replaced with a new trap/skeet range with similar location, orientation, and configuration.

6.7.1 Design Requirements

The trap/skeet range was designed in accordance with Military Handbook 1037/3.

6.7.2 Clubhouse and Appurtenances

The existing clubhouse (mobile home) is in fair condition and will need to be replaced as part of the Site 5 restoration effort. The existing clubhouse will be removed from Site 5 for disposal. The existing deck, located adjacent to the clubhouse will also be removed from the site for disposal.

The clubhouse also includes two vaults, one for storage of guns and one for storage of ammunition and valuables. Both vaults are reportedly Class 5 vaults. The vault for storage of guns reportedly has a weight of approximately 1,200 pounds. The second vault, used for storage of ammunition and valuables, reportedly has a weight of approximately 2,000 pounds.

A building to replace the existing clubhouse has not been selected at this time. A 15-foot wide by 70-foot long concrete pad has been included in the design for restoration of the trap/skeet range. Details of the new clubhouse will be incorporated into the final design as a separate submittal.

6.7.3 Paving

The majority of the target flight zone (assumed to be approximately 100 yards for a trap/skeet range configuration) and the trap/skeet shooting positions will be paved to enable periodic cleanup of lead shot, clay pigeon fragments, and shotgun shell wadding (shooting debris) generated in the trap/skeet range as a result of shooting events.

The paving will be installed over the regraded cap surface as indicated on the drawings.
The asphalt paving will include the following components, in ascending order:

- A roadway stabilization geotextile
- A 10-inch asphalt base/subbase course
- A 2-inch asphalt surface course

The paved area will be sloped to permit drainage of stormwater from the paved areas. An asphalt curb will be installed at the perimeter of the paved area to control stormwater flow and prevent shooting debris from leaving the paved area. Inlets with a sump (bottom elevation lower that the outlet pipe) will be installed at downgradient points in the paved area to prevent discharge of shooting debris from the paved area during storm events. The inlets will be located just outside the low permeability layer of the cap and will outlet to the perimeter ditches. The shooting debris will collect in the sump of the catch basin where it can be removed periodically.

Light trucks are typically used on the existing trap/skeet range to deliver clay pigeon targets to the target launching facilities. The asphalt paving was designed to support car and light truck traffic. The pavement design calculations are presented in Appendix K. Since the area where shooters take position will also be paved, the actual shooting positions will be painted on to the asphalt as indicated on the drawings.

Concrete support pads will be installed within the trap/skeet range to support the high house, low house, sporting clay houses, and related structures. The top-of-pad elevation of these concrete pads will be at or above the level of the surrounding paving.

6.7.4 Utilities

ELECTRIC

B&R Environmental performed a preliminary cost analysis for routing electric service to the trap/skeet range at Site 5. This cost analysis included routing the electric service using the existing route as well as routing the electric service along the existing access road to Site 5. B&R Environmental determined that the existing route was more cost effective and the design drawings reflect this routing.

A new 400-amp electric service (single phase) will be installed to the clubhouse. The new electric service will be installed between the existing supply pole near Asbury Avenue and the clubhouse area using a routing scheme as indicated on the drawings.

The 400-amp service will be terminated at the clubhouse at a service disconnect box. A 42-slot service panel will also be installed to supply electric to the new clubhouse, the trap/skeet range, and the EOD range.

A 100-amp electric service will be supplied to the EOD range from the service panel at the new clubhouse. Electric service to the EOD range will be terminated at a service disconnect box to be located adjacent to the existing EOD bunker.

TELEPHONE

Telephone service is currently supplied to the clubhouse via an underground cable installed adjacent to the access road to the trap/skeet range. From the clubhouse, telephone service is also supplied to the EOD range via an underground cable installed along the access road to the EOD range.

The existing telephone lines will be replaced with new telephone lines (installed underground) as part of the site restoration efforts. Details of the new telephone service are described on the drawings.

WATER

No changes to the potable water service will be required. Potable water to the new clubhouse will be supplied by the existing bottled water supplier. Water for non-potable uses will continue to be supplied by the existing portable tank which will be parked on a concrete pad adjacent to the new clubhouse.

GAS

The heating system for the new building has not been specified at this time, although gas (propane) fuel is preferred and is currently used for the existing clubhouse. A concrete support pad has been included on the drawings with the assumption that propane gas will be used as part of the future heating system for the clubhouse. The heating system will need to be approved by explosives safety personnel.

WASTEWATER

The existing on-lot septic system will be replaced with a separate holding tank. This tank will require periodic removal of wastewater and solids by a vacuum truck or similar equipment.

Shooting events are held periodically at the trap/skeet range, when up to 100 people may attend. At other times, there are no personnel at the trap/skeet range with the exception of an occasional visitor.

To estimate the size of the wastewater holding tank, it was assumed that up to 100 people would attend a shooting event at the trap/skeet range. The NJDEP requires a design capacity of 10 gallons/capita/day(event) of wastewater storage for periodic recreational facilities. Therefore, the wastewater capacity of the holding tank was estimated at 1,000 gallons (working volume). Additional capacity of approximately 50% (500 gallons) was also assumed for emergency capacity and to provide adequate freeboard above the working volume to allow placement of level alarms. Therefore, the total minimum capacity of the wastewater holding tank was estimated at 1,500 gallons.

The NJDEP requires that wastewater holding tanks be equipped with high level alarms to alert personnel when the tank is full. The NJDEP also requires that wastewater holding tanks be aerated at a rate of approximately 2 cubic feet per minute per 1,000 gallons of capacity. The wastewater holding tank will be equipped with a high level alarm which will alert personnel when the wastewater level in the holding tank has reached a level corresponding to approximately 1,000 gallons. An additional level alarm (high-high) will alert personnel if the level reaches 1,500 gallons in the wastewater holding tank. A small blower will be used to supply the required aeration of the tank and a vent pipe will be installed to provide ventilation of the tank contents. A manway will be installed in the top of the tank to provide access for wastewater removal as well as provide access for maintenance and cleaning.

6.8 OTHER DESIGN REQUIREMENTS

6.8.1 Regulatory Standards

The cap designs for Sites 4 and 5 comply with the disposition of the action-specific ARARs and TBCs as discussed in the FS for Sites 4 and 5.

6.8.2 Groundwater Monitoring Wells

Existing monitoring wells at Sites 4 and 5 will remain as groundwater monitoring wells and will be used as part of the long-term periodic monitoring of each site. Installation of additional groundwater monitoring wells is not planned at this time.

All existing monitoring wells have outer casings that protrude approximately 2 feet above surrounding grade. Monitoring wells located within the boundaries of each landfill cap will extended to match the final cap grades and will be converted to flush mount for ease of cap maintenance. Monitoring wells outside the cap boundaries will remain in their present configuration and will not be modified.

6.8.3 Maintenance and Repair

There should be very little maintenance required for this landfill cap, which will be considered permanent. If unforeseen events ever damage the cap components, the damaged area would be uncovered and the damaged geosynthetics removed and replaced, as necessary. However, the thickness of this cap is expected to be sufficient to prevent such an occurrence. It is anticipated that the landfill cap will require mowing twice a year. The paved areas at the trap/skeet range will require periodic resealing.

6.8.4 Wetlands Mitigation

Based on the current cap configurations at Sites 4 and 5, it appears that existing wetlands will be affected at Site 4 as part of the cap installation; however, additional area for wetlands will be created, making the net effect zero. At Site 5, it appears that existing wetlands areas will not be affected during cap installation.

6.8.5 Ordnance Materials

During the test pit investigation, ordnance materials were encountered at both Sites 4 and 5. All of the ordnance materials appeared to be shell casings, shipping containers, and other components. No unexploded ordnance (UXO) materials were encountered.

EOD personnel will be available when intrusive activities in areas where ordnance materials were encountered. If ordnance-type materials are encountered, EOD personnel will inspect the materials and will determine the proper method for disposal.

APPENDIX A

GEOTECHNICAL BORING LOGS - SITE 4

BORING LOG

PROJECT NAME: NWS - EARLE
PROJECT NUMBER: CTO - 289
DRILLING COMPANY: JCA - Drilling
DRILLING RIG: CME - 55
BORING NUMBER: 04-6B-01
DATE: 6-17-97
GEOLOGIST: PAUL DAVIS
DRILLER: Steve Bumer / Jon Urban

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
	0.0												
S-1 @	0.0	3 / 5			Loose	orange-brown	Silty Fine grained	SM	Dry				
1032	2.0	7 / 9	18/24		Med. Dense		Sand (Some clay)						
S-2 @	3.0	7 / 8											
1036	4.0	7 / 9	13/24			Grayish brown	(bands)		moist				
S-3 @	5.0	6 / 8				Grayish orange	(banding)						
1038	6.0	7 / 7	13/24										
S-4 @	7.0	7 / 7					Silty med.-Coarse sand (banding)						
1040	8.0	6 / 6	18/24				Silty Fine grained sand		moist				
S-5 @	9.0	5 / 5					Silty very fine to fine						
1042	10.0	6 / 5	16/24				Grained sand						
S-6 @	11.0	7 / 8											
1044	12.0	8 / 9	16/24						moist				
S-7 @	13.0	5 / 7					(bands)						
1047	14.0	8 / 9	16/24										
S-8 @	15.0	8 / 9											
1105	16.0	11 / 9	17/24						moist				
S-9 @	17.0	9 / 10					Silty Fine grained						
1114	18.0	14 / 13	21/24				sand (banding)						
S-10 @	19.0	13 / 16											
1124	20.0	13 / 12	17/24				(less bands)		moist				
S-11 @	21.0	13 / 20			Dense								
1134	22.0	25 / 22	17/24				Silty Fine to coarse grained sand						
S-12 @	23.0	31 / 45			very Dense	Gray	(with gravels)		moist				
1147	24.0	85 / 60	18/24			grayish orange	Silty F-C gr. sand		orange mottles very moist				
							(some gravel)						

Sample

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm):

Remarks: 140 lb. hammer Falling 30-inches
4.25-inch I.D. HSA Collected sample 04-6B01-2224
2" ID Split Spoon Samplers

Converted to Well: Yes ____ No X Well I.D. #: N/A

BORING LOG

PROJECT NAME: NWS - EARLE
PROJECT NUMBER: CTO - 289
DRILLING COMPANY: JCA - Drilling
DRILLING RIG: CME - 55
BORING NUMBER: 04-GB-01
DATE: 6-17-97
GEOLOGIST: Paul Davis
DRILLER: Steve Bumer / Jon Urban

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	Soil Density/ Consistency or Rock Hardness (MATERIAL DESCRIPTION)	Color	Material Classification	U S C S *	Remarks	PID/FID Reading (ppm) Sample	Sampler BZ	Borehole**	Driller BZ**
S-13 @	25.0	17 / 33			very Dense	Grayish orange	Silty fine to medium	SM/SP	wet				
1155	26.0	53 / 55	18/24		↓	↓	grained Sand (some coarse)						
S-14 @	27.0	26 / 33				Brown	Silty fine grained Sand		Saturated				
1210	28.0	43 / 61	24/24			orange	Silty F-M gr. sand pink/orange/gray VFL sand						
S-15 @	29.0	18 / 40			↓	Orange Pink	Silty fine to coarse		Saturated				
1224	30.0	40 / 34	23/24		↓	↓	grained Sand	↓					
							- EOB -						

sample

* When rock coring, enter rock brokeness.
** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: 140 lb. hammer falling 30-inches
4.25-inch I.D. HSA collected 04-GB01-2830
2" ID Split spoon Samplers

Drilling Area Background (ppm):

Converted to Well: Yes ____ No X
Well I.D. #: N/A

BORING LOG

PROJECT NAME: NWS - EARLE
PROJECT NUMBER: CTO - 289
DRILLING COMPANY: JCA - Drilling
DRILLING RIG: CME - 55
BORING NUMBER: 04 - GB - 02
DATE: 6-17-97
GEOLOGIST: Paul Davis
DRILLER: Steve Burger / Jon Urban

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Sample	Sampler BZ	Borehole**	Driller BZ**
	0.0												
S-1 @	0.0	2 / 2			loose	Grayish orange	Silty fine grained	SM					
1406	2.0	3 / 4	17/24		↓		Sand	↓	moist				
S-2 @	3.0	5 / 6			med. Dense		Silty Clayey fine	SM/SC					
1408	4.0	7 / 8	19/24				grained Sand		moist				
S-3 @	5.0	9 / 9				↓	↓	↓					
1410	6.0	9 / 9	19/24			Gray	Silty very fine	SM					
S-4 @	7.0	7 / 8				↓	grained to fine Sand						
1413	8.0	8 / 7	17/24			Grayish orange	↓	↓					
S-5 @	9.0	5 / 6					Silty clayey VFG sand	SM/SC	moist				
1415	10.0	6 / 11	20/24			↓	Silty very fine gr. Sand	SM					
S-6 @	11.0	8 / 9				Gray							
1418	12.0	13 / 10	18/24										
S-7 @	13.0	7 / 7				Grayish orange	(Trace of Clay)						
1420	14.0	7 / 7	17/24				↓ (Some banding)		moist				
S-8 @	15.0	10 / 11					Silty very fine grained						
1438	16.0	12 / 10	15/24			↓	to fine grained Sand		moist				
S-9 @	17.0	9 / 13			↓	Tan							
1444	18.0	15 / 16	19/24		Dense	↓	↓						
S-10 @	19.0	13 / 15			Med. Dense	Orange Tan	Silty Fine grained Sand						
1451	20.0	12 / 12	21/24			↓	↓ (Some banding)	↓	wet				
S-11 @	21.0	8 / 9				Gray brn	Silty Clayey VFG sand	SM/SC	wet				
1458	22.0	13 / 14	14/24		↓	Orange brn	Silty fine to Coarse Sand	SM/SP	Some gravels				
S-12 @	23.0	13 / 20			Dense				Saturated				
1505	24.0	24 / 14	19/24		↓	↓	↓ (Gravelly)	↓					

Sampled

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm):

Remarks: 140 lb. hammer falling 30-inches
4.25-inch I.D. HSA Collected 04-GB02-18.0 for analysis
2" ID Split spoon Samplers

Converted to Well: Yes ____ No X Well I.D. #: N/A

BORING LOG

PROJECT NAME: NWS - EARLE
PROJECT NUMBER: CTO - 289
DRILLING COMPANY: JCA - Drilling
DRILLING RIG: CME - 55
BORING NUMBER: 04-GB-02
DATE: 6-17-97
GEOLOGIST: PAUL DAVIS
DRILLER: Steve Burger / Jon Urban

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
S13 @	25	11 / 15			Med Dense	orange brown	Silty F. to C. Sand	SM/SP	Saturated				
1513	26	13 / 17	22/24		Med Dense	↓	Silty fine gravel sand	↓					

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm):

Remarks: 140 lb. hammer falling 30-inches
4.25-inch I.D. HSA
2" ID Split Spoon Samplers

Converted to Well: Yes ____ No X   Well I.D. #: N/A

BORING LOG

PROJECT NAME: NWS - EARLE
PROJECT NUMBER: CTO - 289
DRILLING COMPANY: JCA - Drilling
DRILLING RIG: CME - 55
BORING NUMBER: 04-GB-03
DATE: 6-18-97
GEOLOGIST: Paul Davis
DRILLER: Steve Burger / Jon Urban

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm) Sample	Sampler BZ	Borehole**	Driller BZ**
	0.0												
S-1 @	1.0	2 / 4			loose	orange brown	silty fine grained	SM	Dry				
0835	2.0	3 / 2	14/24				sand						
S-2 @	3.0	4 / 6											
0837	4.0	7 / 14	19/24		med. dense	gray orange			moist				
S-3 @	5.0	8 / 8				orange	silty clayey fine	SC	3" wet zone				
0839	6.0	9 / 9	13/24				grained sand						
S-4 @	7.0	8 / 9				gray tan orange	silty fine	SM					
0842	8.0	9 / 9	17/24				grained sand		moist				
S-5 @	9.0	5 / 6					silty clayey fine	SC	4" wet zone				
0845	10.0	7 / 7	20/24				grained sand						
S-6 @	11.0	8 / 9					silty fine grained	SM					
0848	12.0	10 / 11	17/24				sand (banding)		very moist				
S-7 @	13.0	9 / 7											
0904	14.0	9 / 9	18/24				(orange bands)		moist				
S-8 @	15.0	8 / 9					some coarse sand						
0911	16.0	11 / 14	18/24				silty F-C gr. sand	SM/SP	moist				
S-9 @	17.0	13 / 17			Dense	Gray	silty F-C gr. sand		very moist				
0921	18	24 / 32	18/24		very dense	orange	silty F.G. sand	SM	(orange iron dep. lens)				
S-10 @	19.	11 / 17			med dense	gray/tan orange	(some coarse)						
0927	20.	29 / 25	17/24		very dense				very wet				
S-11 @	21.	11 / 17			med dense				saturated				
0933	22.	22 / 24	16/24		Dense								
S-12 @	23.	20 / 30			very dense		silty F-C gr. sand	SM/SP	saturated				
0943	24.	32 / 31	19/24		very dense		(some gravel)						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm):

Remarks: 140 lb. hammer falling 30-inches
4.25-inch I.D. HSA collected 04-GB03-2224 for analysis
2" ID Split spoon Samplers

Converted to Well: Yes ____ No X Well I.D. #: N/A

APPENDIX B

SOIL BORING LOGS - SITE 4 (PREVIOUS INVESTIGATIONS)

US NAVY
1771-0…
FILE

WESTON DESIGNERS CONSULTANTS

DRILLING LOG

WELL NUMBER: 4-1
OWNER: WPNSTA-EARLE
LOCATION: Landfill west of D group
ADDRESS: COLTS NECK NEW JERSEY
TOTAL DEPTH: 30'
SURFACE ELEVATION: 173.00'
WATER LEVEL: 18'
DRILLING COMPANY: JE Fritts
DRILLING METHOD: Auger
DATE DRILLED: 1/8/86
DRILLER: WL
HELPER: RI
LOG BY: AEB

SKETCH MAP

NOTES:
"Surface Elevation" = Top of PVC

DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
0					0-5' Brownish yellow (10YR 6/6) medium sand, some coarse sand
5		28	SS	6 8 11 13	5'-7' Light gray (10YR 7/1) medium sand, some (10%) fine sand, moist, Rec=12"
10		29	SS	8 15 37 41	10'-12' White (10YR 8/1) and brownish yellow (10YR 6/6) medium sand with 10% fine sand, moist, Rec = 12"
15					15'-17' Brownish yellow (10YR 6/6) medium to coarse sand, trace (5%) gravel becoming strong brown (7.5YR 4/6) medium to coarse sand, moist, Rec = 18"
20					

* A.S.T.M. D1586

WESTON

DRILLING LOG

WELL NUMBER: 4-1
OWNER: WPNSTA-EARLE
LOCATION: Landfill west of D Group
ADDRESS: COLTS NECK NEW JERSEY
TOTAL DEPTH: 30'
SURFACE ELEVATION: 173.00'
WATER LEVEL: 18'
DRILLING COMPANY: JE Fritts
DRILLING METHOD: Auger
DATE DRILLED: 1/8/86
DRILLER: WL
HELPER: RI
LOG BY: AEB

SKETCH MAP

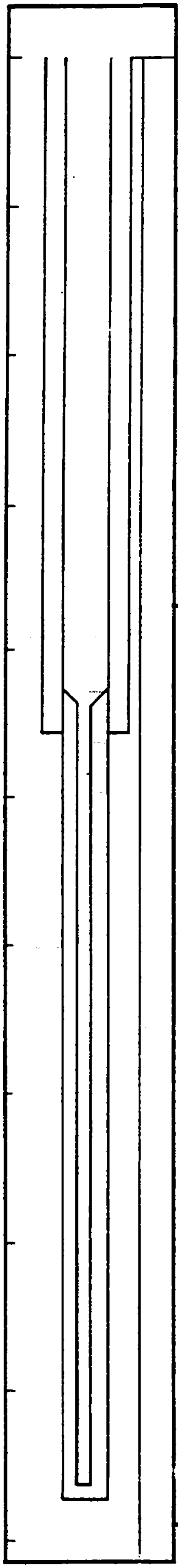
NOTES:

DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
20		31	SS	11 10 19 21	20'-20.5' 2" strong brown (7.5YR 4/6) medium sand over 4" white (10YR 8/1) very coarse sand and gravel.
					20.5'-21.5' Layered, firm fine to medium sand, trace gravel (5%), saturated Rec=18"
25		32		WOR 10 23	25'-27' 2" brown (10YR 4/3) medium to fine sand over 16" of white (10YR 8/1) and brownish yellow (10YR 6/6) fine and medium sand / coarser with depth, Saturated, Rec=18"
30		33			30'-30.5' Very pale brown (10YR 7/4) fine sand
					30.5'-31' Layered light gray (10YR 7/1) and brownish yellow (10YR 6/6) fine sand.
					31'-31.5' 4" Light gray (10YR 7/1) silt over 2" brownish yellow (10YR 6/8) clay, Saturated, Rec = 18"

* A.S.T.M. D1586

Well 4-1

Well Construction Summary



Location or Coords: Landfill West of D Group

Elevation: Ground Level

Top of Casing 173.00'

Drilling Summary:

Total Depth 30'

Borehole Diameter

Driller J.E. Fritts

Rig Mobil Drill B-61

Bit(s) Hollowstem Auger, Roller Bit

Drilling Fluid Water

Surface Casing 6" Steel Locking

Construction Time Log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling:				
HSA	1/8/86	1440	1/8/86	1515
Roller Bit	"	1515	"	1530
Geophys. Logging:				
Casing:				
Install 4" PVC	"	1530	"	1600
Filter Placement:	"	1600	"	1730
Cementing:	1/9/86	0830	1/9/86	0915
Development:	3/21/86	1410	3/21/86	1600
Other:				

Well Design:

Basis: Geologic Log X Geophysical Log

Casing String(s): C = Casing S = Screen

3'	GS+2'	C1	30'	15'	S
15'	GS+2'	C2			

Casing: C1 6" Steel

C2 4" SCH 40 PVC

Screen: S1 4" SCH 40 PVC 10 SLOT

S2

Centralizers

Filter Material #2 Ottawa Sand 30' - 12.5' below GS

Cement 6:1 Portland cement: bentonite 10' - GS

Other Bentonite Pellets 12.5' - 10' below GS

Well Development:

Comments:

Location

Personnel

Project

WESTON DESIGNERS CONSULTANTS

WESTON
DESIGNERS CONSULTANTS

DRILLING LOG

WELL NUMBER: 4-2
OWNER: WPNSTA-EARLE
LOCATION: Landfill west of D group
ADDRESS: COLTS NECK NEW JERSEY
TOTAL DEPTH: 18'
SURFACE ELEVATION: 152.36'
WATER LEVEL: 4'
DRILLING COMPANY: JE Friths
DRILLING METHOD: Auger
DATE DRILLED: 1/9/86
DRILLER: WL
HELPER: RI
LOG BY: AFB

SKETCH MAP

NOTES:
"Surface Elevation" = Top of PVC

DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
0					0-5' Dark brown (10YR 3/3) becoming brownish yellow (10YR 4/6) medium sand, clean. Glauconitic medium sand layer at ~3'. Soil wet at ~4'.
5		34	SS	10 10 11 22	5-5.5' Yellow (10YR 7/8) coarse sand with 50% gravel
					5.5'-7' Yellow (10YR 7/8) fine to coarse sand becoming finer with depth, wet. Rec = 20"
10		35	SS	9 11 19 27	10-12' Yellow (10YR 7/8) fine to medium sand, trace (10%) gravel, saturated, Rec = 20".
15		36	SS	7 6 7 11	15'-16.5' Gray (10YR 7/1) to brownish yellow (10YR 6/6) fine to medium sand, saturated, Rec = 24"
					16.5-17' Reddish yellow (7.5YR 6/8) fine to medium sand
18		37	SS	2 3 3 5	18'-19' Reddish yellow (7.5YR 6/8) clayey silt
					19'-19.4' Light gray (10YR 7/1) very fine sand
20					19.4-20' Reddish yellow (7.5YR 6/8) clay. Saturated, Rec. = 24"

* A.S.T.M. D1586

SHEET 1 OF 1

Well 4-2

Well Construction Summary

Location or Coords: Landfill West of D Group

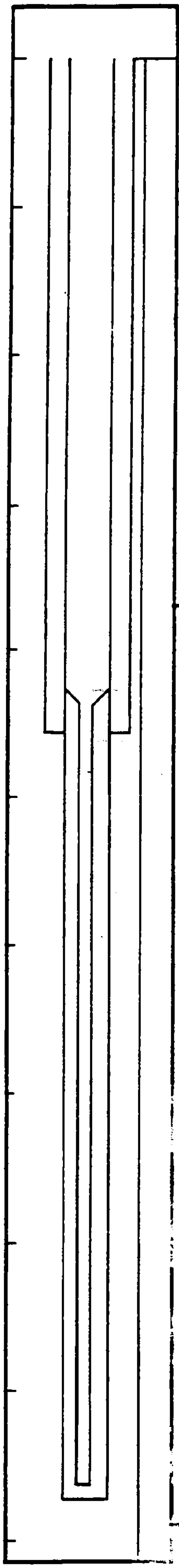
Elevation: Ground Level ______

Top of Casing 152.36'

Project ______

Location ______

Personnel ______



Drilling Summary:

Total Depth 18'

Borehole Diameter ______

Driller J.E. Fritts

Rig Mobil Drill B-61

Bit(s) Hollow stem Auger, Roller Bit

Drilling Fluid ______

Surface Casing 6" Steel Locking

Construction Time Log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling:				
HSA	1/9/86	1350	1/9/86	1500
Roller Bit	"	1500	"	1515
Geophys. Logging:				
Casing:				
Install 4" PVC	"	1515	"	1530
Filter Placement:	"	1530	"	1700
Cementing:	"	1700	"	1715
Development:	3/21/86	1225	3/21/86	1345
Other:				

Well Design:

Basis: Geologic Log X Geophysical Log ______

Casing String(s): C=Casing S=Screen

2' - GS+3' C1 | 18' - 3' S

3' - GS+2' C2

Casing: C1 6" Steel

C2 4" SCH 40 PVC

Screen: S1 4" SCH 40 PVC 10 SLOT

S2 ______

Centralizers ______

Filter Material #2 Ottawa Sand 18' - 2.5' below GS

Cement 6:1 Portland cement: bentonite 2' - GS

Other Bentonite Pellets 2.5' - 2' below GS

Well Development:

Comments:

WESTON DESIGNERS CONSULTANTS

WESTON DESIGNERS CONSULTANTS

DRILLING LOG

WELL NUMBER: 4-3
LOCATION: Landfill west of D group

OWNER: WPNSTA-EARLE
ADDRESS: COLTS NECK NEW JERSEY

TOTAL DEPTH: 25'

SURFACE ELEVATION: 166.40'
WATER LEVEL: 12'

DRILLING COMPANY: JE Fritts
DRILLING METHOD: Auger
DATE DRILLED: 1/10/86

DRILLER: WL
HELPER: RI

LOG BY: AEB

SKETCH MAP

NOTES: "Surface Elevation" = Top of PVC

DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
0					0-5' Brownish yellow (10YR 6/6) fine to medium sand. Light gray (10YR 7/1) at 4.5'.
5		38	SS	4 7 17 22	5'-5.5' White (10YR 8/1) and brownish yellow (10YR 6/6) fine to medium sand
					5.5'-6' Reddish yellow (7.5YR 6/8) medium to coarse sand
					6'-6.5' White (10YR 8/1) and yellowish red (5YR 5/8) medium to very coarse sand + gravel (5%) moist, Rec = 18"
10		39	SS	15 24 32 30	8.5'-10.5' Layered white (10YR 8/1) and brownish yellow (10YR 6/6) fine to medium sand and coarse sand to gravel alternating, moist, tip of spoon damp, Rec = 18"
					13.5'-14' Reddish yellow (7.5YR 6/8) fine to coarse sand, trace (5%) gravel (up to ½").
15		40		12 24 18 18	14'-15.5' Brownish yellow (10YR 6/6) and yellowish red (5YR 5/8) medium to very coarse sand, 20% gravel, saturated, Rec = 22"
20					

* A.S.T.M. D1586

US NAVY

WESTON

1771-02-10

FILE

DRILLING LOG

WELL NUMBER: 4-3

OWNER: WPNSTA - EARLE

LOCATION: Landfill west of D Group

ADDRESS: COLTS NECK NEW JERSEY

TOTAL DEPTH: 25'

SURFACE ELEVATION: 166.40'

WATER LEVEL: 12'

DRILLING COMPANY: JE Fritts

DRILLING METHOD: HSA

DATE DRILLED: 1/10/86

DRILLER: WL

HELPER: RT

LOG BY: AEB

SKETCH MAP

NOTES:

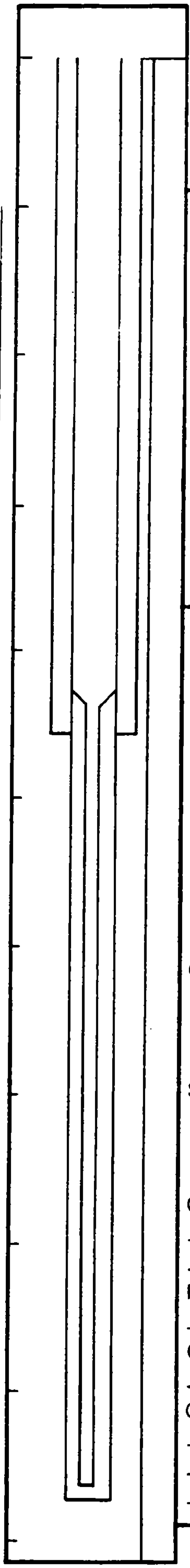
DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
15					
		41	SS	10 12	18.5-19' Brownish yellow (10YR 6/6) very coarse sand
				32 38	and gravel (up to 1/2").
20					19-20' Brownish yellow (10YR 6/6) fine to medium
					sand
					20-20.5' Light gray (10YR 7/1) fine to medium
					sand, saturated, Rec. = 24"
		42		8 14	23.5-24' Brownish yellow (10YR 6/6) medium to
25				19 27	very coarse sand.
					24-25' Brownish yellow (10YR 6/6) fine to medium sand, some reddish yellow (7.5YR 6/8)
					mottles.
					25-25.5' Light gray (10YR 7/1) fine sand, clean,
					saturated, Rec = 24"

* A.S.T.M. D1586

SHEET 2 OF 2

Well 4-3

Well Construction Summary



Location ______
Personnel ______
Project ______

Location or Coords: Landfill West of D Group

Elevation: Ground Level ______
Top of Casing 166.40'

Drilling Summary:

Total Depth 25'
Borehole Diameter ______

Driller J.E. Fritts

Rig Mobil Drill B-61
Bit(s) Hollowstem Auger, Roller Bit
Drilling Fluid Water

Surface Casing 6" Steel Locking

Construction Time Log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling:				
HSA	1/10/86	1015	1/10/86	1145
Roller Bit	"	1315	"	1330
Geophys. Logging:				
Casing:				
Install 4" PVC	"	1330	"	1400
Filter Placement:	"	1400	"	1530
Cementing:	"	1530	"	1550
Development:	3/21/86	1050	3/21/86	1215
Other:				

Well Design:

Basis: Geologic Log X Geophysical Log ______
Casing String(s): C=Casing S=Screen

3' - GS+2'	C1	25' - 10'	S
10' - GS+2'	C2		

Casing: C1 6" Steel
C2 4" SCH 40 PVC

Screen: S1 4" SCH 40 PVC 10 SLOT
S2 ______

Centralizers ______

Filter Material #2 Ottawa Sand 25'-8' below GS

Cement 6:1 Portland cement: bentonite 6'-GS

Other Bentonite Pellets 8'-6' below GS

Well Development:

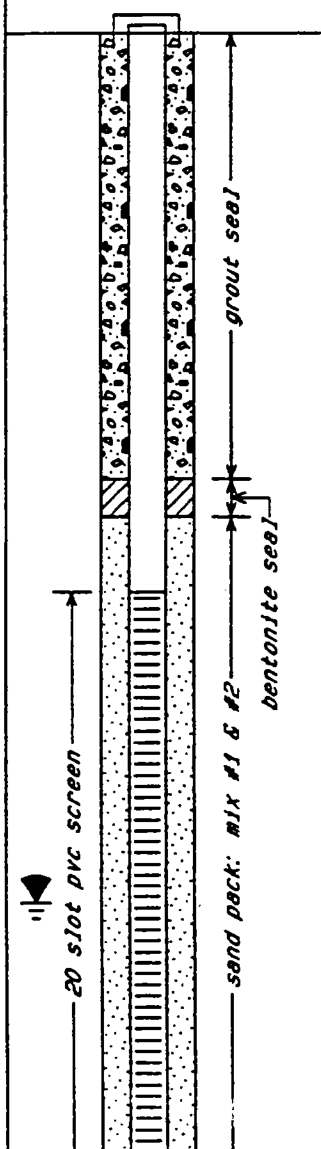
Comments:

WESTON
DESIGNERS CONSULTANTS

MONITOR WELL 4-4

Project	N.W.S. Earle/ Colts Neck	Well Number	MW04-4
Location	Colts Neck, N.J.	Coordinates	
Geologist	T. McCann	Top of Casing Elevation	181.28 feet MSL
Drilling Contractor	B. L. Myers	Groundsurface Elevation	feet
Driller	B. Stringer	Total Borehole Depth	35.5 feet
Drilling Method	Hollow stem auger	Total Well Depth	35.0 feet
Diameter of Borehole	11.5 (7.5) inches	Date Started	1/30/91
Diameter of Well Casing	4 inches	Date Well Completed	2/08/91

WELL CONSTRUCTION DETAIL



DEPTH IN FEET	BLOW COUNT	% RECOVERY	GRAPHIC SYMBOL
0-2	2,3 / 5,5	79	SM
2-4	4,5 / 4,7	67	GM
4-6	3,6 / 7,11	50	
6-8	2,6 / 10,11	79	SM
8-10	4,8 / 8,9	71	
10-12	6,10 / 10,10	75	
12-14	3,9 / 9,14	75	
14-16	9,10 / 16,11	81	
16-18	4,11 / 14,14	75	
18-20	10,21 / 21,30	73	
20-22	15,29 / 30,38	46	GM
22-24	9,34 / 50,99/4		
24-26	7,9 / 16,23	88	GM
29-30	5,8		GM

DESCRIPTION

0.0-2.0
0-6": Very dark brown (10YR2/2), SAND, fine, some Silt, loose, moist.
6-19": grading to a Dark grayish brown (10YR4/2), SAND, v.f. to fine, some SILT, loose, moist.
HNU = BKG

2.0-4.0
Yellowish brown (10YR5/8), SAND, some Silt, little fine-med. Qtz gravel, subrounded, Fe staining, at 2.5-3.5 ft. tan SAND, v. fine, some Silt, moist.
HNU = BKG

4.0-6.0
Same as above, little fine to coarse Sand moist.

6.0-8.0
Yellow (10YR8/6), SAND, v. fine, some Silt, banding apparent at 6-6.5ft and 13-13.5ft, both Yellow (10YR7/6), moist.

8.0-10.0
Reddish yellow (7.5YR6/8), SAND, v.f., some Silt, grading to Brownish yellow (10YR6/8) at 9.5-17", moist.

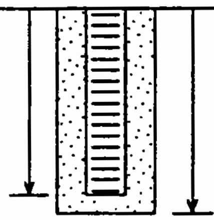
10.0-12.0
10-10.5': Brownish yellow (10YR6/8), SAND, v. fine, some Silt, 2" layer of Dark brown (10YR3/4), SAND, v. fine, some Silt, moist.
10.5-11.5': Very pale brown (10YR7/4), SAND, some Silt, v.f., loose, moist.

12.0-14.0
Very pale brown (10YR7/4), Sand, v. fine, some Silt, grading to Very pale brown (10YR8/4) at 11.5-18". moist.

14.0-16.0
Very pale brown (10YR8/4), SAND and SILT, v. fine, mottled color throughout, strong band of Yellow (10YR7/8) at 6.5-7.5", moist.

MONITOR WELL 4-

PROJECT N.W.S. Earle/ Colts Neck WELL NUMBER MW04-4

DEPTH IN FEET	WELL CONSTRUCTION DETAIL	SAMPLE INTERVAL	BLOW COUNT	% RECOVERY	GRAPHIC SYMBOL
30		X	17, 28		GM
32					
34					
36					
38					
40					
42					
44					
46					
48					
50					
52					
54					
56					
58					
60					
62					
64					
66					
68					
70					

DESCRIPTION

16.0-18.0
Very pale brown (10YR7/3), SAND, v. fine, some Silt, uniform, no banding, little Qtz gravel @ 13-14.5", rounded, moist.

18.0-20.0
Very pale brown (10YR7/4), Sand, some Silt, little gravel, subrounded, SAND: 80% fine, 15% med., 5% crse, banding: 4-5": (10YR7/6), 12.5-13.5": (10YR8/1), 15.5-16": (10YR7/8), moist.

20.0-22.0
Light gray (10YR7/2), SAND, some Silt, 0-2": Pale brown (10YR6/3) SAND, v.f., 7-7.5": dominant Reddish yellow (5YR6/8), fine, some angular Qtz gravel.
7.5-11": White (10YR8/1), fine-med., SAND, damp.

22.0-24.0
No sample taken. Hammer lost in hole.

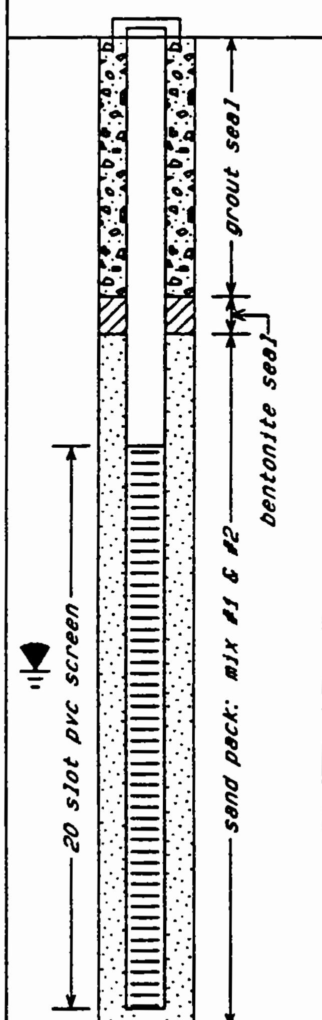
24.0-26.0
Olive yellow (2.5Y6/8), SAND and SILT, v. fine, .25mm bands of Very dark grayish brown (2.5Y3/2), some rounded Qtz gravel, wet.
HNU = .4 ABKG (spoon)

29.0-31.0
Same as above, wet.

MONITOR WELL 4-5

Project	N.W.S. Earle/ Colts Neck	Well Number	MW04-5
Location	Colts Neck, N.J.	Coordinates	
Geologist	J. Williams	Top of Casing Elevation	165.28 feet MSL
Drilling Contractor	B. L. Myers	Groundsurface Elevation	feet
Driller	B. Stringer	Total Borehole Depth	26.5 feet
Drilling Method	Hollow stem auger	Total Well Depth	26.0 feet
Diameter of Borehole	11.5 (7.5) inches	Date Started	2/20/91
Diameter of Well Casing	4 inches	Date Well Completed	2/20/91

DEPTH IN FEET | WELL CONSTRUCTION DETAIL



DEPTH IN FEET	SAMPLE INTERVAL	BLOW COUNT	* RECOVERY	GRAPHIC SYMBOL
0–2	X	1,9 / 15,13	92	SM
2–4	X	11,13 / 14,11	71	
4–6	X	5,8 / 7,10	46	
6–8	X	6,16 / 12,21	62	
8–10	X	8,10 / 21,26	54	GM
10–12	X	9,14 / 28,20	71	
12–14	X	14,16 / 16,10	58	
14–16	X	9,12 / 16,18	62	
16–18	X	9,11 / 11,13	62	

DESCRIPTION

0.0-2.0
Dark brown (10YR4/3), SAND, med. w/ some coarse grains, Black silt layer (10YR2/1), moist.

2.0-4.0
Grayish brown (10YR5/2), SAND, med. and coarse grain, poor sorting, some fine Qtz gravel, moist.

4.0-6.0
Reddish brown (5YR5/4), SAND, fine - med. grain, Fe staining, trace fine gravel, moist.
HNU = BKG

6.0-8.0
Reddish brown (5YR5/4), SAND, f-m, trace fine to med. Qtz gravel, Fe staining, moist.

8.0-10.0
Reddish brown (5YR5/4), SAND, fine - med. little fine to med. Qtz gravel, subangular, Fe staining, dk. brown silt streaks, moist.

10.0-12.0
Reddish brown (5Yr5/4), SAND, fine to med., some f-m subangular Qtz gravel, seams of Fe stains, moist.

12.0-14.0
Pink (5YR7/3), SAND and Qtz GRAVEL, fine to med., poor sorting, moist.

14.0-16.0
Reddish brown (5YR5/4), SAND, fine to coarse, and Qtz GRAVEL, f-m, Fe staining, wet @15'.

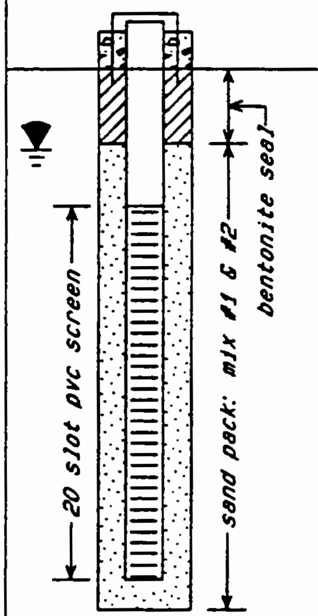
16.0-18.0
Brownish yellow (10YR6/8), SAND, fine, at 17ft there is 2" band coarse SAND and fine GRAVEL, loose, wet.

* Discontinue split spooning due to running sands. Drill to 27 ft.

MONITOR WELL 4-6

Project	N.W.S. Earle/ Colts Neck	Well Number	MW04-6
Location	Colts Neck, N.J.	Coordinates	
Geologist	T. McCann	Top of Casing Elevation	149.75 feet MSL
Drilling Contractor	B. L. Myers	Groundsurface Elevation	feet
Driller	B. Stringer	Total Borehole Depth	14.5 feet
Drilling Method	Hollow stem auger	Total Well Depth	13.7 feet
Diameter of Borehole	11.5 (7.5) inches	Date Started	2/25/91
Diameter of Well Casing	4 inches	Date Well Completed	2/25/91

DEPTH IN FEET | WELL CONSTRUCTION DETAIL



DEPTH IN FEET	SAMPLE INTERVAL	BLOW COUNT	% RECOVERY	GRAPHIC SYMBOL
0–2	X	5,6 / 5,6	75	SP
2–4	X	6,10 / 12,15	75	GM
4–6	X	10,16 / 17,17	54	
6–8	X	10,12 / 17,17	71	
8–10	X	8,10 / 11,12	63	SM

Depth scale: 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30

DESCRIPTION

0.0-2.0
Light gray (10YR7/2), SAND, med. to poor sorting, fine to v.fine grain, damp:
0-1": SILT and SAND loam.
1-5": SAND, v.f. to f., some med. Qtz. gravel, (10YR6/4)
5-18": SAND, vf to f, some med. Qtz grvl. (10YR7/2)

2.0-4.0
Light brownish gray, SAND, some Silt, some gravel, wet:
2.0-2.5': SAND, coarse to fine, poor sort, little Qtz gravel, med.,
2.5-2.8': SAND and SILT, some Qtz gravel, med., Dark gray (10YR4/1).
2.8-3.3': SAND, v.f. to f., some Qtz grvl., Very pale brown (10YR7/4).

4.0-6.0
Pale yellow (2.5Y7/4), SILT and SAND, v.f. to fine, little Qtz Gravel, med. grain, subrounded at 4.9' where color grades to Yellow (2.5Y7/6), wet

6.0-8.0
Yellow (2.5Y7/6), SILT and SAND, v.f. to fine, some medium Qtz Gravel, wet

8.0-10.0
Light gray (10YR7/2), SILT and SAND, very fine, wet:
8.0-8.35': Light gray (10YR7/2), SILT and SAND, v. fine, well sorted.
8.35-8.6': Yellow (10YR7/6), SILT and SAND v. fine.
8.6-9.2': Light gray (10YR7/2), SILT and SAND, v. fine, well sorted.

APPENDIX C

GEOTECHNICAL LABORATORY RESULTS - SITE 4

VALLEY
FORGE
LABORATORIES, INC.

30th
1967 ANNIVERSARY 1997

Engineering Consultants Since 1967

SOIL LABORATORY TEST REPORT 6-6

RECEIVED
JUL 02 1997

Project No. 97128
June 30, 1997

Geotechnical Engineering

Attention: Mr. Dan Witt
Brown and Root Environmental
661 Andersen Drive
Foster Plaza 7
Pittsburgh, PA 15220

Construction Quality Control

Re: Subcontract Agreement No. GCDB-97-526-1298, Analytical Services
CTO No. 289 - Naval Weapons Station (NWS), Earle Colts Neck, N.J.

Samples Picked Up: On 6/23/97 by VFL, 9 samples from 18 jars

Laboratory Testing

Testing Completed: (As requested on Chain of Custody Form, 4 Samples at Level D P.P.E. and 5 Samples at Level C P.P.E.)

NDT and Related Services

Test	ASTM Standard
Natural Moisture Content	D2216
Particle Size Analysis (Sieve and Hydrometer)	D422
Atterberg Limits	D4318
USCS Classification	D2487

Research and Special Studies

Results:

The results of the testing are graphically depicted on the attached Grain Size Distribution Curves. If you have any questions about this test report, please call.

Environmental Engineering

Sincerely,

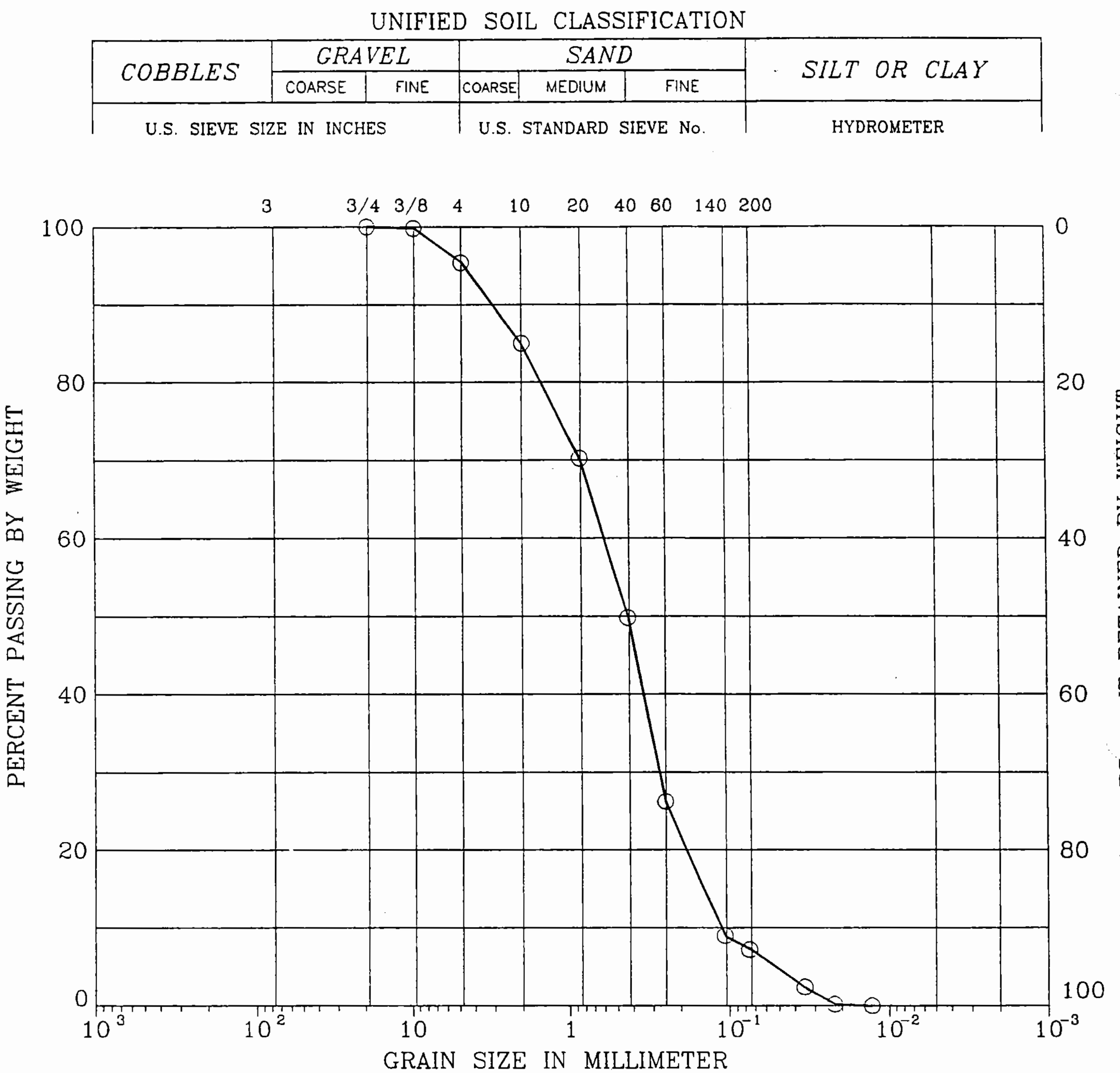
Eric J. Seksinsky

Eric J. Seksinsky, P.G., P.E.
Technical & Quality
System Manager

Transportation and Traffic Engineering

EJS:lcw
Enclosure
cc: Mike Wireman

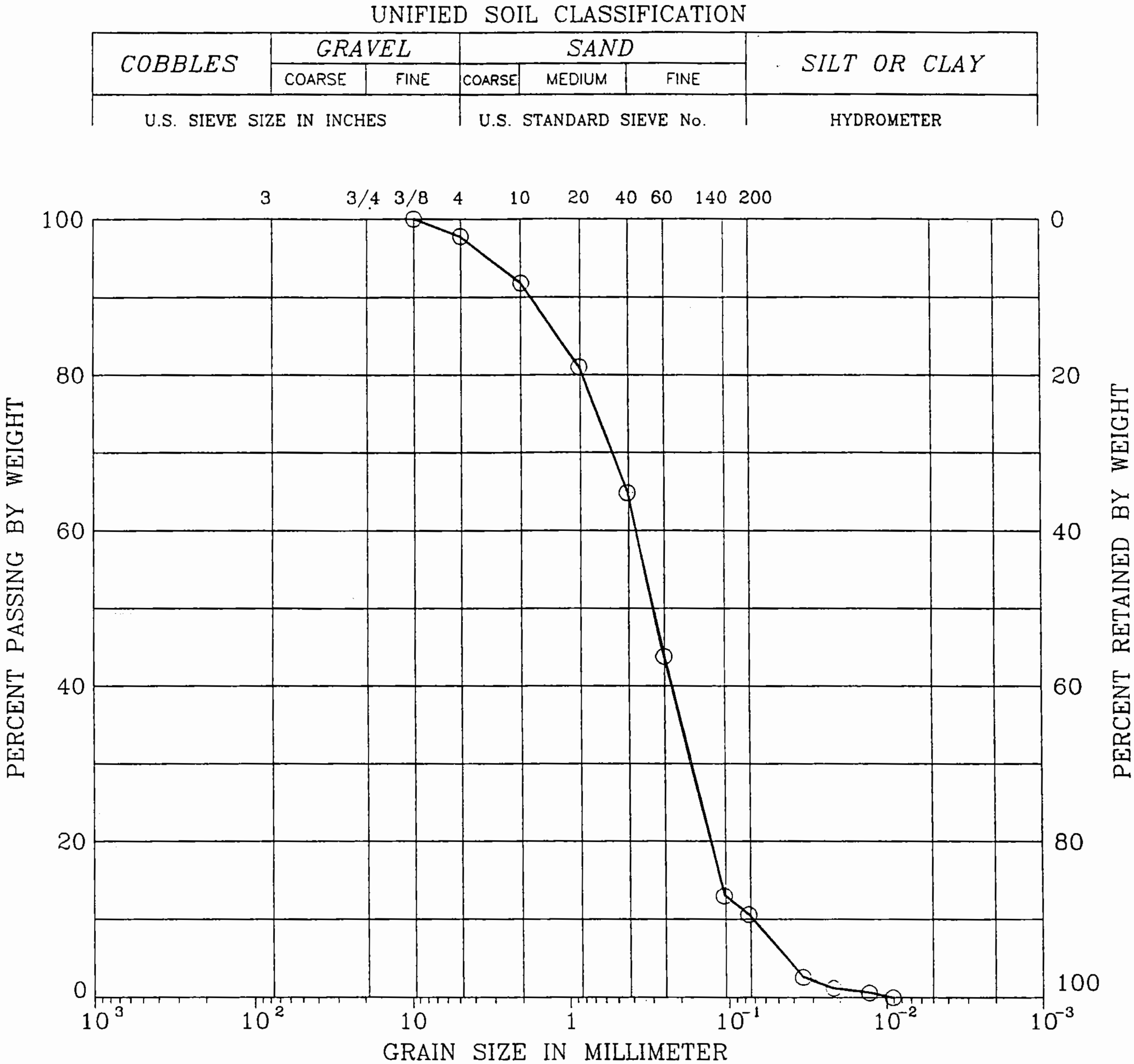
Fax (610) 688-8143 • 6 Berkeley Road, Devon, PA 19333-1397 • (610) 688-8517
URL: http://www.mgar.com/vfl • E-mail : vflabs@voicenet.com



SYMBOL	BORING	LL (%)	PI (%)	DESCRIPTION
O	04-GB01-2224	NON-PLASTIC		TAN POORLY-GRADED SAND WITH SILT (SP-SM)

Remark : NAT. MOISTURE CONTENT 5.4 LEVEL D P.P.E.

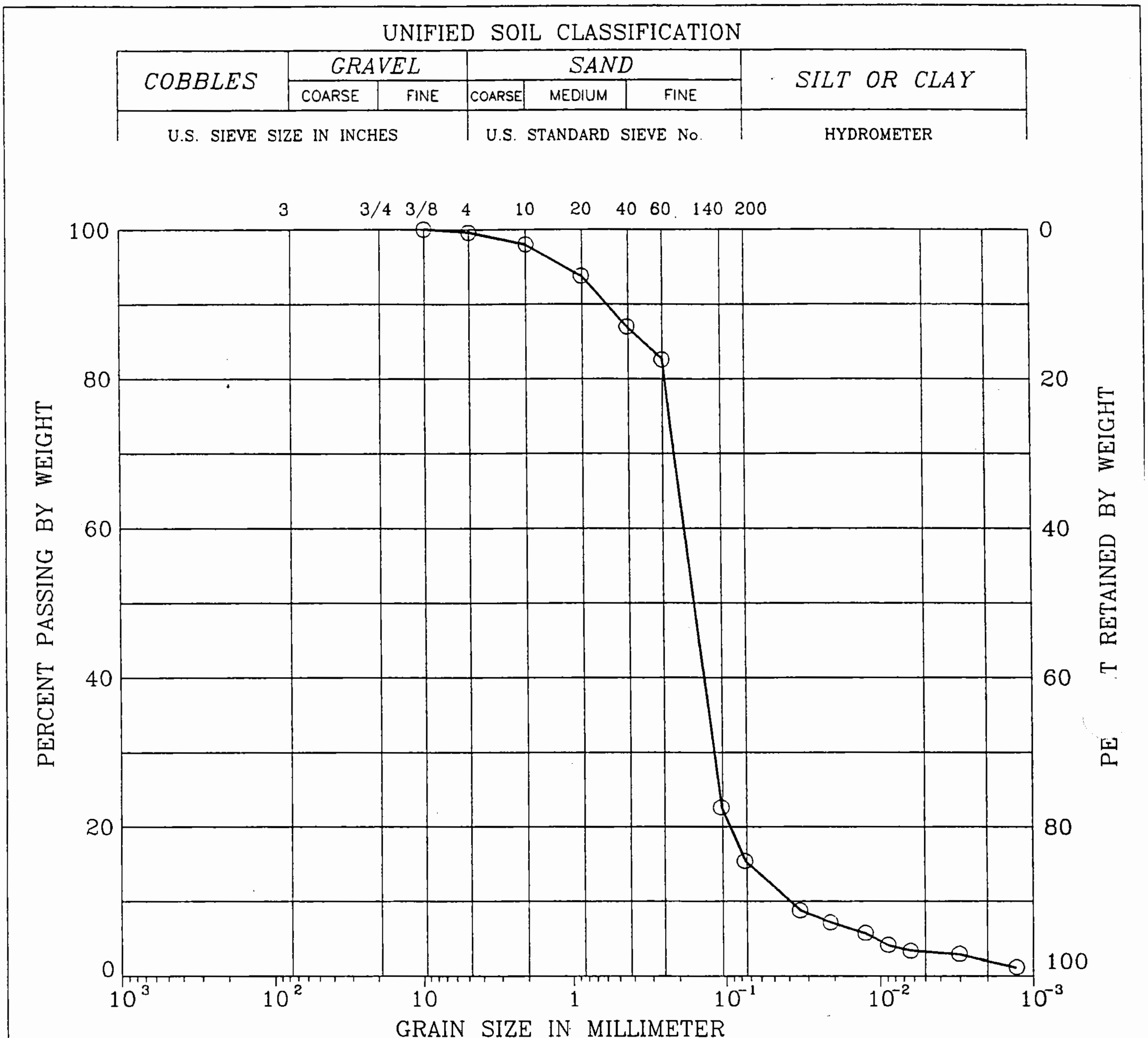
Project No. 97128	BROWN ROOT ENVIRONMENTAL
Valley Forge Laboratories, Inc.	GRAIN SIZE DISTRIBUTION 6/30/97



SYMBOL	BORING	LL (%)	PI (%)	DESCRIPTION
O	04-GB01-2830	NON-PLASTIC		TAN POORLY-GRADED SAND WITH SILT (SP-SM)

Remark : NAT. MOISTURE CONTENT 11.9 LEVEL D P.P.E.

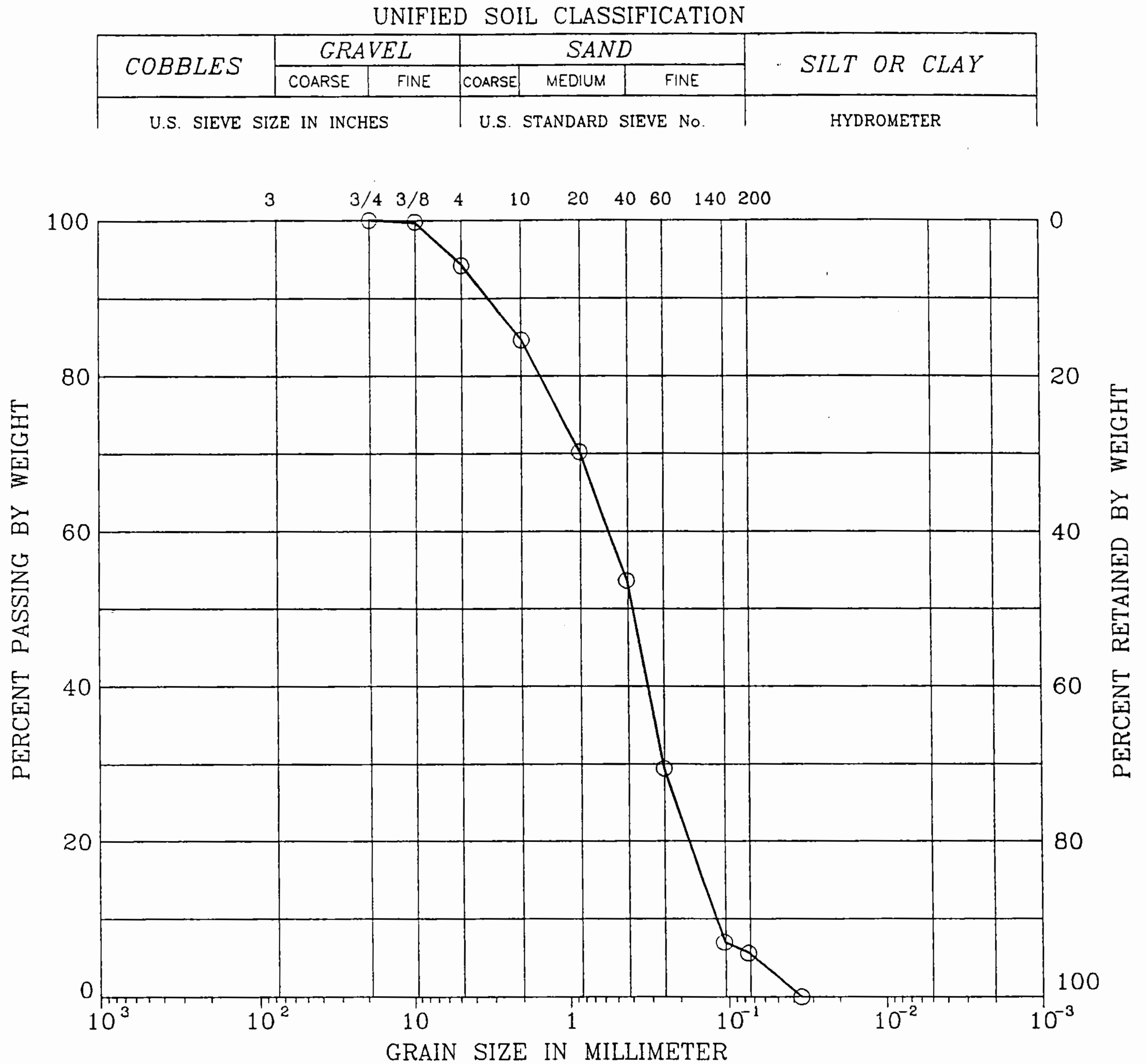
Project No. 97128	BROWN ROOT ENVIRONMENTAL
Valley Forge Laboratories, Inc.	GRAIN SIZE DISTRIBUTION 6/30/97



SYMBOL	BORING	LL (%)	PI (%)	DESCRIPTION
○	04-GB02-1820	NON-PLASTIC		TAN SILTY SAND (SM)

Remark : NAT. MOISTURE CONTENT 12.5

Project No. 97128	BROWN ROOT ENVIRONMENTAL
Valley Forge Laboratories, Inc.	GRAIN SIZE DISTRIBUTION 6/30/97



SYMBOL	BORING	LL (%)	PI (%)	DESCRIPTION
○	04-GB03-2224	NON-PLASTIC		TAN POORLY-GRADED SAND WITH SILT (SP)

Remark : NAT. MOISTURE CONTENT 14.1 LEVEL D P.P.E.

Project No. 97128	BROWN ROOT ENVIRONMENTAL
Valley Forge Laboratories, Inc.	GRAIN SIZE DISTRIBUTION 6/30/97

APPENDIX D

TEST PIT LOGS - SITE 4

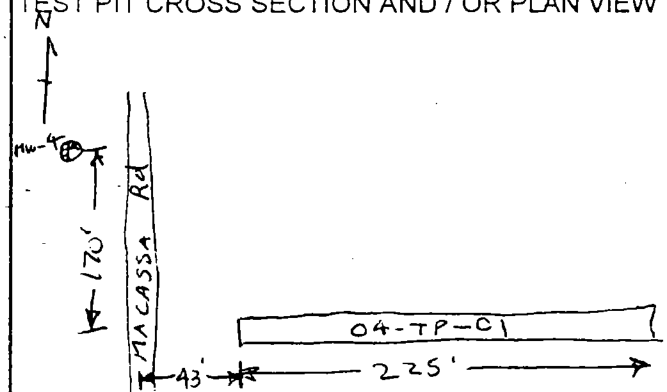
TEST PIT LOG

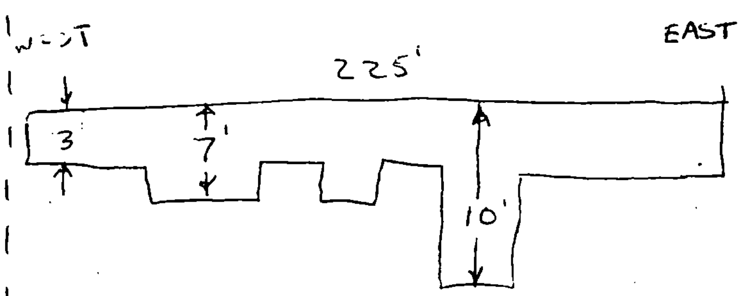
PROJECT NAME: NWS EARLE
PROJECT NUMBER: 7602
LOCATION: SITE 4

TEST PIT NUMBER: 04-TP-01
DATE: 6/17/97
GEOLOGIST: D. WITT

Depth (Ft.)	Lithology Change (Depth/Ft.)	MATERIAL DESCRIPTION Soil/Waste Characteristics (lithology, density, color, etc.)	USCS	Remarks	PID/FID READING Source (ppm)	BZ (ppm)
		-- ORANGE SANDY SOIL				
		APPEARS UNDISTURBED				
	10'					
	END OF TEST TRENCH					

TEST PIT CROSS SECTION AND / OR PLAN VIEW





TEST TRENCH ENDED BEFORE HITTING WASTE BECAUSE BACKHOE COULD NOT ADVANCE PAST TREES

REMARKS: TRENCH DUG CONTINOUSLY, OCCASSIONALLY GOING DEEPER TO 7'-10' DEEP, ALL CLEAN SAND

BEGIN TRENCH 10:30
12:45 BREAK FOR LU.

PHOTO LOG: PICTURES #1, 2, 3

11:00 HNU READING 0 BREATHING ZONE/SPOIL PILE
11:20 " " " " " " "
11:40 " " " " "

BEGIN BACKFILL TRENCH 13:45
FINISH BACKFILLING 15:40

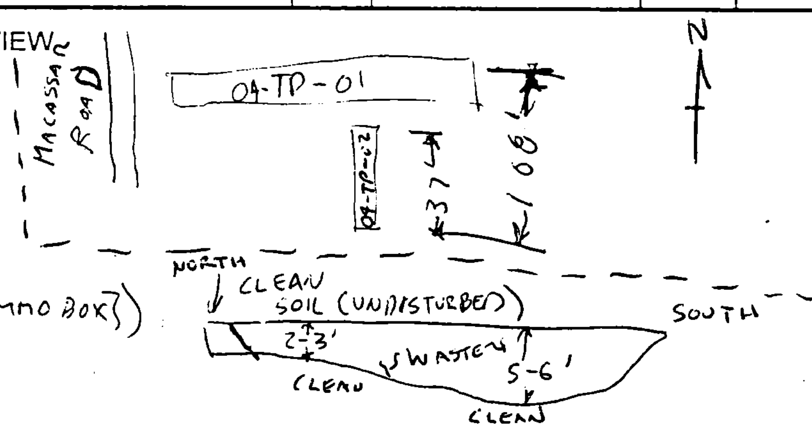
TEST PIT LOG

PROJECT NAME: NWS EARLE
PROJECT NUMBER: 7602
LOCATION: 04-TP-02
TEST PIT NUMBER: 04-TP-02
DATE: 6/17/97
GEOLOGIST: D. WITT

Depth (Ft.)	Lithology Change (Depth/Ft.)	MATERIAL DESCRIPTION Soil/Waste Characteristics (lithology, density, color, etc.)	USCS	Remarks	PID/FID READING Source (ppm)	PID/FID READING BZ (ppm)
		METAL WASTE WITH				
		BROWN SILTY SAND				
		DEPTH OF WASTE ≈ 5-6'				
		END OF TRENCH NEAR 04TP-01				
		AGAIN REACHED ORANGE SAND				

TEST PIT CROSS SECTION AND / OR PLAN VIEW

TEST PIT BEGUN
AT AREA OF SURFACE WATE
METAL BANDING, SMALL PIPES
BATTERIES (EMPTY CONTAINERS [AMMO BOX])
ELECTRONICS IN PLASTIC BAGS?



REMARKS: 10:05 NO HNUS READING BREATING ZONE / SPOIL PILE
10:15 " " " " "
10:25 " "

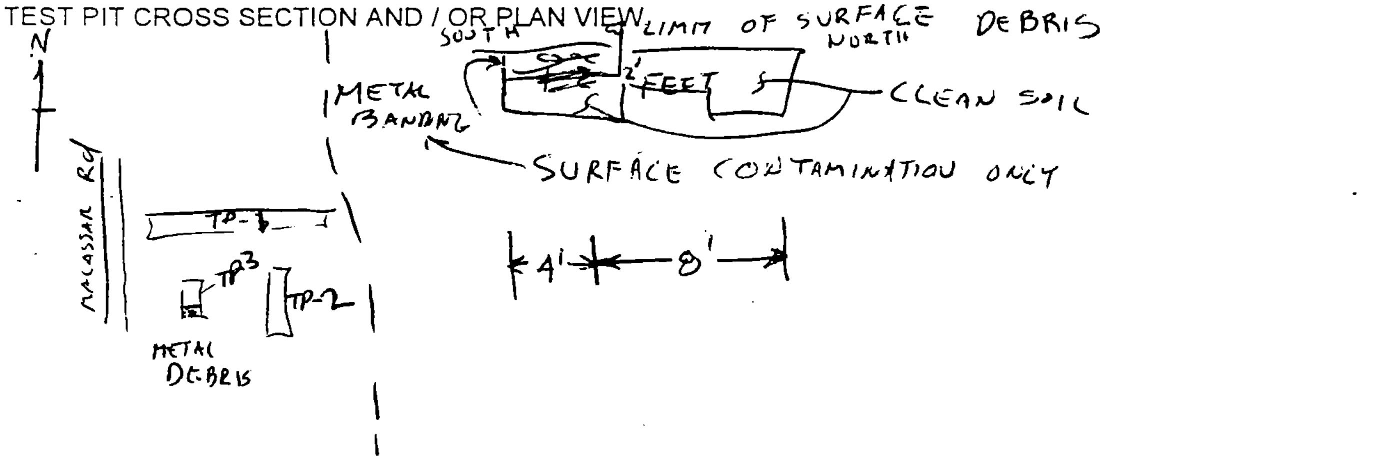
PHOTO LOG: #4 04TP-02

TEST PIT LOG

PROJECT NAME: NWS EARLE
PROJECT NUMBER: 7602
LOCATION: 04-TP-03
TEST PIT NUMBER: 04-TP-03
DATE: 6/18/97
GEOLOGIST: DCW

Depth (Ft.)	Lithology Change (Depth/Ft.)	MATERIAL DESCRIPTION Soil/Waste Characteristics (lithology, density, color, etc.)	USCS	Remarks	PID/FID READING Source (ppm)	BZ (ppm)
		BROWN SAND WITH				
	2'	METAL BANDING				
	END OF	METAL DEBRIS				
	TEST	CLEAN SOIL BELOW				
	PIT					

TEST PIT CROSS SECTION AND / OR PLAN VIEW



REMARKS:

PHOTO LOG:

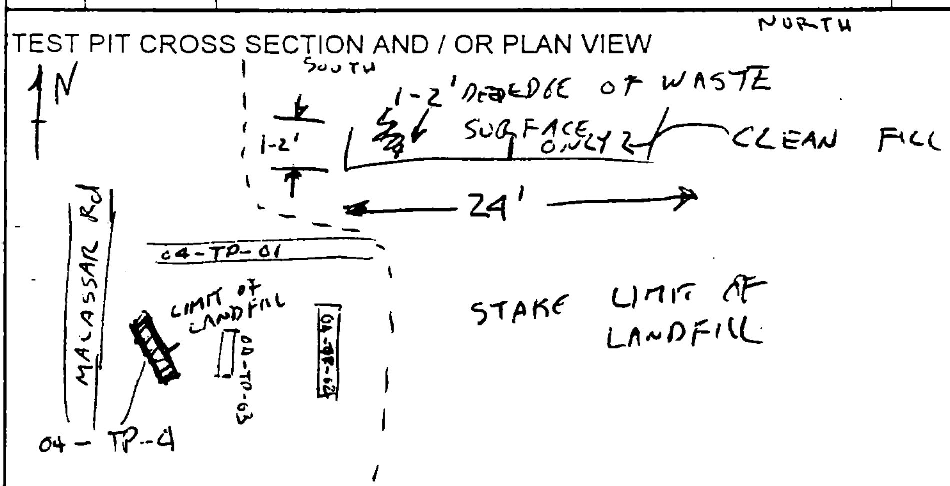
TEST PIT LOG

PROJECT NAME: NWS EARLE
PROJECT NUMBER: 7602
LOCATION: SITE 4

TEST PIT NUMBER: 04-TP-04
DATE: 6/18/97
GEOLOGIST: DCW

Depth (Ft.)	Lithology Change (Depth/Ft.)	MATERIAL DESCRIPTION: Soil/Waste Characteristics (lithology, density, color, etc.)	USCS	Remarks	PID/FID READING: Source (ppm)	PID/FID READING: BZ (ppm)
		BROWN SAND METAL				
	2'	DEBRIS				
	END OF	CLEAN SOIL				
	TEST					
	PIT					

TEST PIT CROSS SECTION AND / OR PLAN VIEW



REMARKS: PHOTO 5 TP-04

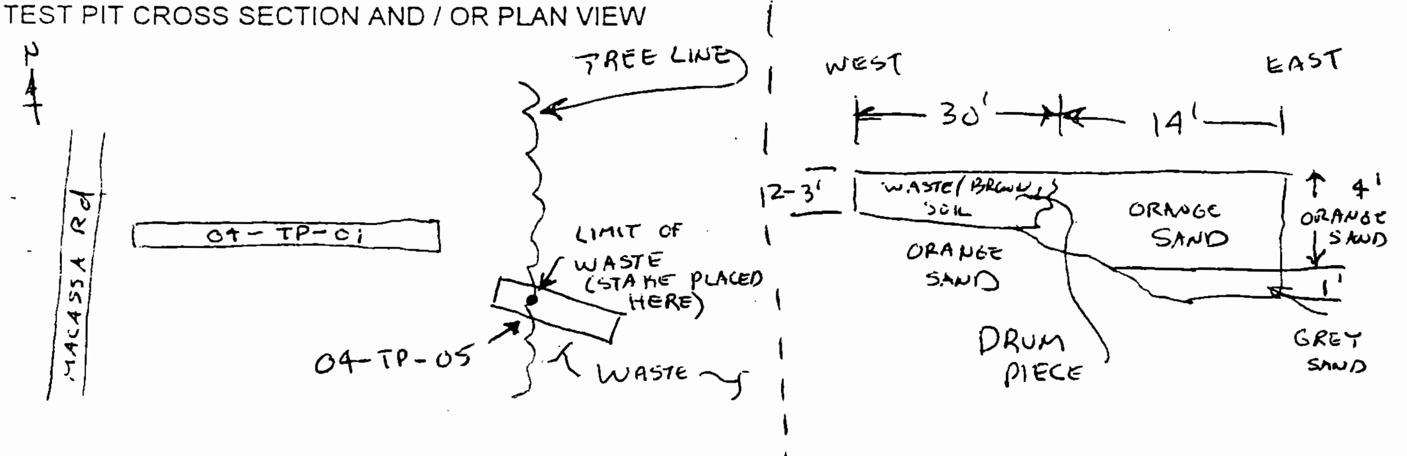
PHOTO LOG:

TEST PIT LOG

PROJECT NAME:	NWS EARLE	TEST PIT NUMBER:	04-TP-05
PROJECT NUMBER:	7602	DATE:	6/18/97
LOCATION:	SITE 4	GEOLOGIST:	D. WITT

Depth (Ft.)	Lithology Change (Depth/Ft.)	MATERIAL DESCRIPTION: Soil/Waste Characteristics (lithology, density, color, etc.)	USCS	Remarks	PID/FID READING: Source (ppm)	PID/FID READING: BZ (ppm)
		BROWN SAND WITH				
		METAL DEBRIS				
	3'					
	4'	ORANGE SAND CLEAN				
	5'	GREY SAND CLEAN				
	END OF TEST PIT					

TEST PIT CROSS SECTION AND / OR PLAN VIEW



REMARKS: BEGIN 9^{15}
FINISH BACKFILL 10^{35}

PHOTO LOG: # ~~5~~-6, 7, 8 PIPE ~~LIEING~~ LYING ACROSS TRENCH
9^{45} HNU 0 READING BREATHING ZONE / SPOIL PILE
10^{10} " " " " " " "

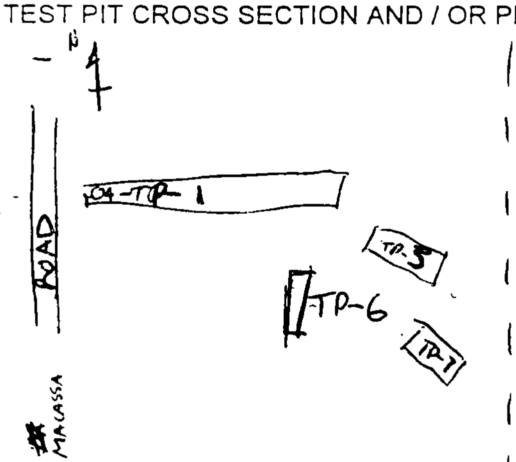
TEST PIT LOG

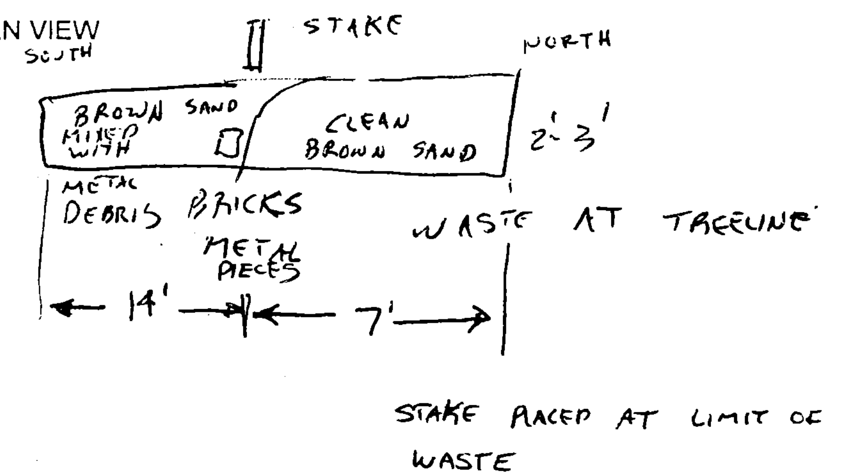
PROJECT NAME: NWS EARLE
PROJECT NUMBER: 7602
LOCATION: SITE 4

TEST PIT NUMBER: 04-TP-06
DATE: DCW 6/18/97
GEOLOGIST: DAN WITT

Depth (Ft.)	Lithology Change (Depth/Ft.)	MATERIAL DESCRIPTION Soil/Waste Characteristics (lithology, density, color, etc.)	USCS	Remarks	PID/FID READING Source (ppm)	PID/FID READING BZ (ppm)
		BROWN SOIL (SAND)				
		MIXED WITH METAL DEBRIS				
	3'					
	END OF					
	TEST PIT					

TEST PIT CROSS SECTION AND / OR PLAN VIEW





REMARKS: TRYED TEST PIT COULD NOT REACH THE END (JUG S
MOVED TRENCH 11 AM NO HNUS RG)
READING

PHOTO LOG:

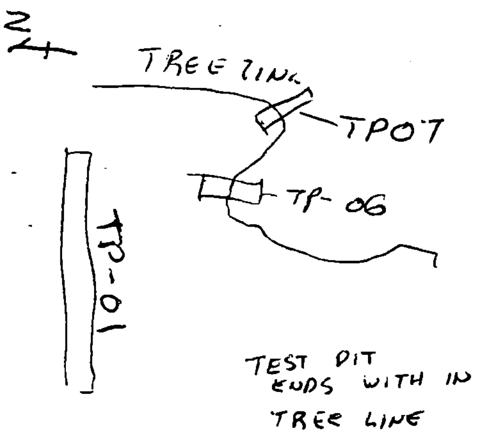
TEST PIT LOG

PROJECT NAME: NWS EARLE
PROJECT NUMBER: 7602
LOCATION: SITE 4

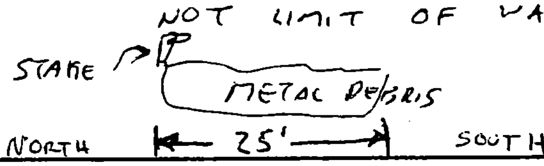
TEST PIT NUMBER: 6/18/97
DATE: 04-TP-07
GEOLOGIST: D WITT

Depth (Ft.)	Lithology Change (Depth/Ft.)	MATERIAL DESCRIPTION Soil/Waste Characteristics (lithology, density, color, etc.)	USCS	Remarks	PID/FID READING Source (ppm)	PID/FID READING BZ (ppm)
		BROWN SOIL (SAND)				
	2-3'	METAL DEBRIS				
	BOTTOM OF TEST PIT					

TEST PIT CROSS SECTION AND / OR PLAN VIEW



- TEST PIT ADVANCE AS FAR AS POSSIBLE
- TREES STOPPED ADVANCE OF BACKHOE
- METAL DEBRIS AT ENT OF TRENCH CONTIUES INTO TREES FURTHER
- STAKES AT THE LIMIT OF T.P NOT LIMIT OF WASTE



REMARKS:

PHOTO LOG:

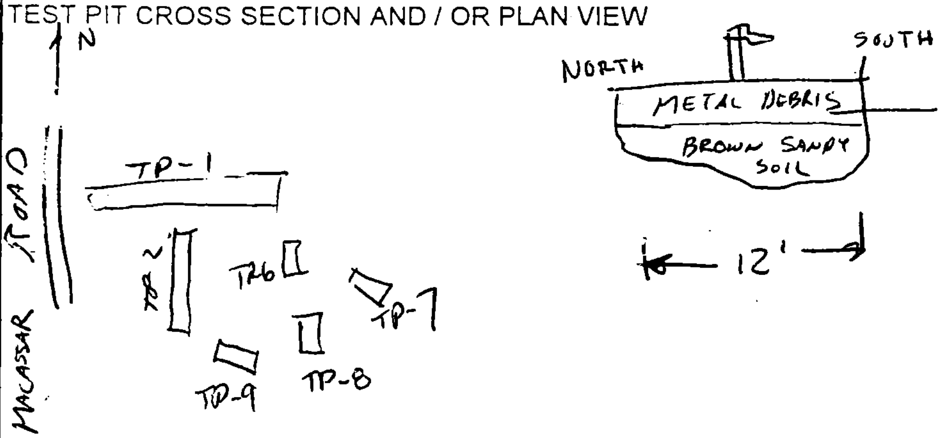
TEST PIT LOG

PROJECT NAME: NWS EARLE
PROJECT NUMBER: 7602
LOCATION: SITE 4

TEST PIT NUMBER: 04-TP-08
DATE: 6/18/97
GEOLOGIST: D WITT

Depth (Ft.)	Lithology Change (Depth/Ft.)	MATERIAL DESCRIPTION Soil/Waste Characteristics (lithology, density, color, etc.)	USCS	Remarks	PID/FID READING Source (ppm)	BZ (ppm)
		BROWN SANDY SOIL				
		METAL DEBRIS				
	3'					
	BOTTOM OF TEST PIT					

TEST PIT CROSS SECTION AND / OR PLAN VIEW



DEPTH OF WASTE ONLY ≈1' THICK

STAKE IS AT CENTER OF TEST PIT NOT THE LIMIT OF WASTE

REMARKS:

PHOTO LOG:

TEST PIT LOG

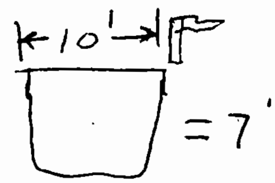
PROJECT NAME: NIWS EARLE
PROJECT NUMBER: 7602
LOCATION: SITE 4

TEST PIT NUMBER: 04-TP-09
DATE: 6/18/97
GEOLOGIST: D. WITT

Depth (Ft.)	Lithology Change (Depth/Ft.)	MATERIAL DESCRIPTION Soil/Waste Characteristics (lithology, density, color, etc.)	USCS	Remarks	PID/FID READING Source (ppm)	BZ (ppm)
		BROWN/BLACK SANDY SOIL				
		WITH DEBRIS				
	7'					
	END OF PIT					

TEST PIT CROSS SECTION AND / OR PLAN VIEW

SEE PREV. TEST PIT LOG 04-TP-08 FOR LOCATION



METAL DEBRIS
BLACK SOIL
HNUS READING 0
MISC. MATERIAL

START 12:30
FINISH BACKFILLING 1300

CANNOT PROCEED FURTHER BECAUSE OF TREES

REMARKS: STAKE IS AT LIMIT OF TRENCH NOT LIMIT OF WASTE

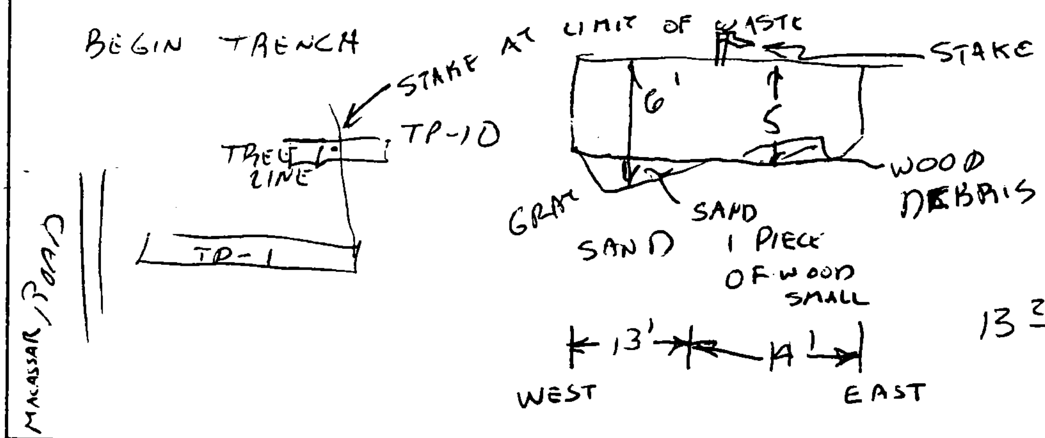
PHOTO LOG:

TEST PIT LOG

PROJECT NAME: NWS EARLE
PROJECT NUMBER: 7602
LOCATION: SITE 4
TEST PIT NUMBER: 04-TP-10
DATE: 6/18/97
GEOLOGIST: D. WITT

Depth (Ft.)	Lithology Change (Depth/Ft.)	MATERIAL DESCRIPTION Soil/Waste Characteristics (lithology, density, color, etc.)	USCS	Remarks	PID/FID READING Source (ppm)	BZ (ppm)
		ORANGE ~~GRY~~ SAND				
	4'					
		WASTE DARK BROWN				
	5'	WOOD				
	BOTTOM OF TEST PIT					

TEST PIT CROSS SECTION AND / OR PLAN VIEW



13^{20} HNUS READING = 0 IN SPOIL PILE AND ~~WASTE~~ PIT

REMARKS: BEGIN 13^{10} 13^{20} – 13^{30} BREAK FOR LUNCH
WASTE JUST INSIDE OF TREELINE

PHOTO LOG:

4:50 BACK HOE

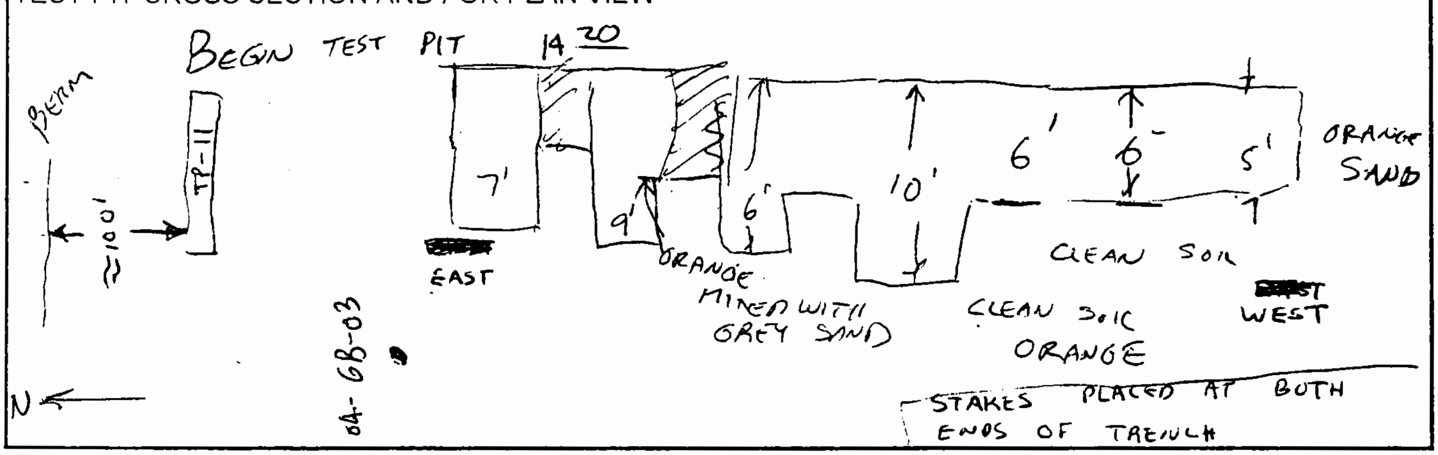
TEST PIT LOG

PROJECT NAME: NWS EARLE
PROJECT NUMBER: 7602
LOCATION: SITE 4

TEST PIT NUMBER: 04-TP-11
DATE: 6/18/97 6-19-97
GEOLOGIST: D. WITT

Depth (Ft.)	Lithology Change (Depth/Ft.)	MATERIAL DESCRIPTION: Soil/Waste Characteristics (lithology, density, color, etc.)	USCS	Remarks	PID/FID READING: Source (ppm)	PID/FID READING: BZ (ppm)
		ORANGE SAND CLEAN				
	6'					

TEST PIT CROSS SECTION AND / OR PLAN VIEW



REMARKS: SOME SURFACE DEBRIS NO WASTE FOUND, PIT BACKFILLED WILL RESUME 09-TP-11 @ 8:15 6/19/97 CONTINUE TOMARROW

PHOTO LOG: #9 10' DEEP SECTION
#10 7' DEEP SECTION TP-12

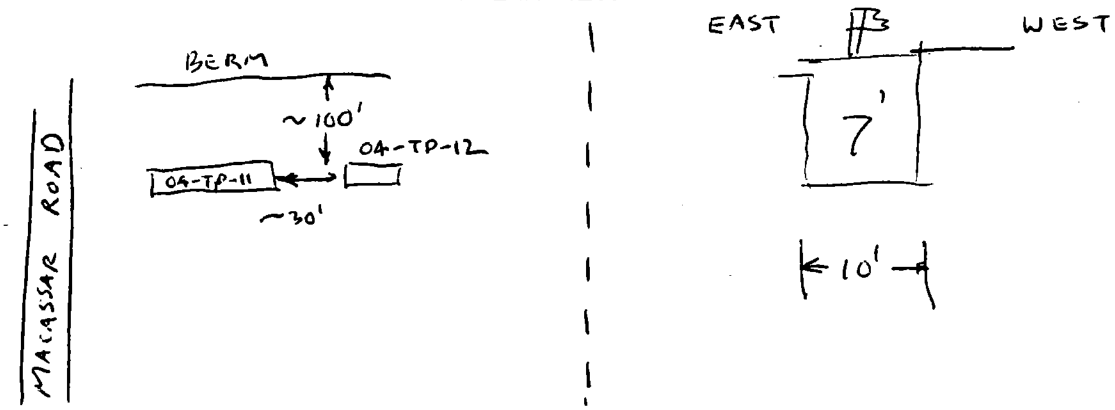
HNUS READING = BACKGROUND 6/19/97

TEST PIT LOG

PROJECT NAME: NWS EARLE
PROJECT NUMBER: 7602
LOCATION: SITE 4
TEST PIT NUMBER: 04-TP-12
DATE: 6/19/97
GEOLOGIST: D. WITT

Depth (Ft.)	Lithology Change (Depth/Ft.)	MATERIAL DESCRIPTION: Soil/Waste Characteristics (lithology, density, color, etc.)	USCS	Remarks	PID/FID READING: Source (ppm)	PID/FID READING: BZ (ppm)
		ORANGE CLEAN SAND				
		NO DEBRIS				
	7'					
	END OF					
	TEST PIT					

TEST PIT CROSS SECTION AND / OR PLAN VIEW



9:30 AM BEGIN

REMARKS:

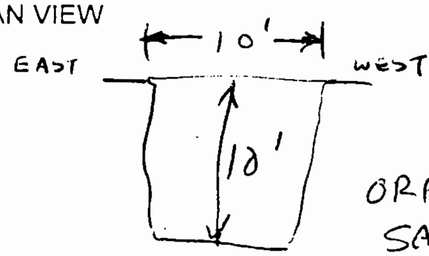
PHOTO LOG: #~~9~~ 10 7' DEEP SECTION

TEST PIT LOG

PROJECT NAME:	NWS EARLE	TEST PIT NUMBER:	04-TP-13
PROJECT NUMBER:	7602	DATE:	6/19/97
LOCATION:	SITE 4	GEOLOGIST:	D WITT

Depth (Ft.)	Lithology Change (Depth/Ft.)	MATERIAL DESCRIPTION Soil/Waste Characteristics (lithology, density, color, etc.)	USCS	Remarks	PID/FID READING Source (ppm)	PID/FID READING BZ (ppm)
		ORANGE SAND SOME				
		GREY SAND				
	10'					
	BOTTOM OF TEST PIT					

TEST PIT CROSS SECTION AND / OR PLAN VIEW



BEGIN PIT 9^30
BEGIN BACK FILL 950
FINISH PIT 10^00

ORANGE SAND NO DEBRIS

SEE TEST PIT LOG FOR 4-TP-14 FOR PLAN OF RELATIVE LOCATIONS OF TEST PITS

REMARKS:

PHOTO LOG:

Page ___ of ___

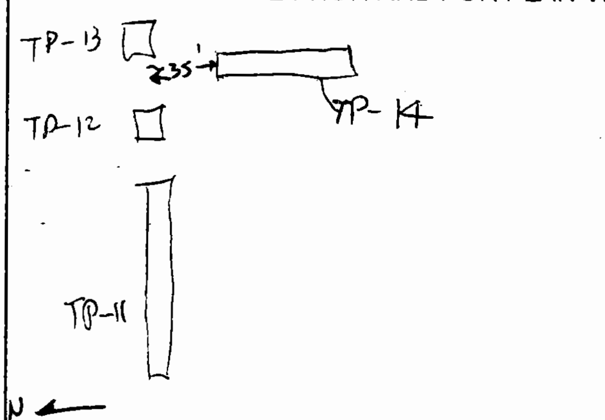
TEST PIT LOG

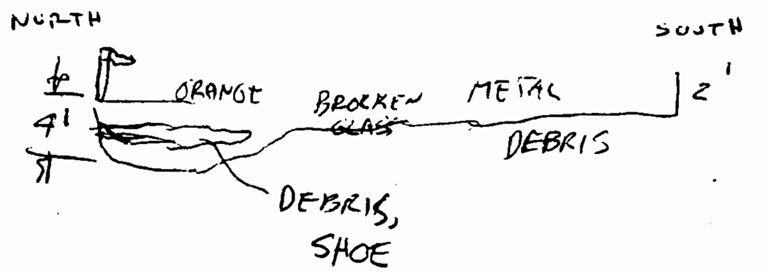
PROJECT NAME: NWS EARLE
PROJECT NUMBER: 7602
LOCATION: SITE 4

TEST PIT NUMBER: 09-TP-14
DATE: 6/19/97
GEOLOGIST: D. WITT

Depth (Ft.)	Lithology Change (Depth/Ft.)	MATERIAL DESCRIPTION: Soil/Waste Characteristics (lithology, density, color, etc.)	USCS	Remarks	PID/FID READING: Source (ppm)	PID/FID READING: BZ (ppm)
		BROWN SANDY SOIL				
		WITH DEBRIS				
	4'					
	END OF TEST PIT					

TEST PIT CROSS SECTION AND / OR PLAN VIEW





STAKE PLACED AT THE LIMIT OF WASTE

START 10:05
FINISH 10:30

REMARKS:

PHOTO LOG: #11 METAL DEBRIS
#12 END OF DEBRIS

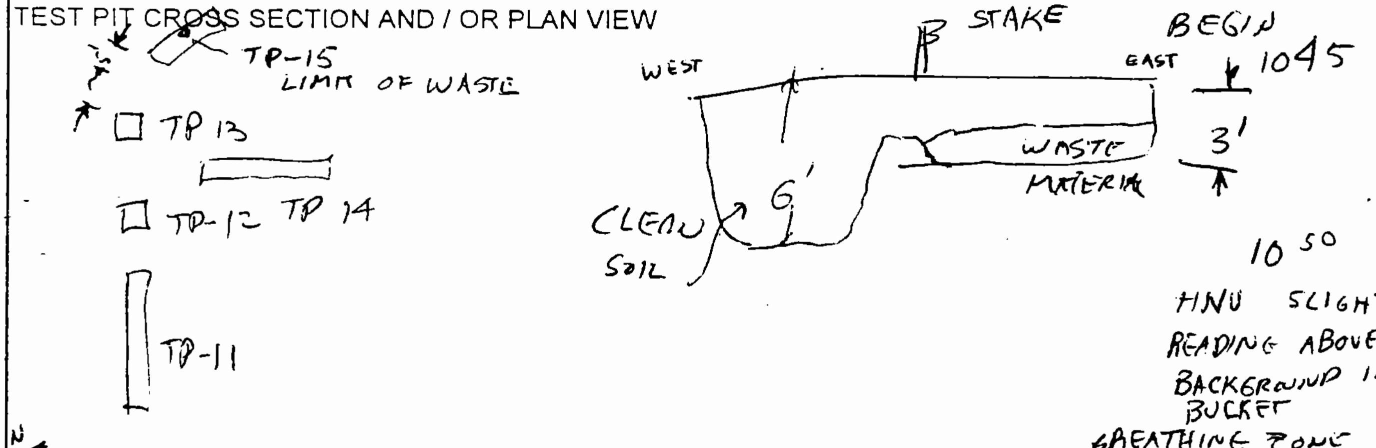
TEST PIT LOG

PROJECT NAME: NWS EARLE
PROJECT NUMBER: 7602
LOCATION: SITE 4

TEST PIT NUMBER: 04-TP-15
DATE: 6/19/97
GEOLOGIST: D. WITT

Depth (Ft.)	Lithology Change (Depth/Ft.)	MATERIAL DESCRIPTION: Soil/Waste Characteristics (lithology, density, color, etc.)	USCS	Remarks	PID/FID READING: Source (ppm)	PID/FID READING: BZ (ppm)
	~~OR~~ ORN	ORANGE SAND				
	2'					
		BLACK SOME METAL				
		DEBRIS, WASTE MATERIAL,				
		SOME RAGS				

TEST PIT CROSS SECTION AND / OR PLAN VIEW



10 50
HNU SLIGHT READING ABOVE BACKGROUND IN BUCKET
BREATHING ZONE NOTHING

REMARKS: WASTE MATERIAL ENCOUNTERED @ IMMEDIATLY, TEST PIT CONTINUED UNTIL CLEAN FILL LOCATED, TEST PIT DEEPENED TO 6' TO CONFIRM NO WASTE PRESENT.

PHOTO LOG: #13 EAST END OF TRENCH
#14 WASTE MATERIAL IN BUCKET

TEST PIT LOG

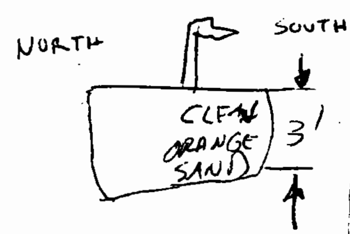
PROJECT NAME: NWS EARLE
PROJECT NUMBER: 7602
LOCATION: SITE 4

TEST PIT NUMBER: 04-TP-16
DATE: 6/19/97
GEOLOGIST: D. WITT

Depth (Ft.)	Lithology Change (Depth/Ft.)	MATERIAL DESCRIPTION: Soil/Waste Characteristics (lithology, density, color, etc.)	USCS	Remarks	PID/FID READING: Source (ppm)	PID/FID READING: BZ (ppm)
		CLEAN ORANGE SAND				
	3'					
	END OF					
	TEST					
	PIT					

TEST PIT CROSS SECTION AND / OR PLAN VIEW

SEE TEST PIT LOG 04-TP-17 FOR RELATIVE LOCATIONS OF TEST PITS



STAKE IN CENTER OF PIT

BEGIN 11:10
BEGIN BACKFILL
END 11:20

REMARKS:

PHOTO LOG: #15 CLEAN SAND

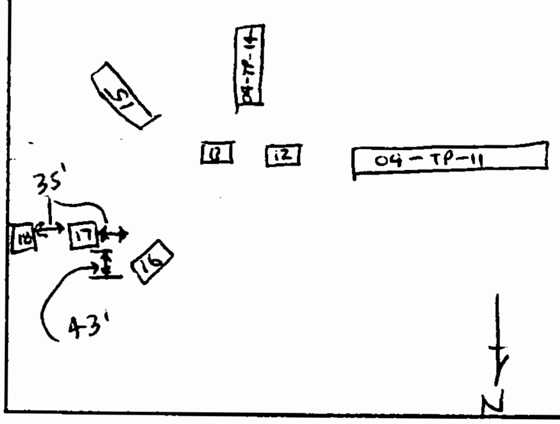
TEST PIT LOG

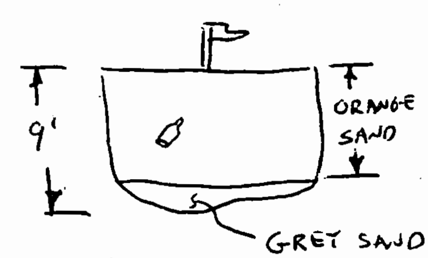
PROJECT NAME: NWS EARLE
PROJECT NUMBER: 7602
LOCATION: SITE 4

TEST PIT NUMBER: 04-TP-17
DATE: 6/19/97
GEOLOGIST: D. WITT

Depth (Ft.)	Lithology Change (Depth/Ft.)	MATERIAL DESCRIPTION Soil/Waste Characteristics (lithology, density, color, etc.)	USCS	Remarks	PID/FID READING Source (ppm)	PID/FID READING BZ (ppm)
		ORANGE SAND				
	8'					
	9'	GREY SAND				

TEST PIT CROSS SECTION AND / OR PLAN VIEW





TWO BOTTLES FOUND IN PIT

FINISH DIGGING TEST PIT/ 11 30
BEGIN BACKFILLING

TEST PIT BACKFILLED 11 45.

NOTE: STAKE PLACED IN CENTER OF PIT

REMARKS:

PHOTO LOG:

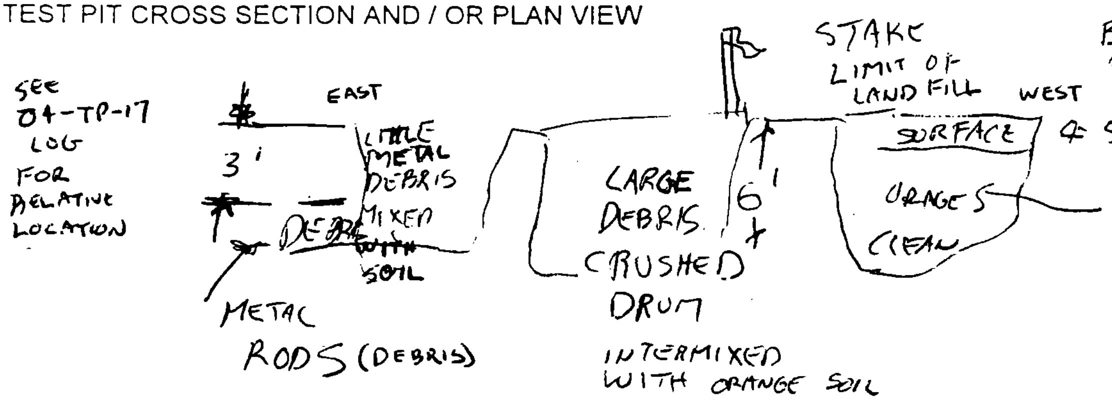
TEST PIT LOG

PROJECT NAME: NWS EARLE
PROJECT NUMBER: 7602
LOCATION: SITE 4
TEST PIT NUMBER: 04-TP-18
DATE: 6/19/97
GEOLOGIST: D. WITT

Depth (Ft.)	Lithology Change (Depth/Ft.)	MATERIAL DESCRIPTION: Soil/Waste Characteristics (lithology, density, color, etc.)	USCS	Remarks	PID/FID READING: Source (ppm)	PID/FID READING: BZ (ppm)
		BROWN SAND				
		GREY SAND				
		~~GRAY~~ SW ORANGE SAND				
		GREY SAND				

TEST PIT CROSS SECTION AND / OR PLAN VIEW

BEGIN 12:00
FINISH 12:45



REMARKS:

PHOTO LOG: 16 CRUSHED DRUM LOOKING EAST

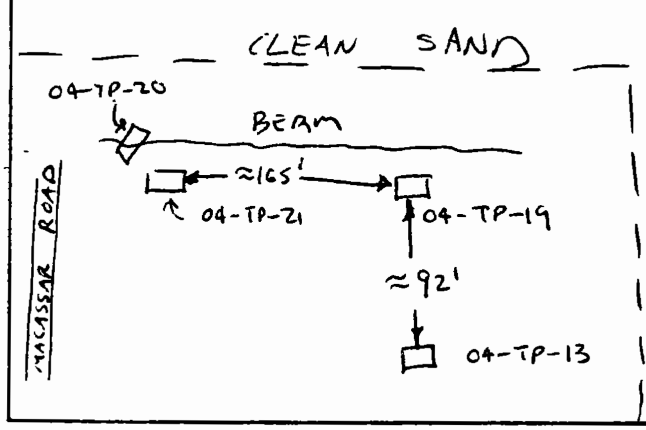
TEST PIT LOG

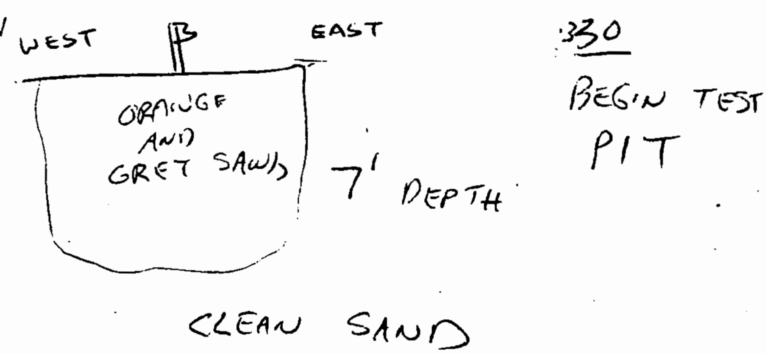
PROJECT NAME: NWS EARLE
PROJECT NUMBER: 7602
LOCATION: SITE 4

TEST PIT NUMBER: 6/19/97
DATE: 04-TP-19
GEOLOGIST: D WITT

Depth (Ft.)	Lithology Change (Depth/Ft.)	MATERIAL DESCRIPTION Soil/Waste Characteristics (lithology, density, color, etc.)	USCS	Remarks	PID/FID READING Source (ppm)	BZ (ppm)
		ORANGE SAND WITH				
		STREAKS OF GREY				
	7'					
	END OF TP.					

TEST PIT CROSS SECTION AND / OR PLAN VIEW





REMARKS: TEST PIT LOCATED NEXT TO BASE OF RIDGE ALONG NORTH END OF SITE 4.

PHOTO LOG: #17 CLEAN SAND LOOKING EAST

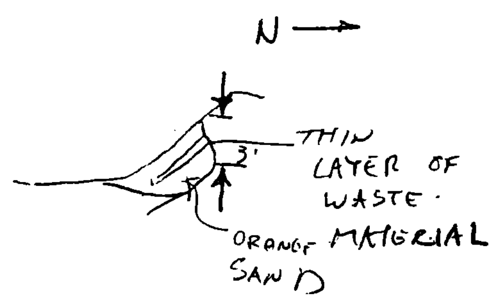
TEST PIT LOG

PROJECT NAME: NWS EARLE
PROJECT NUMBER: 7602
LOCATION: SITE 4
TEST PIT NUMBER: 04-TP-20
DATE: 6/19/97
GEOLOGIST: D. WITT

Depth (Ft.)	Lithology Change (Depth/Ft.)	MATERIAL DESCRIPTION Soil/Waste Characteristics (lithology, density, color, etc.)	USCS	Remarks	PID/FID READING Source (ppm)	BZ (ppm)
	1'	BROWN SAND				
	6"	SOME DEBRIS METAL BLACK				
	3.5'	ORANGE SAND				

TEST PIT CROSS SECTION AND / OR PLAN VIEW

SEE TEST PIT LOG ~~04-21~~ 04-TP-21 FOR RELATIVE LOCATION OF TEST PIT 04-TP-20



REMARKS:

PHOTO LOG: #18 LOOKING NORTH DIGGING INTO BERM

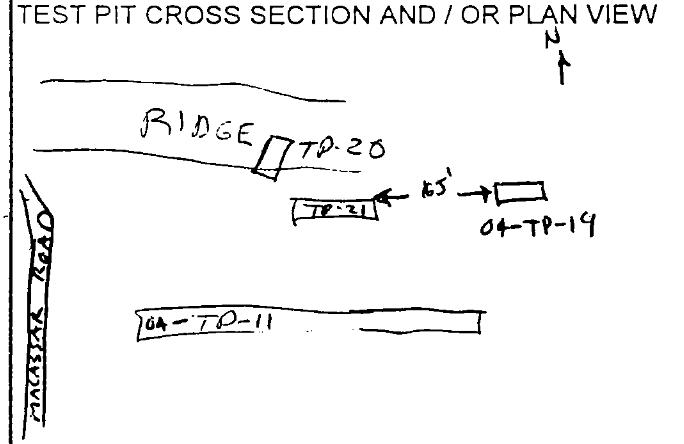
TEST PIT LOG

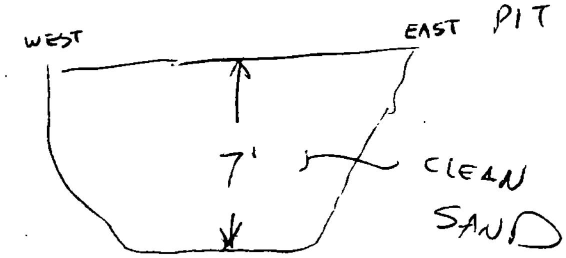
PROJECT NAME: NWS EARLE
PROJECT NUMBER: 7602
LOCATION: SITE 4

TEST PIT NUMBER: 04-TP-21
DATE: 6/19/97
GEOLOGIST: D. WITT

Depth (Ft.)	Lithology Change (Depth/Ft.)	MATERIAL DESCRIPTION: Soil/Waste Characteristics (lithology, density, color, etc.)	USCS	Remarks	PID/FID READING: Source (ppm)	PID/FID READING: BZ (ppm)
	1.0'	LIGHT BROWN SAND				
		ORANGE SAND				
	7' END OF TEST PIT					

TEST PIT CROSS SECTION AND / OR PLAN VIEW





FINISH TEST PIT 14:20

REMARKS:

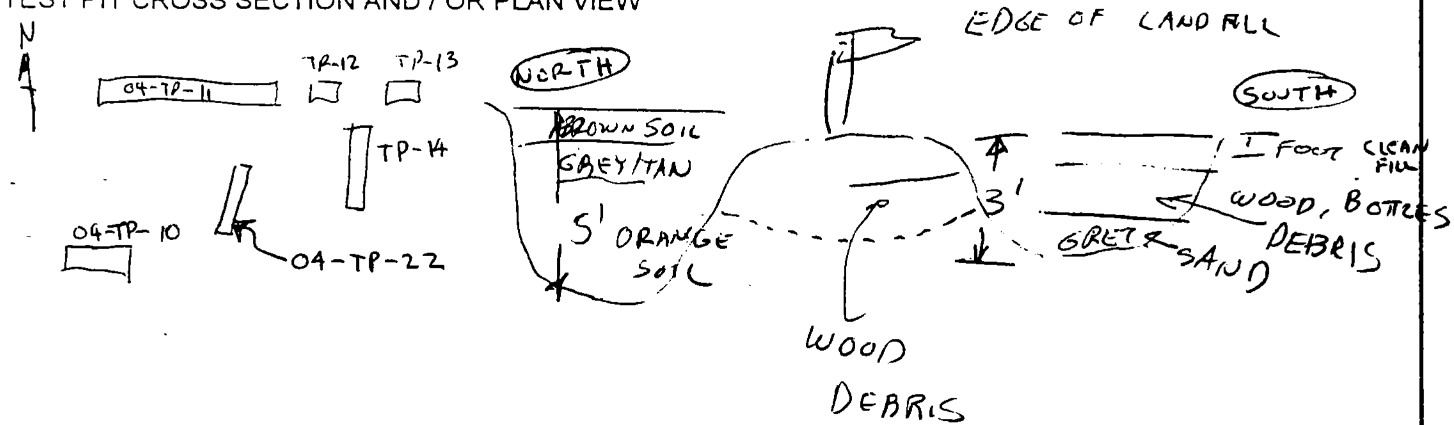
PHOTO LOG:

TEST PIT LOG

PROJECT NAME: NWS EARLE
PROJECT NUMBER: 7602
LOCATION: SITE 4
TEST PIT NUMBER: 04-TP-22
DATE: 6/19/97
GEOLOGIST: D. WITT

Depth (Ft.)	Lithology Change (Depth/Ft.)	MATERIAL DESCRIPTION: Soil/Waste Characteristics (lithology, density, color, etc.)	USCS	Remarks	PID/FID READING: Source (ppm)	PID/FID READING: BZ (ppm)
	1'	BROWN SANDY SOIL				
	2'	WOOD DEBRIS, COKE BOTTLE,				
	3'	GREY SAND				
	END OF TEST PIT					

TEST PIT CROSS SECTION AND / OR PLAN VIEW



REMARKS:

PHOTO LOG:

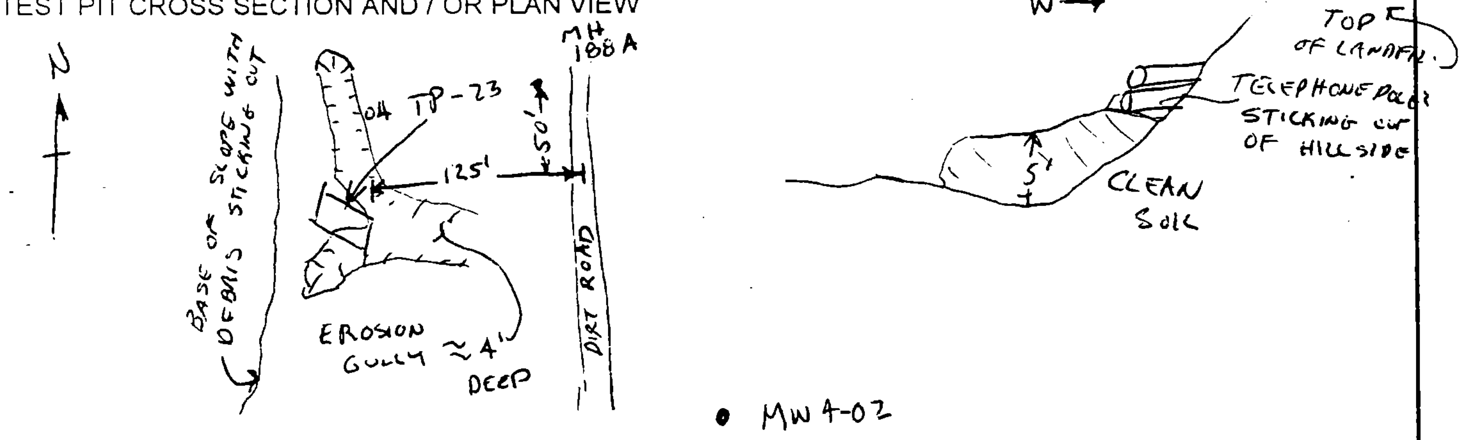
TEST PIT LOG

PROJECT NAME: NWS EARLE
PROJECT NUMBER: 7602
LOCATION: SITE 4

TEST PIT NUMBER: 04-TP-23
DATE: 6/19/97
GEOLOGIST: D. WITT

Depth (Ft.)	Lithology Change (Depth/Ft.)	MATERIAL DESCRIPTION Soil/Waste Characteristics (lithology, density, color, etc.)	USCS	Remarks	PID/FID READING Source (ppm)	BZ (ppm)
		ORANGE SAND				
	3'					
		GREY SAND				
	5'					
	BOTTOM OF ~~BORING~~ DW TEST PIT					

TEST PIT CROSS SECTION AND / OR PLAN VIEW



REMARKS:

PHOTO LOG: #19 LOOKING WEST. NOTE! TELEPHONE POLES IN BACKGROUND

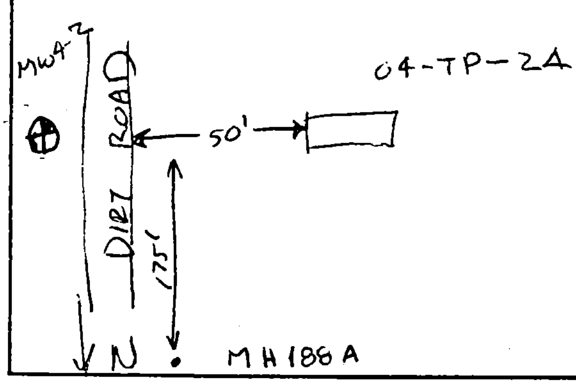
TEST PIT LOG

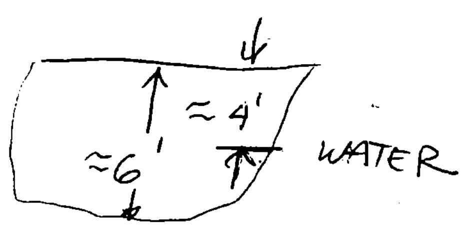
PROJECT NAME: NWS EARLE
PROJECT NUMBER: 7602
LOCATION: SITE 4

TEST PIT NUMBER: 04-TP-24
DATE: 6/19/97
GEOLOGIST: D. WITT

Depth (Ft.)	Lithology Change (Depth/Ft.)	MATERIAL DESCRIPTION: Soil/Waste Characteristics (lithology, density, color, etc.)	USCS	Remarks	PID/FID READING: Source (ppm)	PID/FID READING: BZ (ppm)
		ORANGE SAND				
	2'					
		RED WITH BLACK STREAKS SAND				
	4'	WATER TABLE				
		ORANGE SAND				
	6'					
	END OF TEST PIT					

TEST PIT CROSS SECTION AND / OR PLAN VIEW





REMARKS: PIT COLLAPSED UPON SELF BEFORE MEASURING DEPTH

PHOTO LOG:

APPENDIX E

WETLANDS DELINEATION - SITES 4 AND 5

Wetland Delineation for
Naval Weapon Station Earle, Colt's Neck, New Jersey
July 3, 1997

Prepared by:
Brown and Root Environmental
Aiken, South Carolina

Introduction

On June 23, 1997, Robert Abernethy (Brown and Root Environmental) delineated wetlands on Sites 4 and 5 at Naval Weapon Station Earle, Colt's Neck, New Jersey. The purpose of the delineation was to survey both sites and the surrounding woodland for the presence of wetlands. Wetlands that were located were delineated with blaze orange flagging that was hung from trees. Each flag was coded with the site number followed by the letters "WL", a sample point number and a letter to identify the individual wetland. For example 04 WL 01 A would be Site 4 wetland flag, point 1 of wetland A.

This delineation was performed according to procedures outlined in the U.S. Army Corps of Engineers Wetland Delineation Manual (1987). All delineations were routine and consisted of an onsite inspection of the vegetation, soils and hydrology.

Site 04 - Landfill West of "D" Group

General Description of the landfill

The landfill is located on the top of a small hill. Pitch pine (*Pinus rigida*) is the dominant tree species with individuals in rows and at consistent spacing indicative of a plantation. The soils are classified as Urdothents or a sand pit and are surrounded by soils classified as Atsion sand.

Wetland A (04 WL 01 A - 04 WL 19 A)

Wetland A is located southeast of the landfill adjacent to the toe of the landfill. This wetland drains to the east and surface waters of this wetland were previously sampled at 04SW02 (see Figure 7-1). Red maple (Acer rubrum) is the dominant tree species with a few black gum (*Nyssa sylvatica*) and sassafras (Sassafrass albidum) also present. Dominant understory plants included blueberry (*Vaccinium* sp., wax myrtle (*Myrica cerifera*) and *Phragmites australis*. Ground cover in much of the wetland is absent due to shading. Where present, the ground cover is limited to small blueberry bushes and poison ivy (*Toxicodendron radicans*).

The soil is classified as Atsion sand which is listed as a hydric soil on the hydric soils list for Monmouth County NJ. The soil was a gleyed sand under 1 - 6 inches of black organic muck. Saturated soil conditions were encountered at a depth of 6 inches in some pits and at the surface in others.

This small wetland drains much of the landfill. Spoil and debris from the landfill (barrels, telephone poles etc) formed the upland boundary of the north edge of the wetland.

Wetland B (04 WL 01 B - 04 WL 10 B)

Wetland B is also located southeast of the landfill and separated from wetland A by an upland sand ridge. This upland sand ridge is dominated by chestnut oak (*Quercus prinus*), blackjack oak (*Q. marilandica*) and sassafras with a few pitch pines. The New Jersey Department of Environmental Protection (NJDEP) maps show this upland as a wetland. This discrepancy may be attributable to a mapping methodology which may have relied heavily on the interpretation of aerial photography as opposed to extensive field surveys.

Surface water sample point 04SW01 was taken from this wetland and a wetland sample point was also taken at the same location. Like Wetland A, the dominant tree species was black gum and red maple with an understory of blueberry. However, unlike Wetland A, Wetland B has a dense groundcover of Sphagnum moss over extremely liquid sediments. Soils and hydrology are similar to Wetland A.

Small depression area in the landfill (04 WL 01 C)

A small depression area (less than a quarter acre) was located in the center of the landfill. This area collects surface runoff and channels it through an old ditch (2 feet wide and 1 foot deep) to the south and into Wetland A. This depression appears to be a wetland dominated by Phragmites and having a single black willow (*Salix nigra*) in the center. However, a hole was excavated at the lowest area adjacent to the willow and no saturation, gleyed soils, or bright mottles were noted to a depth of 30 inches. While the vegetation was indicative of a wetland, the soils and the hydrology were not. This area was not classified as a wetland because it failed to fulfill all three of the necessary criteria

Wetland surrounding Lake Earle north of Site 4

The area southwest of Lake Earle was identified as a wetland on NJDEP maps. A field inspection revealed that like the sand ridge located south of the land fill, this area had been mapped incorrectly. This area was dominated by hardwoods that may have resulted in the incorrect photo-interpretation. Red maple and sweetgum (*Liquidambar styraciflua*) adjacent to the lake graded into chestnut oaks and pitch pines as the elevation increased. The wetland adjacent to the lake is limited to a fringe of no greater than 10 to 15 feet in width and dominated by sweetgum, wax myrtle, and blueberry.

Conclusion

There are no wetlands located within the confines of the Site 4 landfill. However, a small wetland is located south of the landfill and immediately adjacent to it. This wetland (Wetland A) contains barrels and some debris from the landfill along one edge. This area could be impacted by remediation activities.

Site 05 - Landfill west of army barricades

General description

The landfill is located in a relatively flat area dominated by planted pitch pines (Figure 8-1). The surface of the landfill is somewhat irregular and drainage flows off the skeet range to the south and west eventually collecting in a small depression area (05 WL 01 A). The soils are classified as Lakewood sand.

Depression Area in Landfill (05 WL 01 A)

Much of the landfill drains into a small depression southwest of the skeet range. This area is dominated by *Phragmites*, *Juncus* sp. and *Panicum* sp. Vegetation indicated that this area was a wetland and a hole was excavated in the lowest portion to a depth of 30 inches. The soils in this area appear to contain more clay and less sand than other areas. Saturated conditions were encountered at 14 inches but no water was noted in the bottom of the hole after 1 hour. The soil did contain mottles below 12 inches however the chroma of the matrix was above 2. The area probably held water throughout the winter and into the early spring, but the area did not meet the soils and hydrology criteria to be classified as a wetland.

Wetland B (05 WL 01 B - 05 WL 17 B)

This wetland area is located southwest of the landfill between a dirt road and the railroad. The area southwest of the railroad drains under the railroad grade by way of a culvert and skirts the wetland area through a ditch. Wetland B is characterized by a canopy of pitch pine and red maple and an understory of red maple and blueberry. The soils were mapped as a Keyport sandy loam which contains hydric conditions in swales and depressions. There was a 6 inch layer of black organic muck over gleyed sand in the wetland. There was no evidence of saturation to a depth of 20 inches, however the presence of black stained leaves and mosses growing at the base of trees, indicated that water had collected in the area for an extended period of time. This area was classified as a wetland.

Wetland C (05 WL 01 C - 05 WL 04 C)

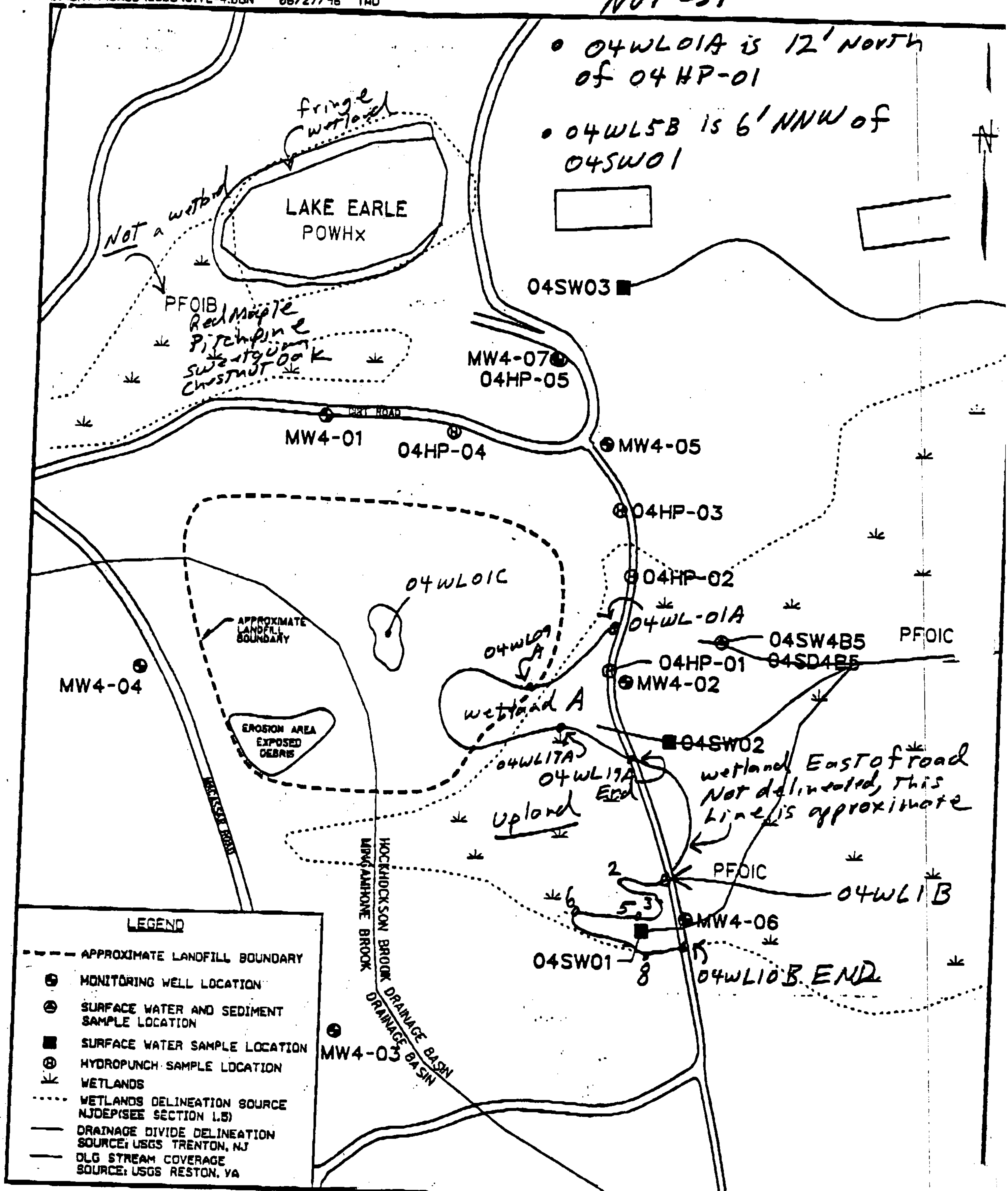
This wetland area is located north of Wetland B and is separated from Wetland B by a ditch and associated spoil bank that acts as a dam. This spoil bank diverts drainage of water from Wetland C and directs it southwest into a small depression wetland adjacent to the railroad. A small (1 foot wide, 6 inches deep) drainage ditch extends north from the wetland but is no longer functional. Dominant species in the wetland include black gum with scattered red maple. Pitch pine grows adjacent to the wetland. Soils consisted of Keyport sandy loam and like Wetland B, this area was dry to 20 inches. Like Wetland B, this area had 6 inches of black muck over gleyed sand and blackened and stained leaves were present on the surface indicating prolonged flooding.

Conclusion

Site 5 contains no wetlands within the confines of the landfill. The closest wetland is over 200 feet to the southwest.

Field Notes: June 23 1997

O:\DATA\CADD\5883\SITE-4.DGN 06/27/96 TAD



SAMPLE LOCATIONS

SITE 4 - LANDFILL WEST OF "D" GROUP

0 200 400

SCALE IN FEET

FIGURE 7-1

Brown & Root Environmental

DATA FORM 1 WETLAND DETERMINATION

Applicant Name: NWS EARLE
Application Number: ________
Project Name: ________

State: N.J. County: Monmouth Legal Description: Township: _ Range: ____
Date: 6/23/97 Plot No.: 04 TP 24 Section: ________

Vegetation [list the three dominant species in each vegetation layer (5 if only 1 or 2 layers)].
Indicate species with observed morphological or known physiological adaptations with an asterisk.

Species	Indicator Status	Species	Indicator Status
Trees		**Herbs**	
1. None		7. Phragmites	FaCW
2.		8. Juncus	Fac FacW or obl
3.		9.	
Saplings/shrubs		**Woody vines**	
4. wax myrtle	Fac	10. None	
5. Red maple	Fac	11.	
6. Sweet gum	Fac	12.	

% of species that are OBL, FACW, and/or FAC: 100% Other indicators: ________.
Hydrophytic vegetation: Yes ✓. No ________. Basis: ________

Soil
Series and phase: Atsion Sand On hydric soils list? Yes ✓ No ____
Mottled: Yes ____; No ✓. Mottle color: ________; Matrix color: ________
Gleyed: Yes ✓ No____. Other indicators: ________
Hydric soils: Yes ✓ No ________; Basis:
4 inchs of organic muck on top of Gleyed Sand

Hydrology
water in hole at 5 inchs
Inundated: Yes ____ No ✓ Depth of standing water: ________
Saturated soils: Yes ✓; No ____. Depth to saturated soil: 1 inch
Other indicators: ________
Wetland hydrology: Yes ✓; No ________. Basis: All 3 Parameters met
Saturated soil at 1 inch
Atypical situation: Yes ____; No ✓
Normal Circumstances?: Yes ✓ No ________.
Wetland Determination: Wetland ✓; Nonwetland ____
Comments: Point taken 18 feet NNE of 04 TP 24
This point is in the wetland and west of point 04 HP-01

Determined by: Robert Abernethy

This point is in
Wetland A

DATA FORM 1 WETLAND DETERMINATION

Applicant Name: NWS EARLE

Application Number: ______

Project Name: ______

State: N.J. County: Monmouth Legal Description: Township: _ Range: ______

Date: June 23 97 Plot No.: 04 WL 09 A Section: ______

Vegetation [list the three dominant species in each vegetation layer (5 if only 1 or 2 layers)].
Indicate species with observed morphological or known physiological adaptations with an asterisk.

Species	Indicator Status	Species	Indicator Status
Trees		Herbs	
1. Red Maple	FAC	7. Phragmites	FACW
2. Acer rubrum		8.	
3.		9.	
Saplings/shrubs		Woody vines	
4. Vaccinium		10. Poison Ivy	FAC
5.		11.	
6.		12.	

% of species that are OBL, FACW, and/or FAC: 100%. Other indicators: ______.

Hydrophytic vegetation: Yes ✓. No ______. Basis: ______

Soil

Series and phase: Atsion Sand On hydric soils list? Yes ✓ No ______

Mottled: Yes ______; No ✓. Mottle color: ______; Matrix color: ______

Gleyed: Yes ✓ No ______. Other indicators: 1-2 inchs Black Muck on Gleyed Sand

Hydric soils: Yes ✓; No ______; Basis: Black organic muck over Gleyed Sand indicates wetland Soil

Hydrology

Inundated: Yes ______ No ✓ Depth of standing water: ______

Saturated soils: Yes ✓; No ______. Depth to saturated soil: 3 inchs

Other indicators: ______

Wetland hydrology: Yes ✓; No ______. Basis: Saturated Soil at 3 inchs

Atypical situation: Yes ______; No ✓

Normal Circumstances?: Yes ✓ No ______.

Wetland Determination: Wetland ✓; Nonwetland ______

Comments:

Over

Determined by: Robert Abernethy

DATA FORM 1 WETLAND DETERMINATION

Applicant Name: NWS EARLE Application Number: ______ Project Name: ______

State: N. J. County: Monmouth Legal Description: Township: _ Range: ____

Date: 6-~~23~~-97 Plot No.: 04 WL 17 A Section: ______

Vegetation [list the three dominant species in each vegetation layer (5 if only 1 or 2 layers)].
Indicate species with observed morphological or known physiological adaptations with an asterisk.

Species	Indicator Status	Species	Indicator Status
Trees		**Herbs**	
1. Chestnut oak Q. Prinus	upland	7. Vaccinium	
2. Sassafrass	FACU	8.	
3. ~~Black~~ Black Jack oak	NL upland	9.	
Saplings/shrubs		**Woody vines**	
4. Vaccinium		10. None	
5.		11.	
6.		12.	

% of species that are OBL, FACW, and/or FAC: ~~none~~ 0% Other indicators: ______

Hydrophytic vegetation: Yes __. No ✓. Basis: No wetland plants

Soil

Series and phase: Atsion sand But only inclusions On hydric soils list? Yes ✓ No ____

Mottled: Yes ____; No ✓. Mottle color: ______; Matrix color: ______

Gleyed: Yes ____ No ✓. Other indicators: No Black muck. Just Humus

Hydric soils: Yes ___; No ✓; Basis: 1 inch of Leaf mold over sand

Hydrology

Inundated: Yes ____ No ✓ Depth of standing water: ______

Saturated soils: Yes ___; No ✓. Depth to saturated soil: Dry white sand to 2 feet

Other indicators: ______

Wetland hydrology: Yes ___; No ✓. Basis: No saturation Dry to 2 feet down

Atypical situation: Yes ____; No ✓.

Normal Circumstances?: Yes ✓ No ______.

Wetland Determination: Wetland ____; Nonwetland ✓

Comments:

Hole was Dug 10 feet South of Flag
2 feet higher in elevation

Determined by: Robert Abernethy

This Sheet is typical of the ~~wetlan~~ upland Area south of the landfill

DATA FORM 1 WETLAND DETERMINATION

Applicant Name: NWS EARLE

Application Number: ________

Project Name: ________

State: N. J. County: Monmouth Legal Description: Township: _ Range: ____

Date: June ~~22~~ 23/97 Plot No.: 04 SW 01 Section: ________

Vegetation [list the three dominant species in each vegetation layer (5 if only 1 or 2 layers)].
Indicate species with observed morphological or known physiological adaptations with an asterisk.

Species	Indicator Status	Species	Indicator Status
Trees		**Herbs**	
1. Red maple	Fac	7. Sphagnum Moss	
2. Black Gum	Fac	8.	
3.		9.	
Saplings/shrubs		**Woody vines**	
4. Vaccinium sp		10. None	
5.		11.	
6.		12.	

% of species that are OBL, FACW, and/or FAC: 100 %. Other indicators: ________.

Hydrophytic vegetation: Yes ✓. No ________. Basis: > 50%

Soil

Series and phase: Atsion Sand On hydric soils list? Yes ✓ No ____

Mottled: Yes ____; No ✓. Mottle color: ________; Matrix color: ________

Gleyed: Yes ✓ No ____. Other indicators: 6 inch of Black Muck over Gleyed Soil

Hydric soils: Yes ✓; No ________; Basis: Same ↑

Hydrology

Inundated: Yes ✓ No ___. Depth of standing water: 0 → 2 inchs

Saturated soils: Yes ✓; No ______. Depth to saturated soil: at Surface

Other indicators: ________________

Wetland hydrology: Yes ✓; No ________. Basis: saturation at surface

Atypical situation: Yes ____; No ✓.

Normal Circumstances?: Yes ✓ No ________.

Wetland Determination: Wetland ✓; Nonwetland ____

Comments:

Wetland B

Point was at 04SW01 which is 6' SSE of the wetland line point 04WSFB

Determined by: Robert Abernethy

DATA FORM 1 WETLAND DETERMINATION

Applicant Name: NWS EARLE
Application Number: ________
Project Name: ________

State: N. J. County: Monmouth Legal Description: Township: _ Range: ____

Date: June 23 97 Plot No.: 04 WL 01 e Section: ________

Vegetation [list the three dominant species in each vegetation layer (5 if only 1 or 2 layers)].
Indicate species with observed morphological or known physiological adaptations with an asterisk.

Species	Indicator Status	Species	Indicator Status
Trees		**Herbs**	
1. Black willow (1)	OBL	7. Phragmites australis	FACW
2. Salix nigra		8.	
3.		9.	
Saplings/shrubs		**Woody vines**	
4. None		10. None	
5.		11.	
6.		12.	

% of species that are OBL, FACW, and/or FAC: 100%. Other indicators: ________.
Hydrophytic vegetation: Yes ✓. No ________. Basis: > 50% FAC

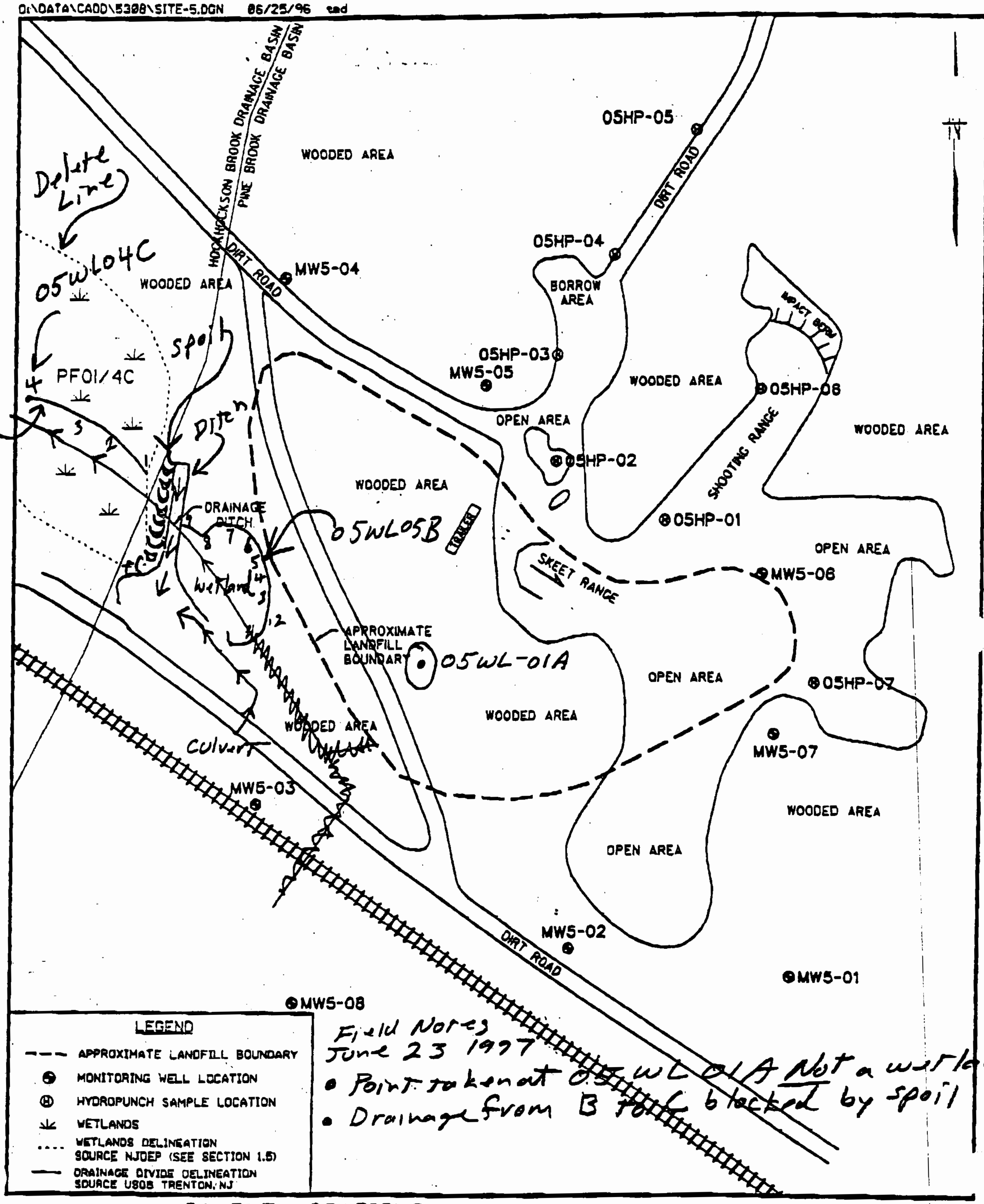
Soil
Series and phase: Udorthents (Landfill) On hydric soils list? Yes ______ No ✓
Mottled: Yes ____; No ✓. Mottle color: ________; Matrix color: ________
Gleyed: Yes ____ No ✓. Other indicators: ________
Hydric soils: Yes ____; No ✓; Basis: No mottles or other indications of Hydric conditions

Hydrology
Inundated: Yes ____ No ✓ Depth of standing water: ________
Saturated soils: Yes ___; No ✓. Depth to saturated soil: went to 30 inchs no Satur...
Other indicators: ________
Wetland hydrology: Yes ___; No ✓. Basis: ________
Atypical situation: Yes ✓; No ___.
Normal Circumstances?: Yes ___ No ✓.
Wetland Determination: Wetland ___; Nonwetland ✓
Comments:

Over

Determined by: Robert Abernethy

O:\DATA\CADD\5308\SITE-5.DGN 06/25/96 tad



SAMPLE LOCATIONS

SITE 5 - LANDFILL WEST OF ARMY BARRICADES

0 150 300

SCALE IN FEET

FIGURE 8-1

Brown & Root Environmental

DATA FORM 1 WETLAND DETERMINATION

Applicant Name: NWS EARLE Application Number: ________ Project Name: ________

State: N.J. County: Monmouth Legal Description: Township: _ Range: ____

Date: June 23 97 Plot No.: 05WL01 A Section: ________

Vegetation [list the three dominant species in each vegetation layer (5 if only 1 or 2 layers)]. Indicate species with observed morphological or known physiological adaptations with an asterisk.

Species	Indicator Status	Species	Indicator Status
Trees		**Herbs**	
1. None		7. Phragmites	FacW
2. Area surrounded		8. Cyperus	
3. by Pitch + White Pine		9. pannicum	
Saplings/shrubs		**Woody vines**	
4. Blackberry		10.	
5.		11. None	
6.		12.	

% of species that are OBL, FACW, and/or FAC: 100% Other indicators: ________.

Hydrophytic vegetation: Yes ✓. No ________. Basis: > 50%

Soil

Series and phase: ~~Lakewood Sand~~ udorthents Lakewood Sand On hydric soils list? Yes ______ No ______

Mottled: Yes ✓; No ____. Mottle color: 10 YR 5/8; Matrix color: 10 YR 5/3

Gleyed: Yes ____ No ✓. Other indicators: ________

Hydric soils: Yes ~~✓~~; No ✓; Basis: Bright mottles ~~in top 12 inches~~ at 12 inches and Below

Matrix color above 2 and Mottles below 10 inches

Hydrology

Inundated: Yes ____ No ✓ Depth of standing water: ________

Saturated soils: Yes ✓; No ____. Depth to saturated soil: 14 inches

Other indicators: ________

Wetland hydrology: Yes __; No ✓. Basis: ________

Atypical situation: Yes ✓; No __.

Normal Circumstances?: Yes __ No ✓.

Wetland Determination: Wetland ____; Nonwetland ✓

Comments:

over

Determined by: Robert Abernethy

DATA FORM 1 WETLAND DETERMINATION

Applicant Name: NWS EARLE Application Number: ________ Project Name: ________

State: N. J. County: Monmouth Legal Description: Township: _ Range: ____

Date: 6/23/97 Plot No.: 05 WL-01 B Section: ________

Vegetation [list the three dominant species in each vegetation layer (5 if only 1 or 2 layers)]. Indicate species with observed morphological or known physiological adaptations with an asterisk.

Species	Indicator Status	Species	Indicator Status
Trees	FacU	Herbs	
1. Pitch Pine		7.	
2. Red Maple	Fac	8. None	
3.		9.	
Saplings/shrubs	Fac	Woody vines	
4. Red maple		10. None	
5. Vaccinium		11.	
6.		12.	

% of species that are OBL, FACW, and/or FAC: 75% Other indicators: ________.

Hydrophytic vegetation: Yes ✓. No ________. Basis: > 50% Fac

Soil

Series and phase: Keyport Sandy Loam ~~Atsion Sand~~ On hydric soils list? Yes ✓ in Swales No ______

Mottled: Yes _____; No ✓. Mottle color: ________; Matrix color: ________

Gleyed: Yes ✓ No_____. Other indicators: ________

Hydric soils: Yes ✓; No _______; Basis: There is 6" of Black Muck on Top of Gleyed Sand

Hydrology

Inundated: Yes _____ No ✓ Depth of standing water: ________

Saturated soils: Yes ___; No ✓. Depth to saturated soil: None to 20 inches

Other indicators: Black Stained ~~...~~ leaves and Moss at base of all maples

Wetland hydrology: Yes ✓; No _______. Basis: indicate higher water table and standing water in early spring

Atypical situation: Yes ______; No ✓.

Normal Circumstances?: Yes ✓ No _______.

Wetland Determination: Wetland ✓; Nonwetland _____

Comments: Point is in middle of wetland I mapped the edge

Determined by: Robert Abernethy

DATA FORM 1 WETLAND DETERMINATION

Applicant Name: NWS EARLE
Application Number: ______
Project Name: ______

State: N. J. County: Monmouth Legal Description: Township: _ Range: ____
Date: 6/23/97 Plot No.: 05WL04 Section: ______

Vegetation [list the three dominant species in each vegetation layer (5 if only 1 or 2 layers)].
Indicate species with observed morphological or known physiological adaptations with an asterisk.

Species	Indicator Status	Species	Indicator Status
Trees		Herbs	
1. Black Gum	FaC	7.	
2.		8. None	
3.		9.	
Saplings/shrubs		Woody vines	
4. Vaccinium		10. smilax	
5.		11.	
6.		12.	

% of species that are OBL, FACW, and/or FAC: 100 %. Other indicators: ______.
Hydrophytic vegetation: Yes ✓. No ______. Basis: > 50 %

Soil
Series and phase: ~~Atsion~~ Keyport Sandy Loam On hydric soils list? Yes ✓ in Swales No ______
Mottled: Yes ____; No ✓. Mottle color: ______; Matrix color: ______
Gleyed: Yes ✓ No____. Other indicators: 6" or muck on Gleyed Sand
Hydric soils: Yes ✓ No ______; Basis:

Hydrology
Inundated: Yes ____ No ✓. Depth of standing water: ______
Saturated soils: Yes ___; No ✓. Depth to saturated soil: ______
Other indicators: Black Stained leaves indicate flooding
Wetland hydrology: Yes ✓; No ______. Basis: ______
Atypical situation: Yes ~~NA~~; No ✓.
Normal Circumstances?: Yes ✓ No ______.
Wetland Determination: Wetland ✓; Nonwetland ____
Comments: OWL

Determined by: Robert Abernethy

APPENDIX F

GEOTECHNICAL BORING LOGS - SITE 5

BORING LOG

PROJECT NAME: NWS - EARLE
PROJECT NUMBER: CTO - 289
DRILLING COMPANY: JCA - Drilling
DRILLING RIG: CME - 55
BORING NUMBER: 05- GB-01
DATE: 6-18-97
GEOLOGIST: PAUL DAVIS
DRILLER: Steve Burger / Jon Urban

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	U S C S *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
S-1 @	0.0	1 / 2			very loose	Drk. brn	silty fine grained	SM	Dry				
1250	2.0	4 / 6	16/24		med Dense		sand						
S-2 @	3.0	6 / 9											
1253	4.0	9 / 7	17/24			Drk. olive brn.	silty clayey F.G. sand (charred	SC	moist				
S-3 @	5.0	6 / 9					wood pieces)		wet				
1256	6.0	100 / –	12/18		—		(wood)		Tin foil, paper, metal straps				
S-4 @	7.0	7 / 8			med. Dense		(paper, Tin foil)		Landfill odors				
1309	8.0	8 / 10	18/24										
S-5 @	9.0	7 / 9					(Tin foil)		wet				
1316	10.0	8 / 7	12/24				(Charred wood)		Landfill odors				
S-6 @	11	4 / 5			loose				No Recovery				
1321	12	5 / 6	0/24		med. Dense				No Recovery				
S-7 @	13	12 / 11					Silty clayey fine	SC					
1330	14	10 / 10	2/24				grained sand						
S-8 @	15	5 / 5					(Charred wood)		Landfill odors				
1337	16	8 / 8	11/24				(Plastic paper Tin foil)		very moist				
S-9 @	17	7 / 7					Silty clayey fine	SC	"No waste"				
1345	18	7 / 8	20/24				grained sand		wet				
S-10 @	19	7 / 8							Saturated				
1352	20	8 / 8	19/24										
S-11 @	21	6 / 10							Saturated				
1357	22	12 / 14	21/24						"No waste"				
S-12 @	23	13 / 15							Saturated				
1403	24	21 / 23	23/24		Dense								

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm):

Remarks: 140 lb. hammer falling 30-inches
4.25-inch I.D. HSA collected 05-GB01-2022 for analysis
2" ID Split spoon Samplers

Converted to Well: Yes ____ No X Well I.D. #: N/A

BORING LOG

PROJECT NAME: NWS - EARLE
PROJECT NUMBER: CTO - 289
DRILLING COMPANY: JCA - Drilling
DRILLING RIG: CME - 55

BORING NUMBER: 05 - GB - 02
DATE: 6-18-97
GEOLOGIST: PAUL DAVIS
DRILLER: Steve Burger / Jon Urban

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Sample	Sampler BZ	Borehole**	Driller BZ**
	0.0						grass/roots						
S-1 @	0.0	3 / 5			loose	orange brown	Silty fine gr. sand	SM					
1448	2.0	5 / 7	14/24		med. Dense	gray-brn.	silt & F. Gr. Sand	SM	Dry				
S-2 @	3.0	7 / 8					Silty Clay	SC	Dry				
1451	4.0	10 / 13	14/24			gray	Silty clayey fine grained sand		(charred wood)				
S-3 @	5.0	15 / 21			Dense		No Recovery		(piece of wood				
1455	6.0	15 / 27	0/24		very Dense		No Recovery		in spoon shoe)				
S-4 @	7.0	24 / 22			Dense		No Recov.						
1459	8.0	25 / 21	9/24		Dense		No. Recov.						
S-5 @	9.0	8 / 5			med Dense	Dark olive brn.	Silty clayey F. G. sand	SC					
1552	10.0	5 / 6	12/24				charred wood paper, plastic		strong land-				
S-6 @	11	7 / 9					News paper paper, plastic		fill odors				
1601	12	9 / 10	16/24										
S-7 @	13	7 / 9				orange brown	Silty F-M gr. Sand	SM/SP					
1607	14	14 / 13	14/24				(pc. of wood)		Landfill odors				
S-8 @	15	17 / 11					Silty clayey fine	SC	landfill odors.				
1615	16	13 / 10	16/24				grained, sand		"no waste"				
S-9 @	17	13 / 15				olive brn.			very wet				
1624	18	21 / 27	19/24		Dense								
S-10 @	19	8 / 8			med Dense				Saturated				
1629	20	9 / 10	20/24										
S-11 @	21	3 / 2			loose				saturated				
1638	22	8 / 9	22/24		med Dense								
	23												
	24												

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: 140 lb. hammer falling 30-inches
4.25-inch I.D. HSA   Collected 05-GB 02-1616 for analysis
2" ID Split spoon Samplers

Drilling Area Background (ppm):

Converted to Well: Yes ____ No X   Well I.D. #: N/A

BORING LOG

PROJECT NAME: NWS - EARLE
PROJECT NUMBER: CTO - 289
DRILLING COMPANY: JCA - Drilling
DRILLING RIG: CME - 55
BORING NUMBER: 05 - GB - 03
DATE: 6-19-97
GEOLOGIST: PAUL DAVIS
DRILLER: Steve Bu[illegible] / Jon Urban

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm) Sample	Sampler BZ	Borehole**	Driller BZ**
	0.0												
S-1 @	1.0	3 / 4			loose	Brn.	Silty fine grained	SM	Dry				
0807	2.0	4 / 4	3/24		↓	↓	sand (wood, plastic)	↓					
S-2 @	3.0	8 / 10			Med Dense		Silty clayey f.G. sand	SC					
0810	4.0	15 / 16	12/24		Dense		Silty F. Gr. Sand	SM	moist				
S-3 @	5.0	3 / 3			loose	↓	↓	↓					
0814	6.0	5 / 6	15/24		Med Dense	Grayish brn.	Silty clay	CL	moist				
S-4 @	7.0	3 / 4			loose	olive brn.	Silty clayey F. Gr. Sand	SC	(Landfill odors)				
0819	8.0	6 / 9	17/24		Med Dense		(wood, paper, plastic)		Moist				
S-5 @	9.0	7 / 6				↓			L.F. odors				
0822	10.0	5 / 9	16/24		↓	Gray brn.	(Charred wood)		moist				
S-6 @	11	3 / 6			loose	olive brn.	(Plastic, paper) ↓	↓	L.F. odors				
0827	12	7 / 8	15/24		Med Dense		Silty F. Gr. sand	SM					
S-7 @	13	6 / 7					(Trace of clay)		"No waste"				
0834	14	8 / 8	16/24			↓	↓	↓	Moist				
S-8 @	15	7 / 8				olive brn. Orange	~~Clayey~~ silty F. Gr. Sand	SM					
0842	16	9 / 9	18/24				(Some clay)		moist				
S-9 @	17	7 / 8							"No waste"				
0850	18	8 / 8	18/24						very moist				
S-10 @	19	7 / 8											
0855	20	8 / 9	20/24		↓				wet				
S-11 @	21	3 / 3			loose				Saturated				
0900	22	4 / 3	14/24						"No waste"				
S-12 @	23	3 / 4							saturated				
0905	24	4 / 5	20/24		↓	↓	↓	↓					

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm):

Remarks: 140 lb. hammer falling 30-inches
4.25-inch I.D. HSA collected 05-GB03-1820 for analysis
2" ID Split spoon Samplers

Converted to Well: Yes ____ No X Well I.D. #: N/A

BORING LOG

PROJECT NAME: NWS - EARLE
PROJECT NUMBER: CTO - 289
DRILLING COMPANY: JCA - Drilling
DRILLING RIG: CME - 55
BORING NUMBER: 05 - GB - 04
DATE: 6-19-97
GEOLOGIST: PAUL DAVIS
DRILLER: Steve Burger / Jon Urban

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	Sample	Sampler BZ	Borehole**	Driller BZ**
S-1 @	0.0 / 1.0	3/6			loose	Brn	Silty fine gr. sand	SM	moist				
0936	2.0	12/14	12/24		med dense	olive brn.	Silty clayey F.G. Sand	SC					
S-2 @	3.0	14/13				olive green	Clayey Fine grained	SC					
0939	4.0	11/8	18/24				sand		moist				
S-3 @	5.0	10/8											
0945	6.0	3/3	6/24		loose		(wood)		wet				
S-4 @	7.0	4/5					No Recovery						
0947	8.0	5/5	0/24				No Recovery						
S-5 @	9.0	7/10			med dense		Silty clayey F. Gr. Sand	SC	Saturated				
0949	10.0	11/7	15/24				(paper, plastic)						
S-6 @	11	6/6					Clayey Fine grained Sa.	SC	Saturated				
0954	12	6/5	15/24				(wood)						
S-7 @	13	10/13					Silty Clayey F. Gr. sand	SC	saturated				
1001	14	13/13	14/24						"No waste"				
S-8 @	15	13/13							Saturated				
1010	16	15/14	15/24										
S-9 @	17	13/14					Silty fine grained	SM	Saturated				
1018	18	15/13	13/24				sand (some clay)						
S-10 @	19	5/7							saturated				
1024	20	9/9	20/24										
S-11 @	21	3/2			loose		Silty Fine to medium	SM	saturated				
1030	22	1/1	20/24		very loose		grained sand						
S-12 @	23	2/1			loose								
1034	24	5/8	23/24		med dense	olive brn.	Silty F. Gr. Sand	SM	Saturated				

* When rock coring, enter rock brokeness.
** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area
Background (ppm):

Remarks: 140 lb. hammer falling 30-inches
4.25-inch I.D. HSA collected 05-GB04-2022 for analysis
2" ID Split spoon samplers

Converted to Well: Yes ____ No X Well I.D. #: N/A

BORING LOG

PROJECT NAME: NWS - EARLE
PROJECT NUMBER: CTO - 289
DRILLING COMPANY: JCA - Drilling
DRILLING RIG: CME - 55

BORING NUMBER: 05 - GB - 05
DATE: 6-19-97
GEOLOGIST: PAUL DAVIS
DRILLER: Steve Burger / Jon Urban

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm) Sample	Sampler BZ	Borehole**	Driller BZ**
	0.0												
S-1 @	1.0	2 / 1			very loose	olive brn.	Silty Fine grained Sand	SM	moist				
1320	2.0	4 / 5	12/24		loose	↓	↓ (paper, plastic)	↓					
S-2 @	3.0	5 / 6			med Dense	olive green	Silty clayey fi. Gr. Sand	SC	moist to				
1322	4.0	6 / 5	4/24		↓		↓ (wood)	↓	very moist				
S-3 @	5.0	– / –			–		No Recovery	–	Auger Thru.				
1327	6.0	– / –	–		–		No Recovery	–					
–	7.0	– / –	–		–		Auger Thru	–	Auger cuttings: wire, cans,				
–	8.0	– / –	–		–	↓	↓	–	metal straps, wood.				
S-4 @	9.0	7 / 3			med Dense	olive green	Silty clayey F. Gr. Sand	SC	very moist				
1345	10.0	5 / 12	12/24			↓	↓ (paper, plastic, glass, wood)		Landfill odors				
S-5 @	11	9 / 7				Gray-brn.	Silty Fine gr. Sand	SM					
1349	12	7 / 5	14/24		↓	olive	↓ (paper, plastic, wood)	↓	Landfill odors				
–	13	– / –	–		–		Auger Thru	–	On wood				
–	14	– / –	–		–	↓	↓	–	auger thru.				
S-6 @	15	4 / 5			loose	olive green	Silty Clayey fine	SC	L.F. odors				
1404	16	6 / 7	15/24		med Dense		grained sand		very wet. "No waste"				
S-7 @	17	5 / 6							Saturated				
1411	18	9 / 11	13/24						L.F. odors				
S-8 @	19	4 / 8							Saturated				
1416	20	7 / 6	18/24		↓				"No waste"				
S-9 @	21	4 / 5			loose				Saturated				
1420	22	6 / 6	16/24		med Dense				"No waste"				
S-10 @	23	7 / 8							saturated				
1425	24	8 / 9	23/24		↓	↓	↓	↓					

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm):

Remarks: 140 lb. hammer falling 30-inches
4.25-inch I.D. HSA collected 05-GBCS-2224 for analysis
2" ID Split spoon Samplers

Converted to Well: Yes ______ No X   Well I.D. #: N/A

APPENDIX G

SOIL BORING LOGS - SITE 5 (PREVIOUS INVESTIGATIONS)

WESTON

DRILLING LOG

US NAVY
1771-02-10

WELL NUMBER: 5-1 FILE
OWNER: WPNSTA Earle
LOCATION: Landfill West of Army Barricades
ADDRESS: Colts Neck New Jersey
TOTAL DEPTH: 29'
SURFACE ELEVATION: 108.77'
WATER LEVEL: 18'
DRILLING COMPANY: J.E. Fritts
DRILLING METHOD: HSA
DATE DRILLED: 2/20/86
DRILLER: WL
HELPER: RI
LOG BY: AEB

SKETCH MAP

NOTES: "Surface Elevation" = Top of PVC

DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
0					0-5' Dark brown (10YR 3/3) becoming pale brown fine to medium sand.
5		103	SS	4 8 8 10	4'-4.3' Olive yellow (2.5Y 6/6) sandy silt. 4.3'-4.9' Olive (5Y 4/4) and olive brown (2.5Y 4/4) medium to coarse sand with some (10%) silt, wet, Rec. =10"
10		104	SS	18 21 28 36	9'-9.5' Olive (5Y 4/4) and yellowish brown (10YR 6/8) medium to coarse sand with some (10%) silt, damp, Rec. =6"
15		105	SS	WOR 6 8 13	14'-14.25' Olive (5Y 4/4) and yellowish brown medium to coarse sand with 10% silt, slightly wet, Rec. = 15"

* ASTM D1586

WESTON

DRILLING LOG

WELL NUMBER: 5-1
OWNER: WPNSTA Earle
LOCATION: Landfill west of Army Barricades
ADDRESS: Colts Neck New Jersey
TOTAL DEPTH: 29'
SURFACE ELEVATION: 108.77'
WATER LEVEL: 18'
DRILLING COMPANY: J.E. Fritts
DRILLING METHOD: HSA
DATE DRILLED: 2/20/86
DRILLER: WL
HELPER: RI
LOG BY: AEB

SKETCH MAP

NOTES:

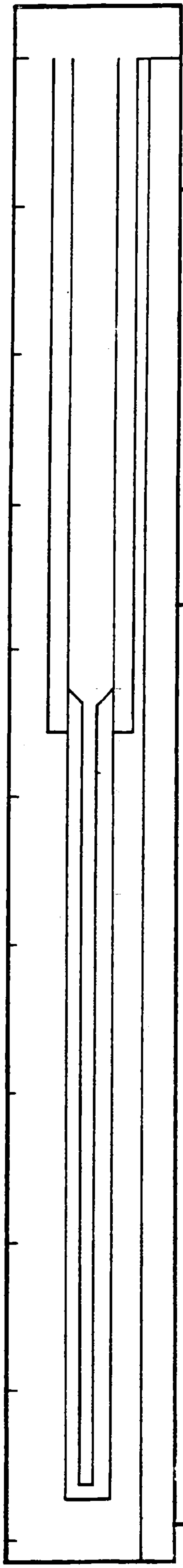
DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
20		106	SS	2 6 10 12	19'-21' Olive (5Y 4/4) and olive brown (2.5Y 4/4) fine to coarse sand, saturated, Rec=24"
25		107	SS	4 10 14 21	24'-26' Olive (5Y 4/4) and olive brown (2.5Y 4/4) fine to coarse sand, saturated, Rec=24"

* A.S.T.M D1586

SHEET 2 OF 2

Well 5-1

Well Construction Summary



Location ______
Personnel ______
Project ______

Location or Coords: Landfill West of Army Barricades

Elevation: Ground Level ______

Top of Casing 108.77'

Drilling Summary:

Total Depth 29'

Borehole Diameter ______

Driller J.E. Fritts

Rig Track Rig

Bit(s) Hollow Stem Auger; Roller Bit

Drilling Fluid Water

Surface Casing 6" Steel Locking

Construction Time Log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling: HSA	2/20 1986	0750	2/20 1986	0930
Roller Bit	"	0930	"	1000
Geophys. Logging:				
Casing: Install 4" PVC	"	1000	"	1030
Filter Placement:	"	1100	"	1215
Cementing:	"	1315	"	1430
Development:	3/20/86	1100	3/20/86	1155
Other:				

Well Design:

Basis: Geologic Log X Geophysical Log ______

Casing String(s): C = Casing S = Screen

3'	GS+2'	C1	29'	14'	S
14'	GS+2'	C2			

Casing: C1 6" Steel Locking

C2 4" SCH 40 PVC

Screen: S1 4" SCH 40 PVC 10 SLOT

S2 ______

Centralizers ______

Filter Material No. 2 Ottawa Sand 29'-12'

Cement 6:1 Portland Cement: Bentonite 11'-GS

Other Bentonite Pellets 12'-11'

Well Development:

Pumped at average rate of 2.5 gpm until free of fines.

Comments:

WESTON
DESIGNERS CONSULTANTS

WESTON

US NAVY
1771-02-10
FILE

DRILLING LOG

WELL NUMBER: 5-2
OWNER: WPNSTA Earle
LOCATION: Landfill west of Army Barricades
ADDRESS: Colts Neck, New Jersey
TOTAL DEPTH: 28'
SURFACE ELEVATION: 113.96'
WATER LEVEL: 18'
DRILLING COMPANY: JE Fritts
DRILLING METHOD: HSA
DATE DRILLED: 1/21/86
DRILLER: WL
HELPER: RI
LOG BY: AEB

SKETCH MAP

NOTES: "Surface Elevation" = Top of PVC

DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
0					0-3' Pale brown (10YR 6/3) fine to medium sand.
					3'-4' Strong brown (7.5YR 5/8) fine to medium sand.
5		72	SS	3 1 1 1	4'-5' Light gray (10 YR 7/1) with strong brown (7.5YR 5/8) very fine sand.
					5'-5.25' Dark grayish brown (10YR 4/2) clayey silt.
					5.25'-5.5' Dark grayish brown (10YR 4/2) silty very fine sand, wet to saturated, Rec - 18".
10		73	SS	5 6 9 11	9'-10.5' Strong brown (7.5YR 4/6) medium sand, little fine sand (5%), moist, Rec = 18"
					Water perched above 9'
15		74	SS	3 5 9 10	14'-15.5' Strong brown (7.5YR 4/6) medium sand, trace fine sand, moist. Rec = 18".
20		75	SS	4 6	19'-20.5' Olive (5Y 4/4) medium sand,

* A.S.T.M. D1586

WESTON

DRILLING LOG

US NAVY
1771-...-1

WELL NUMBER: 5-2
OWNER: WPNSTA Earle
LOCATION: Landfill west of Army Barricades
ADDRESS: E Colts Neck, New Jersey
TOTAL DEPTH: 28'
SURFACE ELEVATION: 113.96'
WATER LEVEL: 18'
DRILLING COMPANY: JE Fritts
DRILLING METHOD: HSA
DATE DRILLED: 1/21/86
DRILLER: WL
HELPER: RI
LOG BY: AEB

SKETCH MAP

NOTES:

DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
20				8 12	saturated, Rec = 18"
25		76	SS	WOR 6 9 12	24'-25.5' Olive (5Y 4/4) clean medium sand, saturated, Rec = 18"
30		77	SS	6 7 13 19	29'-31' Olive brown (2.5Y 4/4) medium sand, trace (10%) fine sand, saturated, Rec = 24"

* A.S.T.M. D1586

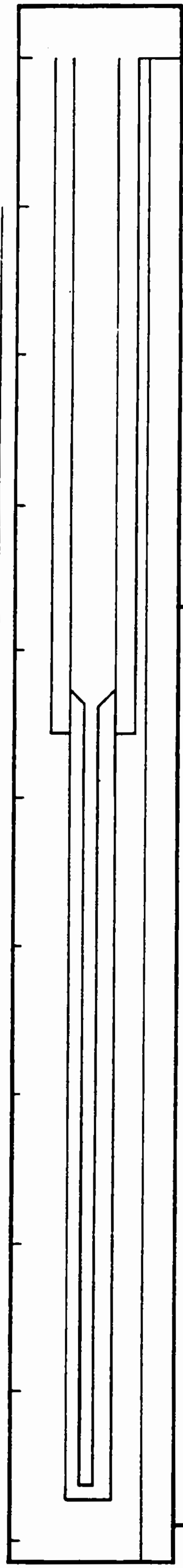
Well 5-2

Well Construction Summary

Location or Coords: Landfill West of Army Barricades

Elevation: Ground Level ______

Top of Casing 113.96'



Location ______ Personnel ______ Project ______

Drilling Summary:

Total Depth 28'

Borehole Diameter ______

Driller J.E. Fritts

Rig Mobil Drill B-61

Bit(s) Hollow stem Auger, Roller Bit

Drilling Fluid Water

Surface Casing 6" Steel Locking

Construction Time Log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling:				
HSA	1/21/86	1000	1/21/86	1145
Roller Bit	"	1145	"	1210
Geophys. Logging:				
Casing:				
Install 4" PVC	"	1330	"	1400
Filter Placement:	"	1400	"	1630
Cementing:	"	1630	"	1700
Development:				
Other:				

Well Design:

Basis: Geologic Log X Geophysical Log ______

Casing String(s): C=Casing S=Screen

3'	GS+2'	C1	28'	13'	S
13'	GS+2'	C2			

Casing: C1 6" Steel

C2 4" SCH 40 PVC

Screen: S1 4" SCH 40 PVC 10 SLOT

S2 ______

Centralizers ______

Filter Material #2 Ottowa Sand 28' - 11' below GS

Cement 6:1 Portland cement : bentonite 9' - GS

Other Bentonite Pellets 11' - 9' below GS

Well Development:

Well did not sustain pumping
Pumped 2 gallons every 10 minutes

Comments:

WESTON
DESIGNERS CONSULTANTS

WESTON

DRILLING LOG

US NAVY

WELL NUMBER: 5-3

OWNER: NWS Earle

LOCATION: Landfill West of Army Barricades

ADDRESS: Colts Neck New Jersey

TOTAL DEPTH: 32'

SURFACE ELEVATION: 109.78'

WATER LEVEL: 20'

DRILLING COMPANY: J.E. Fritts

DRILLING METHOD: Auger

DATE DRILLED: 3/3/86

DRILLER: WL

HELPER: RI

LOG BY: AEB

SKETCH MAP

NOTES:
"Surface Elevation" = Top of PVC

DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
0					0-5' Yellowish brown (10YR 6/8) silty sand
5		125	SS	4 2 6 12	5'-5.5' Pale yellow (2.5Y 7/4) very fine sand, 5.5'-6' Light olive brown (2.5Y 5/6) sandy silt, wet, Rec=12".
10		126	SS	4 3 5 8	10'-11.5' Dark yellowish brown (10YR 4/6) with olive (5Y 4/4) fine to medium sand, 10% silt, damp, Rec=18"
15		127	SS	4 5 9 13	15'-15.5' Pale yellow (2.5Y 7/4) fine sand 15.5'-16' Dark yellowish brown (10YR 4/6) with olive fine to medium sand, 10% silt, slightly wet, Rec= 12"

* A.S.T.M. D1586

SHEET 1 OF 2

WESTON

US NAVY
1771-02-10
FILE

DRILLING LOG

WELL NUMBER: 5-3
OWNER: WPNSTA Earle
LOCATION: Landfill West of Army Barricades
ADDRESS: Colts Neck New Jersey
TOTAL DEPTH: 32'
SURFACE ELEVATION: 109.78'
WATER LEVEL: 20'
DRILLING COMPANY: J.E. Fritts
DRILLING METHOD: Auger
DATE DRILLED: 3/3/86
DRILLER: WL
HELPER: RI
LOG BY: AEB

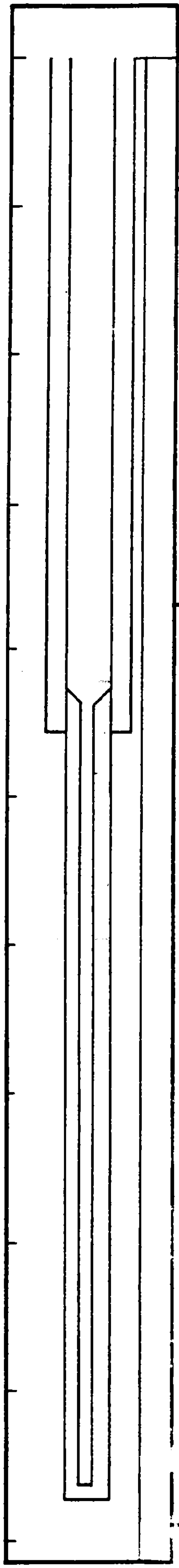
SKETCH MAP

NOTES:

DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
20		128	SS	5 7 9 12	20'-20.5' Dark yellowish brown (10YR 4/6) with olive (5Y 4/4) fine to medium sand, 15-20% silt becoming less silty (to 5% silt) with depth, Saturated, Rec = 6"
25		129	SS	7 8 13 22	25'-25.5' Yellowish brown (10YR 5/6) sandy silt. 25.5'-26' Olive (5Y 4/4) fine to medium sand, Saturated, Rec. = 12"
30		130	SS	7 8 13 22	30'-30.9' Olive (5Y 4/4) and dark yellowish brown (10YR 4/6) fine to medium sand with 10-15% silt, saturated, Rec = 10"

* A.S.T.M. D1586

Location ______
Personnel ______
Project ______



Well 5-3

Well Construction Summary

Location or Coords: Landfill West of Army Barricades

Elevation: Ground Level ______

Top of Casing 109.78

Drilling Summary:

Total Depth 32'

Borehole Diameter ______

Driller J. E. Fritts

Rig Track Rig

Bit(s) Hollow stem Auger, Roller Bit

Drilling Fluid Water

Surface Casing 6" Steel Locking

Well Design:

Basis: Geologic Log X Geophysical Log ______

Casing String(s): C=Casing S=Screen

3'	GS+2'	C1	32'	17'	S1
17'	GS+2'	C2			
37'	32'	C3			

Casing: C1 6" Steel Locking

C2 4" SCH 40 PVC

C3 4" SCH 40 PVC

Screen: S1 4" SCH 40 PVC 10 SLOT

S2 ______

Centralizers ______

Filter Material No. 2 Ottawa Sand 32'-15'

Cement 6:1 Portland Cement : Bentonite 14' - GS

Other Bentonite Pellets 15' - 14'

Construction Time Log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling: HSA	3/3/86	0830	3/3/86	1000
Roller Bit	"	1000	"	1225
Geophys. Logging:				
Casing: Install 4" PVC	"	1315	"	1330
Filter Placement:	"	1410	"	1525
Cementing:	"	1525	"	1615
Development:	3/20/86	0915	3/20/86	1040
Other:				

Well Development:

Pumped at average rate of 25 gpm until discharge free of fines.

Comments:

WESTON
DESIGNERS CONSULTANTS

WESTON

DRILLING LOG

US N

WELL NUMBER: 5-4

OWNER: 17 NPNSTA Earle

LOCATION: Landfill west of Army Barricade

ADDRESS: Colts Neck New Jersey

FILE

TOTAL DEPTH: 27'

SURFACE ELEVATION: 105.65'

WATER LEVEL: 17'

DRILLING COMPANY: J.E. Fritts

DRILLING METHOD: Auger

DATE DRILLED: 2/19/86

DRILLER: WL

HELPER: RI

LOG BY: AB

SKETCH MAP

NOTES: "Surface Elevation" = Top of PVC

DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
0					0-5' Olive yellow (2.5Y 6/6) to olive brown (2.5Y 4/4) medium to coarse sand.
5		98		2 11 18 22	4'-4.4' Light yellowish brown (2.5Y 6/4) with light gray (10YR 7/1) fine to medium sand.
					4.44'-4.9' Olive yellow (2.5Y 6/6) fine to medium sand.
					4.9'-5.25' Olive (5Y 4/4) fine to medium sand with some (25%) silt, Rec. = 15", damp.
10		99		9 25 23 26	9'-9.25' Gray (5Y 6/1) fine to medium sand
					9.25'-9.9' Olive yellow (2.5Y 6/6) fine to medium sand
					9.9'-10.25' Olive (5Y 4/4) and olive brown (2.5Y 4/4) fine to medium sand with little (10%) silt, damp, Rec = 15"
15		100		6 10 15 14	14'-15' Olive (5Y 4/4) and olive brown (2.5Y 4/4) medium to coarse sand, wet, Rec. = 12"

* A.S.T.M. D1586

WESTON

US ARMY
1771-02-10

DRILLING LOG

WELL NUMBER: 5-4

OWNER: FILE USATHAMA Earle

LOCATION: Landfill west of Army Barricades

ADDRESS: Colts Neck New Jersey

TOTAL DEPTH: 27'

SURFACE ELEVATION: 105.65'

WATER LEVEL: 17'

DRILLING COMPANY: JE Friths

DRILLING METHOD: HSA

DATE DRILLED: 2/19/86

DRILLER: WL

HELPER: RI

LOG BY: AEB

SKETCH MAP

NOTES:

DEPTH (FEET)	GRAPHIC LOG	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE BLOWS*	DESCRIPTION / SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURES)
20		101		6 5 15 19	19'-21' Olive (5Y 4/4) to olive brown (2.5Y 4/4) medium to very coarse sand, saturated. Rec=24"
25		102		7 9 15	24'-25.5' Olive (5Y 4/4) to olive brown (2.5Y 4/4) medium to very coarse sand, saturated. Rec.=18"

* A.S.T.M. D1586

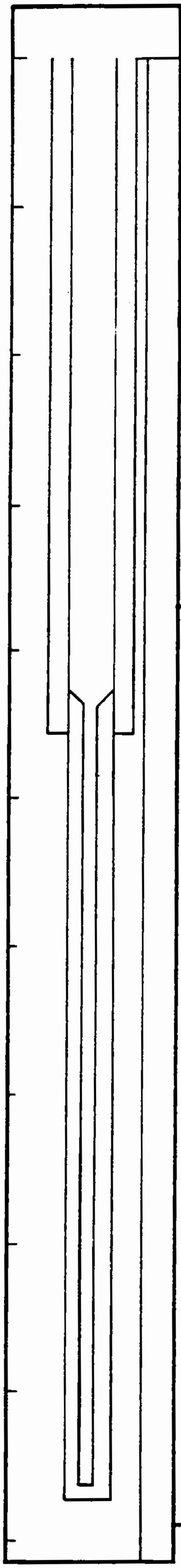
Well 5-4

Well Construction Summary

Location or Coords: Landfill West of Army Barricades

Elevation: Ground Level ______

Top of Casing 105.65'



Location ______

Personnel ______

Project ______

Drilling Summary:

Total Depth 27'

Borehole Diameter ______

Driller J.E. Fritts

Rig Track mounted

Bit(s) Hollow Stem Auger; Roller Bit

Drilling Fluid ______

Surface Casing ______

Well Design:

Basis: Geologic Log X Geophysical Log ______

Casing String(s): C=Casing S=Screen

2'	GS+2'	C1	27'	12'	S
12'	GS+	C2			

Casing: C1 6" Steel Locking

C2 4" SCH 40 PVC

Screen: S1 4" SCH 40 PVC 10 SLOT

S2 ______

Centralizers ______

Filter Material NO. 2 Ottawa Sand 27'-10'

Cement 6:1 Cement : Bentonite 9' - GS

Other Bentonite Pellets 10' - 9'

Construction Time Log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling: HSA	2/19 1986	0830	2/19 1986	0930
Roller Bit	"	0930	"	1000
Geophys. Logging:				
Casing: Install 4" PVC	"	1025	"	1100
Filter Placement:	"	1220	"	1400
Cementing:	"	1400	"	1430
Development:	3/20/86	1200	3/20/86	1345
Other:				

Well Development:

Pumped at average rate of 2.5 gpm until discharge free of fines

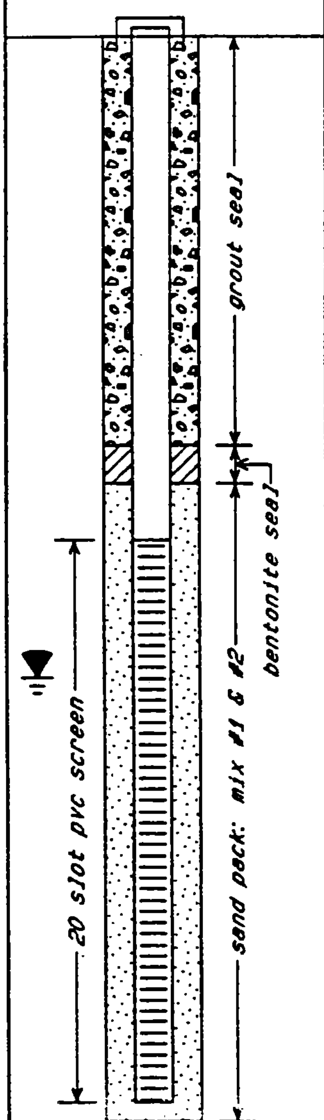
Comments:

WESTON DESIGNERS CONSULTANTS

MONITOR WELL 5-5

Project	N.W.S. Earle/ Colts Neck	Well Number	MW05-5
Location	Colts Neck, N.J.	Coordinates	
Geologist	N. Pulczak	Top of Casing Elevation	112.05 feet MSL
Drilling Contractor	B. L. Myers	Groundsurface Elevation	feet
Driller	B. Stringer	Total Borehole Depth	55.0 feet
Drilling Method	Hollow stem auger	Total Well Depth	28.5 feet
Diameter of Borehole	11.5 (7.5) inches	Date Started	1/18/91
Diameter of Well Casing	4 inches	Date Well Completed	1/18/91

WELL CONSTRUCTION DETAIL



DEPTH IN FEET	SAMPLE INTERVAL	BLOW COUNT	% RECOVERY	GRAPHIC SYMBOL
0–2	X	3,8 / 10,13	75	SW
2–4	X	6,10 / 18,16	50	
4–6	X	6,13 / 16,19	45	
6–8	X	8,142 / 8,12	75	
8–10	X	8,13 / 15,11	75	
10–12	X	6,14 / 18,15	40	
12–14	X	7,11 / 12,12	80	
14–16	X	6,10 / 7,9	80	
16–18	X	6,7 / 8,12	75	
18–20	X	7,7 / 10,13	85	
20–22	X	3,5 / 12,17	100	
22–24	X	7,8 / 8,10	100	
24–26	X		100	
26–28	X		100	

DESCRIPTION

0.0-2.0
Brownish yellow (10YR6/8), SAND, fine-med grain, trace couarse grain, damp.

2.0-4.0
Olive (5Y5/4), SAND, med. grain, 10% fine 10% coarse, damp:
2.0-2.6: Brownish yellow SAND, as above.
2.6-4.0': Olive SAND.

4.0-6.0
Same as above, trace Qtz fragments in split spoon. Dry.

6.0-8.0
Same as above, trace silt, no Qtz. At 6.8-7.0ft. found paper/cardboard , dry

8.0-10.0
Light gray (10YR7/1), SAND, med. - fine grain, trace coarse sand, trace organics (roots), peat fragemnt- pos. charred wood, v. low plast., dry.

10.0-12.0
10.0-10.6: Same as above. Wood gragments at 10.4-10.6ft.
10.6-11.6: Olive (5Y5/4) and Brownish yellow (10YR6/8) mix, med. grain, low plast., dry.

12.0-14.0
Olive (5Y5/4), White and Olive yellow (2.5Y6/6) mix, SAND, med grain, trace fine (5%), trace coarse (2%), firm, Fe stain @13.2ft, low plast., dry.

14.0-16.0
Same as above w/o Olive Yellow component, dry.

16.0-18.0
Dark green (5GY4/1), SAND, med.-coarse grain, trace fine, moist.

MONITOR WELL 5-

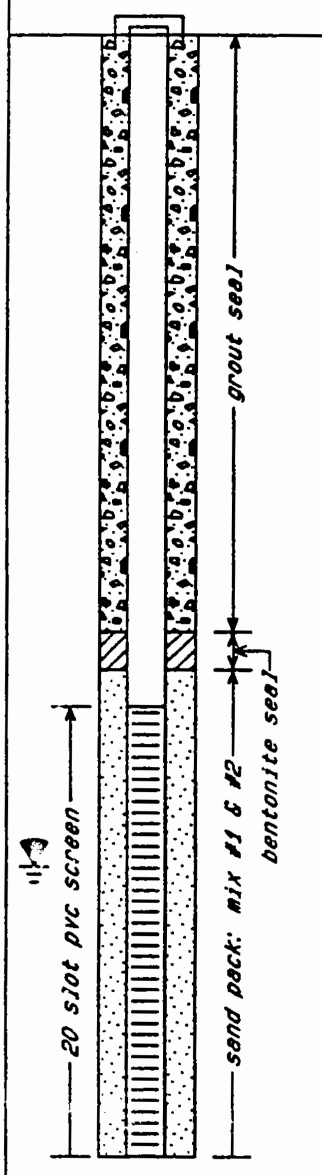
PROJECT N.W.S. Earle/ Colts Neck WELL NUMBER MW05-5

DEPTH IN FEET	WELL CONSTRUCTION DETAIL	SAMPLE INTERVAL	BLOW COUNT	% RECOVERY	GRAPHIC SYMBOL	DESCRIPTION
30						18.0-20.0 Olive (5y5/4), SAND, med- coarse grain, trace fine sand & silt, little orange sand, med grain, wet.
32						
34						20.0-22.0 Same as above. wet
36						22.0-24.0 Same as above. wet.
38						24.0-26.0 Same, with increase in coarse fraction, wet.
40						26.0-28.0 Same, wet.
42						
44						
46						
48						
50						
52						
54						
56						
58						
60						
62						
64						
66						
68						
70						

MONITOR WELL 5-6

Project	N.W.S. Earle/ Colts Neck	Well Number	MW05-6
Location	Colts Neck, N.J.	Coordinates	
Geologist	T. McCann	Top of Casing Elevation	117.30 feet MSL
Drilling Contractor	B. L. Myers	Groundsurface Elevation	feet
Driller	B. Stringer	Total Borehole Depth	33.5 feet
Drilling Method	Hollow stem auger	Total Well Depth	33.0 feet
Diameter of Borehole	11.5 (7.5) inches	Date Started	1/22/91
Diameter of Well Casing	4 inches	Date Well Completed	1/23/91

WELL CONSTRUCTION DETAIL



DEPTH IN FEET	BLOW COUNT	% RECOVERY	GRAPHIC SYMBOL
0–2	3,3 / 5,7	54	SW
2–4	6,6 / 9,12	25	ML
4–6	3,5 / 6,5	67	SP
6–8	2,1 / 7,2	50	CL
8–10	3,5 / 4,7	58	SM
10–12	3,10 / 10,9	50	
12–14	9,11 / 13,19	75	
14–16	7,9 / 27,26	67	
16–18	4,4 / 11,8	67	
18–20	4,2 / 9,11	71	
20–22	2,5 / 5,4	71	
22–24	2,4 / 7,2	92	
24–26	2,4 / 6,9	75	
26–28	2,2 / 1,0	75	

DESCRIPTION

0-2.0
Very pale brown (10YR7/3), SAND, med. grain, some Qtz gravel, med. grain, sub-rounded to rounded.
HNU = BKG

2.0-4.0
Very dark grayish brown (10YR3/2), SILT some sand, low plast., moist.
HNU=BKG

4.0-6.0
Very dark grayish brown (10YR3/2), SILT, v. fine grain, grading to grayish brown (10YR5/2), SAND , coarse grain, moist.
HNU=BKG

6.0-8.0
Yellow (10YR7/6), SAND, fine to v. fine grain, moderate sorting, grading to a yellow (10YR7/8), SILT, low plast, moist
HNU=BKG

8.0-10.0
Yellow (10YR7/8), SILT, low plast., grading to Very pale brown (10YR7/3) SAND, med. grain at 10'5".

10.0-12.0
Very pale brown (10YR7/3), SAND, med. grain, moist, as above,

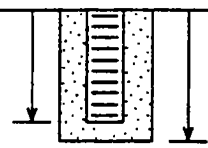
12.0-14.0
Gray (10YR5/1), SAND, med. grain, med. sorting, Fe staining at 12'3", damp

14.0-16.0
Light brownish gray (10YR6/2), SAND, tan to lt. brown grain color, med. in gr. size, Fe staining at 8", wet.

MONITOR WELL 5-

PROJECT N.W.S. Earle/ Colts Neck

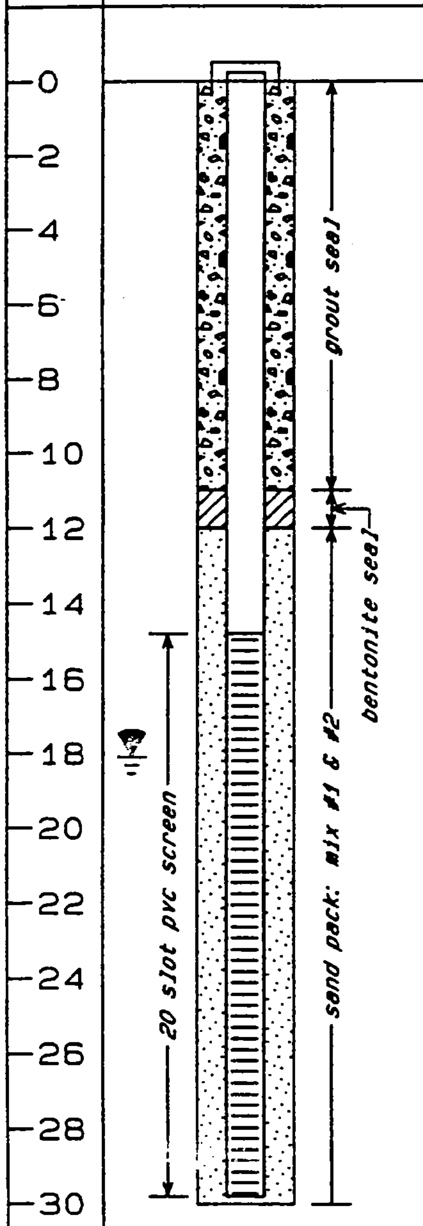
WELL NUMBER MW05-6

DEPTH IN FEET	WELL CONSTRUCTION DETAIL	SAMPLE INTERVAL	BLOW COUNT	*	RECOVERY	GRAPHIC SYMBOL	DESCRIPTION
30						SM	16.0-18.0 Yellowish brown (10YR5/4). SAND, fine to med. grain, damp
32							18.0-20.0 Brownish yellow (10YR6/6). SAND, fine to med. grain, 5%=green (glauconitic), 15%= dk. brown, 80% = tan, moist.
34							
36							20.0-22.0 Same as above, moist.
38							22.0-24.0 Same as above, wet
40							24.0-26.0 same as above, wet.
42							26.0-28.0 Brownish yellow (10YR6/6). SAND little silt, fine to med. grain, wet.
44							
46							* Auger to 34'. Discontinue split spoon sampling due to sands running up auger.
48							
50							
52							
54							
56							
58							
60							
62							
64							
66							
68							
70							

MONITOR WELL 5-7

Project	N.W.S. Earle/ Colts Neck	Well Number	MW05-7
Location	Colts Neck, N.J.	Coordinates	
Geologist	T. McCann	Top of Casing Elevation	113.97 feet MSL
Drilling Contractor	B. L. Myers	Groundsurface Elevation	feet
Driller	B. Stringer	Total Borehole Depth	30.5 feet
Drilling Method	Hollow stem auger	Total Well Depth	29.8 feet
Diameter of Borehole	11.5 (7.5) inches	Date Started	1/23/91
Diameter of Well Casing	4 inches	Date Well Completed	1/24/91

DEPTH IN FEET | WELL CONSTRUCTION DETAIL | SAMPLE INTERVAL | BLOW COUNT | % RECOVERY | GRAPHIC SYMBOL | DESCRIPTION



Depth (ft)	Blow Count	% Recovery	Graphic Symbol
0-2	2,3 / 8,8	88	SM
2-4	4,3 / 7,8	79	ML
4-6	2,3 / 4,8	58	
6-8	2,4 / 5,8	67	SW
8-10	3/4 / 99/5	50	
10-12	22,28 / 34,38	96	SP
12-14	4,6 / 10,18	75	
14-16	4,9 / 10,11	83	
16-18	2,5 / 6,1	54	
18-20	3,5 / 8,10	79	
20-22	3,8 / 12,10	62	SW

DESCRIPTION

0.0-2.0
Pale brown (10YR6/3), SILT, v. low plast., damp.

2.0-4.0
Very dark grayish brown (10YR3/2), SILT, low to med plast., grades to v.low plast. silt after 10", damp.

4.0-6.0
Very dark grayish brown (10YR3/2), SILT, as above, more clay stringers apparent, damp.

6.0-8.0
Gray (5G5/1), SAND and SILT, v.f. to fine, Glauconitic, 10% green grains v.f., 90% tan grains, v.f. to fine, trace Fe stains, damp.

8.0-10.0
Strong brown (7.5YR5/6), SAND, v.f. to fine, med. sorting, some Fe staining damp

10.0-12.0
Same as above:
10% green (glauconitic) sand, v.f.
90% tan sand v.f. to fine (Fe stains)
damp.

12.0-14.0
Brown to Dark brown (7.5Yr4/4), same as above, slightly more glauconitic sand (15-20% total green grains), damp.

14.0-16.0
Same as above, damp

MONITOR WELL 5-

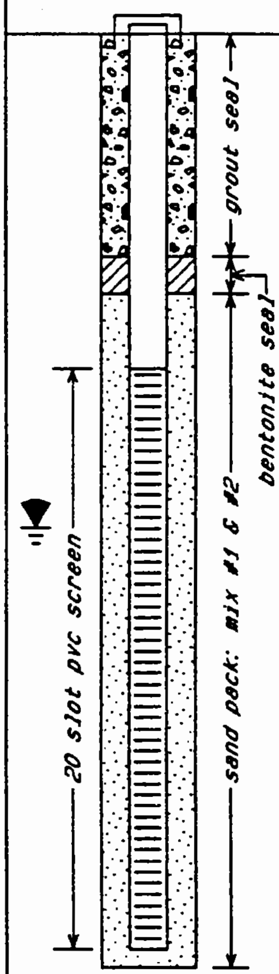
PROJECT N.W.S. Earle/ Colts Neck WELL NUMBER MW05-7

DEPTH IN FEET	WELL CONSTRUCTION DETAIL	SAMPLE INTERVAL	BLOW COUNT	% RECOVERY	GRAPHIC SYMBOL	DESCRIPTION
30						16.0-18.0 Strong brown (7.5YR5/6), SAND, v.f. to fine, less Glauconitic, damp 2-5% green glauconitic sand, v.f. 98-95% tan to orange sand, v.f to f.
32						
34						18.0-20.0 Same as above, damp.
36						20.0-22.0 Same as above, wet.
38						* Discontinue split spoon sampling due to running sands. Following samples taken from cuttings.
40						24.0-26.0 Gray (7.5YR5/0), SAND and SILT, low plast., wet
42						
44						28.0-30.0 Brown(10YR5/4) SAND and SILT, v. fine, wet.
46						
48						
50						
52						
54						
56						
58						
60						
62						
64						
66						
68						
70						

MONITOR WELL 5-8

Project	N.W.S. Earle/ Colts Neck	Well Number	MW05-8
Location	Colts Neck, N.J.	Coordinates	
Geologist	J. Williams	Top of Casing Elevation	110.30 feet MSL
Drilling Contractor	B. L. Myers	Groundsurface Elevation	feet
Driller	B. Stringer	Total Borehole Depth	25.0 feet
Drilling Method	Hollow stem auger	Total Well Depth	24.5 feet
Diameter of Borehole	11.5 (7.5) inches	Date Started	2/12/91
Diameter of Well Casing	4 inches	Date Well Completed	2/13/91

WELL CONSTRUCTION DETAIL



DEPTH IN FEET	SAMPLE INTERVAL	BLOW COUNT	% RECOVERY	GRAPHIC SYMBOL
0-2	X	5,4 3,4	83	SM
2-4	X	4,4 4,5	60	ML
4-6	X	3,4 6,6	65	
6-8	X	10,12 11,14	80	SW
8-10	X	11,13 14,16	85	
10-12	X	7,10 15,19	75	SP
12-14	X	8,11 12,12	75	
14-16	X	6,11 13,16	85	
16-18	X	8,11 12,17	80	
18-20	X	6,10 14,14	85	
20-22	X	6,10 11,14	85	SW
22-24	X	3,7 14,21	90	

DESCRIPTION

0-2.5
Sand and Silt, trace gravel, v. fine sand, Orange Brown,
HNU=BKG

2.5-6.0'
Silt with trace clay, low plasticity, little (15%) fine to coarse sand and fine gravel, Fe precipitate at 4.6ft.
HNU=BKG

6-10'
Sand, fine to med. grain, little silt (10%), little Fe staining at 8-10 ft.
HNU=BKG

`d=10
10-20'
Sand, fine to med. grain, little (10%) to some (20%) silt, Olive Brown (2.5Y4/4), trace mica at 12', slightly cohesive at 17', low plasticity at 18-20'.
HNU=BKG

20-24'
Sand, fine-med., little (10%) silt, trace coarse sand, becmes Dark Yellow Brown (10YR4/6) at 20-22' then becomes Olive Brown again.
HNU=BKG

APPENDIX H

GEOTECHNICAL LABORATORY RESULTS - SITE 5

VALLEY
FORGE
LABORATORIES, INC.

30th ANNIVERSARY 1967 1997

Engineering Consultants Since 1967

SOIL LABORATORY TEST REPORT 6-6

RECEIVED
JUL 02 1997

Project No. 97128
June 30, 1997

Geotechnical Engineering

Attention: Mr. Dan Witt
Brown and Root Environmental
661 Andersen Drive
Foster Plaza 7
Pittsburgh, PA 15220

Construction Quality Control

Re: Subcontract Agreement No. GCDB-97-526-1298, Analytical Services
CTO No. 289 - Naval Weapons Station (NWS), Earle Colts Neck, N.J.

Samples Picked Up: On 6/23/97 by VFL, 9 samples from 18 jars

Laboratory Testing

Testing Completed: (As requested on Chain of Custody Form, 4 Samples at Level D P.P.E. and 5 Samples at Level C P.P.E.)

Test	ASTM Standard
Natural Moisture Content	D2216
Particle Size Analysis (Sieve and Hydrometer)	D422
Atterberg Limits	D4318
USCS Classification	D2487

NDT and Related Services

Research and Special Studies

Results:

The results of the testing are graphically depicted on the attached Grain Size Distribution Curves. If you have any questions about this test report, please call.

Environmental Engineering

Sincerely,

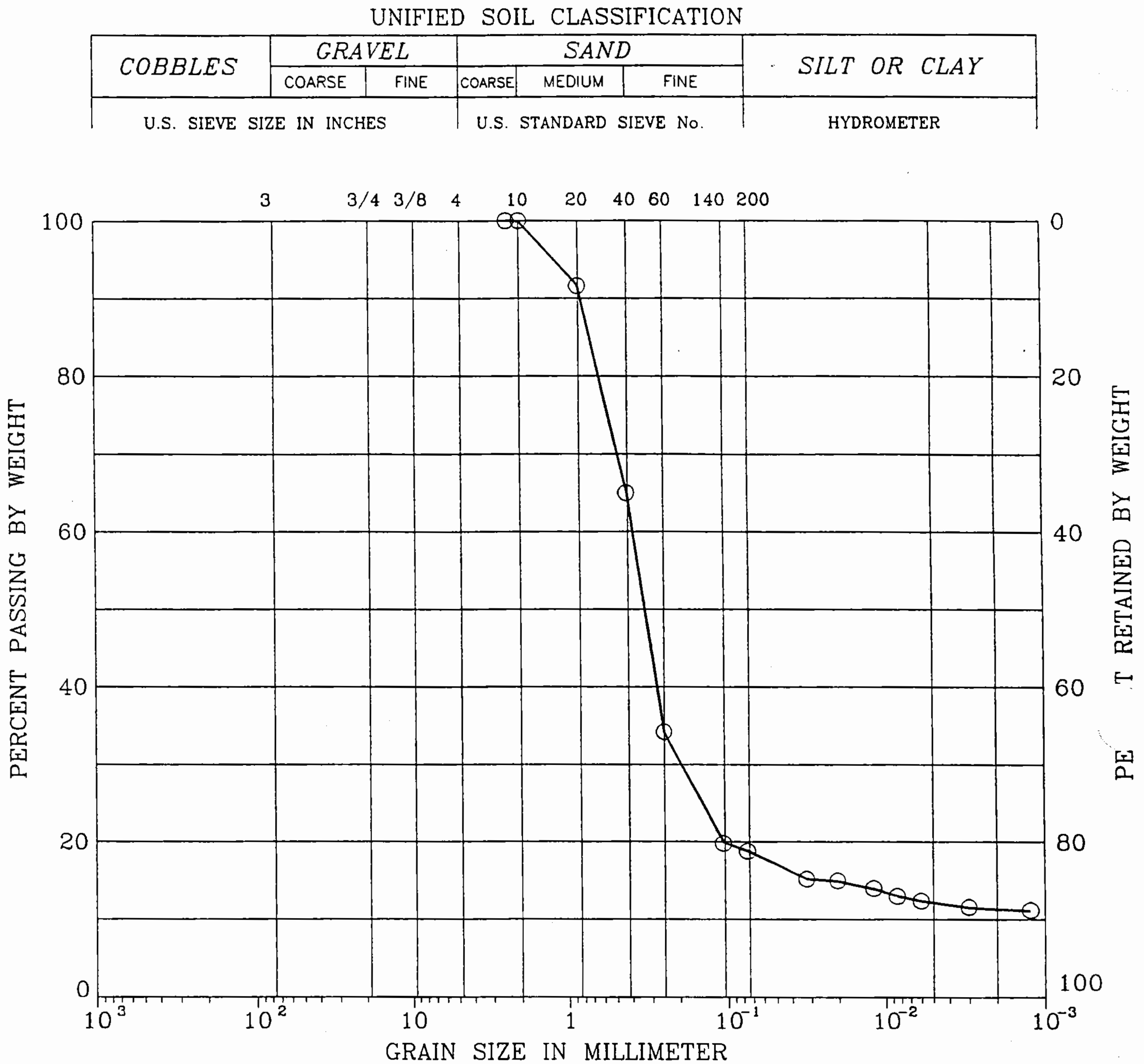
Eric J. Seksinsky, P.G., P.E.
Technical & Quality
System Manager

Transportation and Traffic Engineering

EJS:lcw
Enclosure
cc: Mike Wireman

Fax (610) 688-8143 • 6 Berkeley Road, Devon, PA 19333-1397 • (610) 688-8517

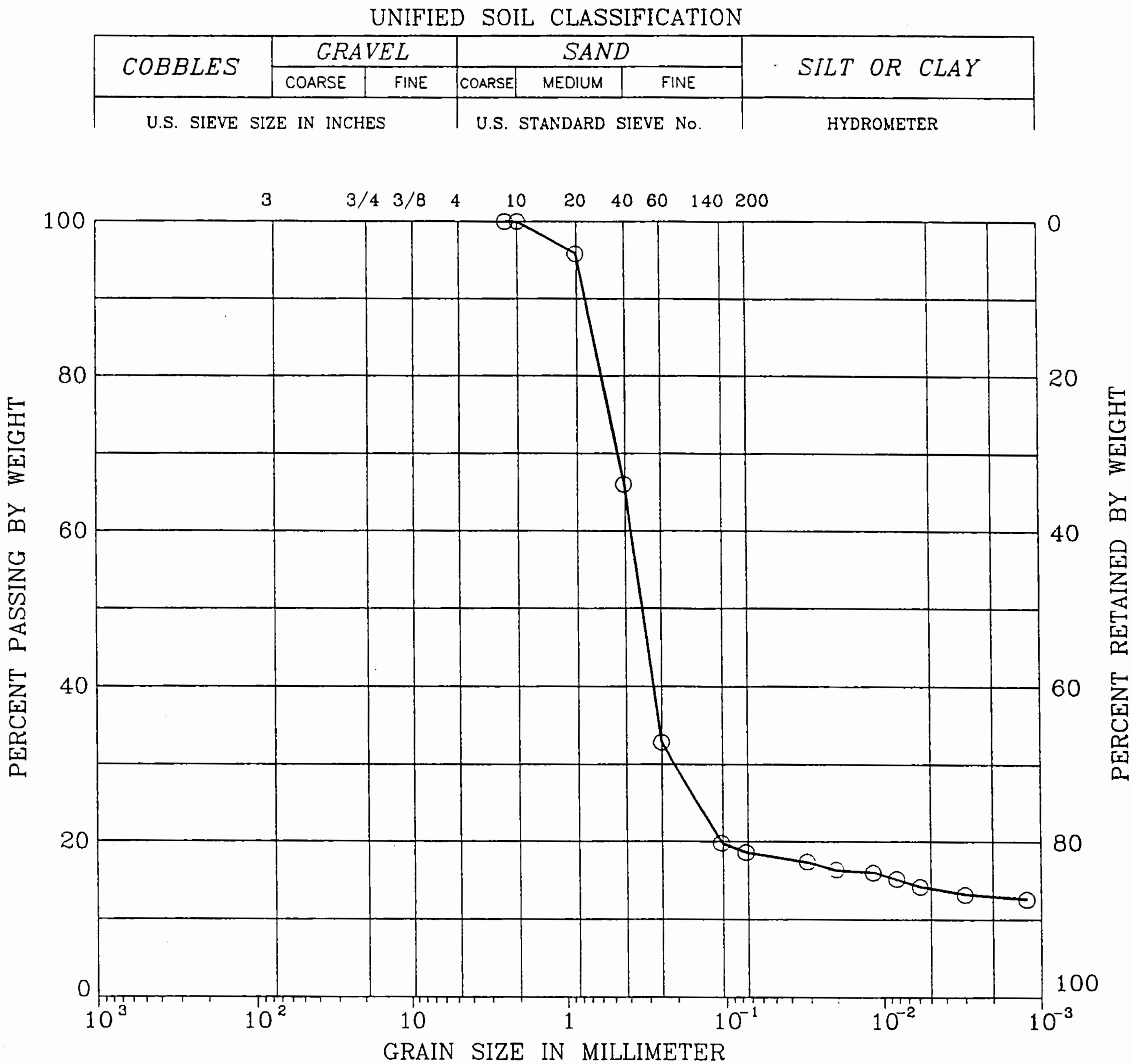
URL: http://www.mgar.com/vfl • E-mail : vflabs@voicenet.com



SYMBOL	BORING	LL (%)	PI (%)	DESCRIPTION
O	05-GB01-2022	28	8	GREEN CLAYEY SAND (SC)

Remark : NAT. MOISTURE CONTENT 22.6 LEVEL C P.P.E.

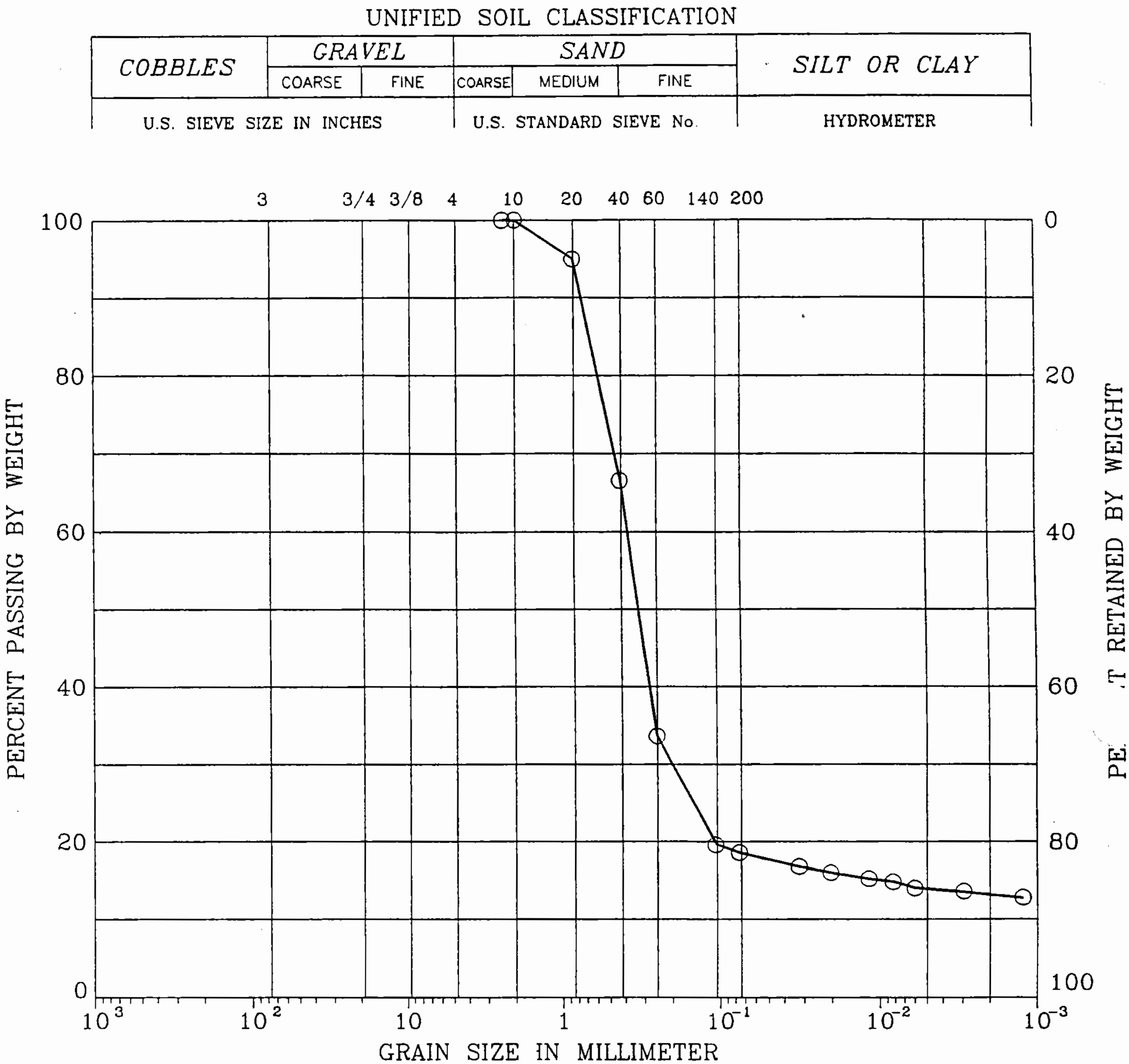
Project No. 97128	BROWN ROOT ENVIRONMENTAL
Valley Forge Laboratories, Inc.	GRAIN SIZE DISTRIBUTION 6/30/97



SYMBOL	BORING	LL (%)	PI (%)	DESCRIPTION
○	05-GB02-1416	24	5	GREEN SILTY, CLAYEY SAND (SM-SC)

Remark : NAT. MOISTURE CONTENT 9.0 LEVEL C P.P.E.

Project No. 97128	BROWN ROOT ENVIRONMENTAL
Valley Forge Laboratories, Inc.	GRAIN SIZE DISTRIBUTION 6/30/97



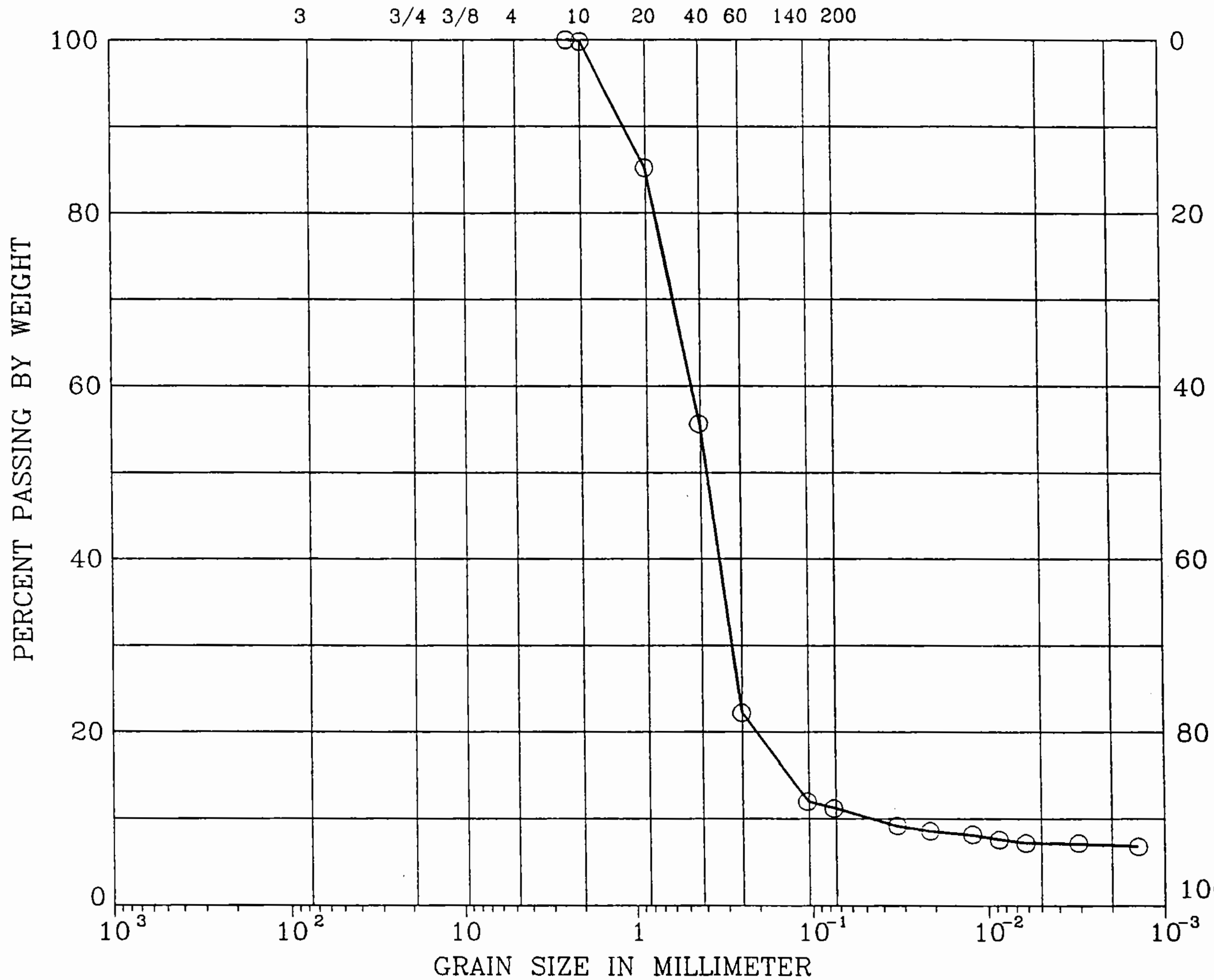
SYMBOL	BORING	LL (%)	PI (%)	DESCRIPTION
○	05-GB03-1820	27	8	GREEN CLAYEY SAND (SC)

Remark : NAT. MOISTURE CONTENT 19.7 LEVEL C P.P.E.

Project No. 97128	BROWN ROOT ENVIRONMENTAL
Valley Forge Laboratories, Inc.	GRAIN SIZE DISTRIBUTION 6/30/97

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	
U.S. SIEVE SIZE IN INCHES			U.S. STANDARD SIEVE No.			HYDROMETER



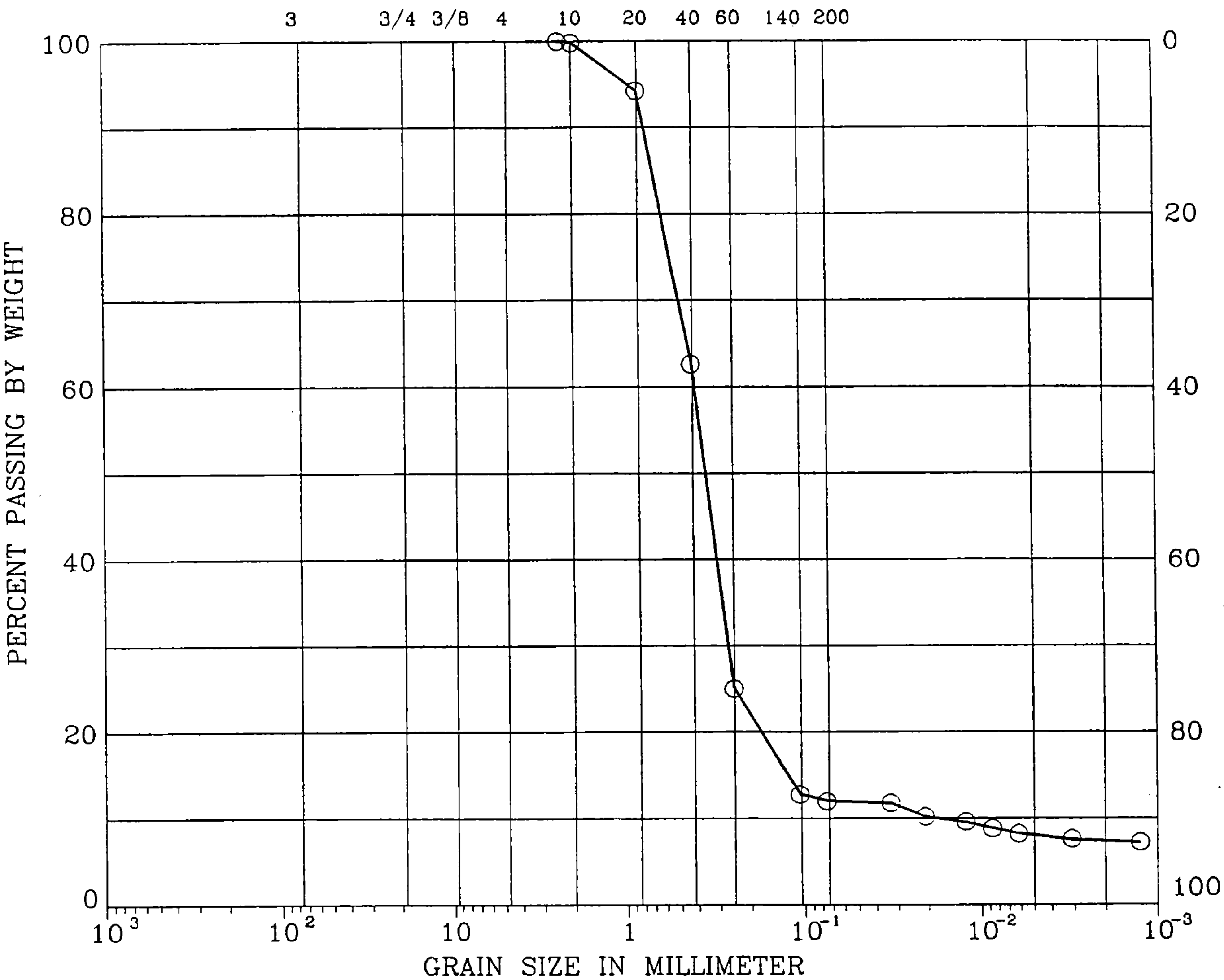
SYMBOL	BORING	LL (%)	PI (%)	DESCRIPTION
○	05-GB04-2022	NON-PLASTIC		GREEN POORLY-GRADED SAND WITH SILT (SP-SM)

Remark : NAT. MOISTURE CONTENT 22.0 LEVEL C P.P.E.

Project No. 97128	BROWN ROOT ENVIRONMENTAL
Valley Forge Laboratories, Inc.	GRAIN SIZE DISTRIBUTION 6/30/97

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	
U.S. SIEVE SIZE IN INCHES			U.S. STANDARD SIEVE No.			HYDROMETER



SYMBOL	BORING	LL (%)	PI (%)	DESCRIPTION
○	05 - GB05-2224	NON-PLASTIC		GREEN POORLY GRADED SAND WITH SILT (SP-SM)

Remark : NAT. MOISTURE CONTENT 21.7 LEVEL C P.P.E.

Project No. 97128	BROWN ROOT ENVIRONMENTAL
Valley Forge Laboratories, Inc.	GRAIN SIZE DISTRIBUTION 6/30/97

APPENDIX I

TEST PIT LOGS - SITE 5

TEST PIT LOG **Brown & Root Environment[al]**

PROJECT: NWS - EARLE TEST PIT NO.: 05-TP-0[1]

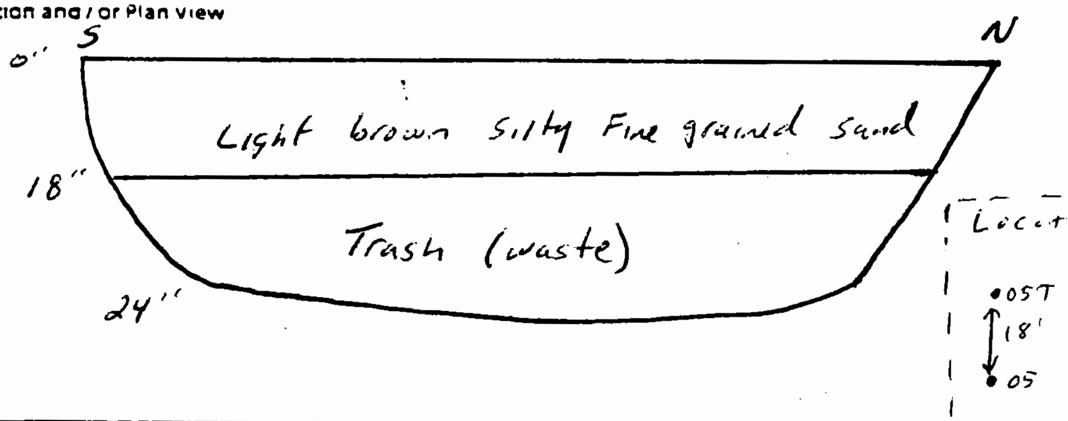
PROJECT NO.: CTO - 289 DATE: 6/23/97

LOCATION: Colts Neck, NJ.

FIELD GEOLOGIST: PAUL M. DAVIS

DEPTH (ft.)	LITHOLOGY CHANGE (Depth,ft.)	MATERIAL DESCRIPTION (Soil Density / Consistency, Color)	USCS	REMARKS
6"		Light brown silty Fine grained sand		
18"		↓		
		Trash (waste material) paper,		
		plastic, metal straps		
24"				

Test Pit Cross Section and / or Plan View



REMARKS 2' x 2' x 9' long

Test pit located in eastern side of landfill within Shooter clearing

PHOTO LOG

TEST PI[T]

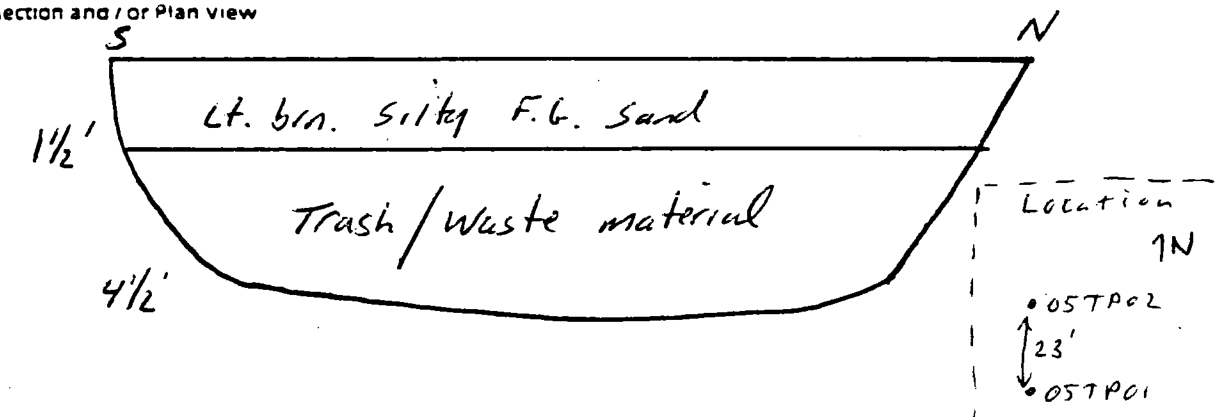
PAGE

TEST PIT LOG — **Brown & Root Environmental**

PROJECT: NWS - EARLE   TEST PIT NO.: 05-TP-02
PROJECT NO.: CTO - 289   DATE: 6/23/97
LOCATION: Colts Neck, NJ.
FIELD GEOLOGIST: PAUL M. DAVIS

DEPTH (ft.)	LITHOLOGY CHANGE (Depth,ft.)	MATERIAL DESCRIPTION (Soil Density / Consistency, Color)	USCS	REMARKS
		Light brown silty fine grained Sand		
18"				
		Trash/waste - wood, lumber, metal straps, grayish-black silty Clayey F.G. Sand, burnt material, metal debris, and a tree stump		
4.5'				

Test Pit Cross Section and / or Plan view



REMARKS 2' x 4½' x 11' long
Test pit located in eastern area of landfill within Shooters Club Clearing

PHOTO LOG

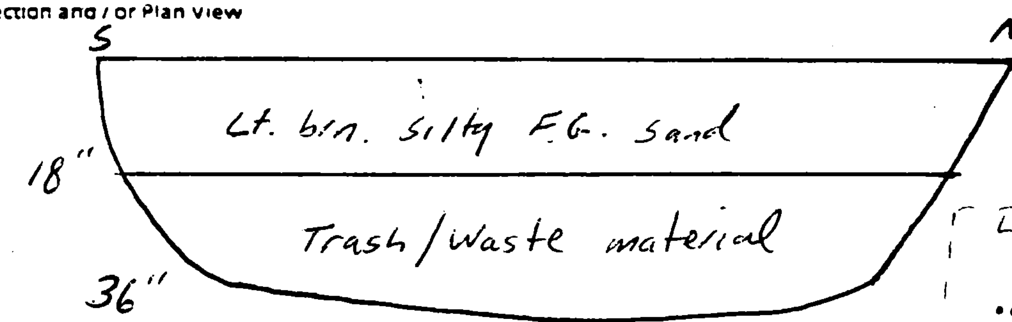
TEST PIT 05-TP-02
PAGE 1 OF 1

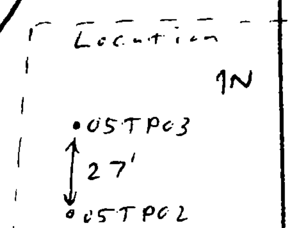
TEST PIT LOG — **Brown & Root Environmental**

PROJECT: NWS - EARLE — TEST PIT NO.: 05-TP-03
PROJECT NO.: CTO - 289 — DATE: 6/23/97
LOCATION: Colts Neck, NJ.
FIELD GEOLOGIST: PAUL M. DAVIS

DEPTH (ft.)	LITHOLOGY CHANGE (Depth, ft.)	MATERIAL DESCRIPTION (Soil Density / Consistency, Color)	USCS	REMARKS
		Light brown silty fine grained sand		
18"		↓		
		Trash/waste material - lumber, metal straps, cables, black/gray silty clayey F.G. sand, black poly sheet		
36"				

Test Pit Cross Section and / or Plan View





REMARKS: 2' x 3' x 7' long

Test pit located in Eastern area of landfill within Shooters Club Clearing

PHOTO LOG: Photo, - View facing NW of Test pit.

TEST PIT 05-TP-03

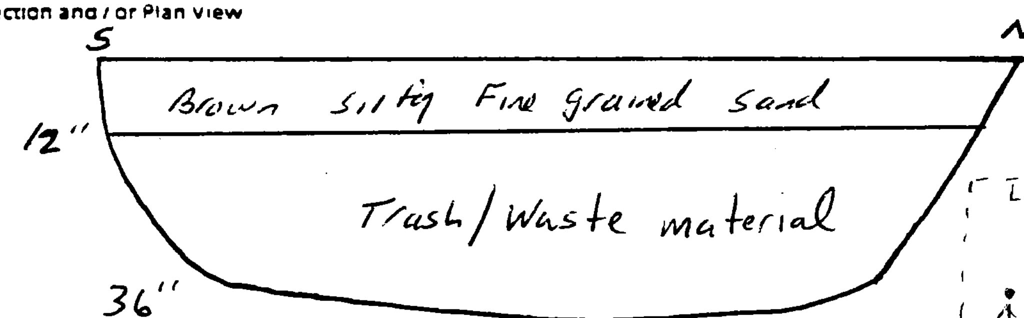
PAGE 1 OF 1

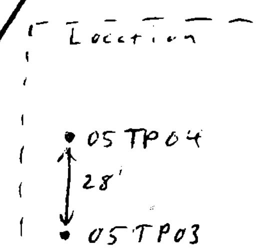
TEST PIT LOG **Brown & Root Environmental**

PROJECT: NWS - EARLE TEST PIT NO.: 05-TP-04
PROJECT NO.: CTO - 289 DATE: 6/23/97
LOCATION: Colts Neck, N.J.
FIELD GEOLOGIST: PAUL M. DAVIS

DEPTH (ft.)	LITHOLOGY CHANGE (Depth, ft.)	MATERIAL DESCRIPTION (Soil Density / Consistency, Color)	USCS	REMARKS
		Brown silty fine grained sand		
		↓		
12"				
		Black silty clayey fine grained		
		sand - Trash/waste material -		
		lumber, rubber hose, plastic		
		sheeting, broken glass bottles,		
		O.J. container		
36"				

Test Pit Cross Section and / or Plan View





REMARKS 2' X 3' X 8' long

Test pit located in Northeast area of land fill. Within Shore Club clearing

PHOTO LOG

TEST PIT 05-TP-04

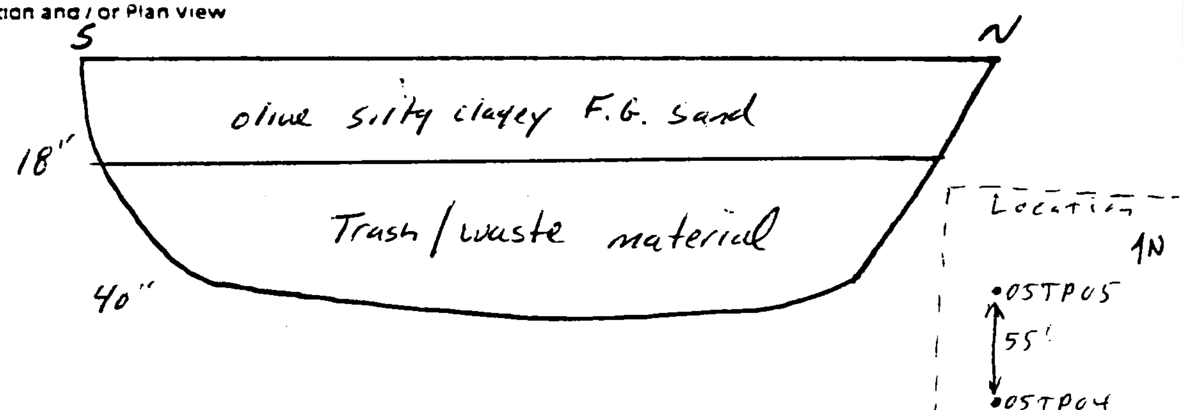
PAGE 1 OF 1

TEST PIT LOG — **Brown & Root Environmental**

PROJECT: NWS-EARLE — TEST PIT NO.: 05-TP-05
PROJECT NO.: CTO - 289 — DATE: 6/23/97
LOCATION: Colts Neck, NJ.
FIELD GEOLOGIST: PAUL M. DAVIS

DEPTH (ft.)	LITHOLOGY CHANGE (Depth, ft.)	MATERIAL DESCRIPTION (Soil Density / Consistency, Color)	USCS	REMARKS
		Olive-brown silty clayey fine grained sand		
18"				
		Trash/waste material - paper/plastic, garden hose, metal straps, Aluminum cans, 55-gal. drum filled with garbage, styrofoam, glass		
40"		bottles		

Test Pit Cross Section and / or Plan View



REMARKS: 2' x 3.5' x 8' long
Test pit located in northeastern area of landfill within Shooters Club clearing.

PHOTO LOG

TEST PIT 05-TP-05

PAGE 1 OF 1

TEST PIT LOG **Brown & Root Environmental**

PROJECT: NWS - EARLE TEST PIT NO.: 05-TP-06

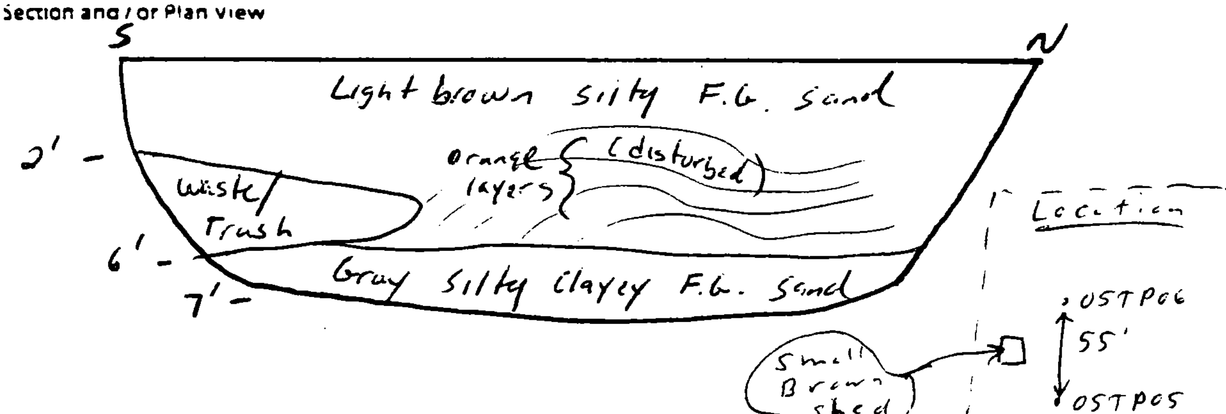
PROJECT NO.: CTO - 289 DATE: 6/25/97

LOCATION: Colts Neck, NJ.

FIELD GEOLOGIST: PAUL M. DAVIS

DEPTH (ft.)	LITHOLOGY CHANGE (Depth/ft.)	MATERIAL DESCRIPTION (Soil Density / Consistency, Color)	USCS	REMARKS
1'		Light brown silty fine grained		
2'		sand		
3'		Trash / waste material - lumber,		
4'		Small drum with liquid in it,		
5'		gray silty clayey F.G. sand		
6'				
7'		Gray silty clayey fine grained		
		Sand.		

Test Pit Cross Section and / or Plan view



REMARKS 2' x 7' x 16' long

Test pit located in Northeastern ~~area~~ edge of landfill within skeet club clearing

PHOTO LOG Photo 2 - View facing Southeast

TEST PIT 05-TP-06

PAGE 1 OF 1

TEST PIT LOG | **Brown & Root Environmental**

PROJECT: NWS-EARLE TEST PIT NO.: 05-TP-07

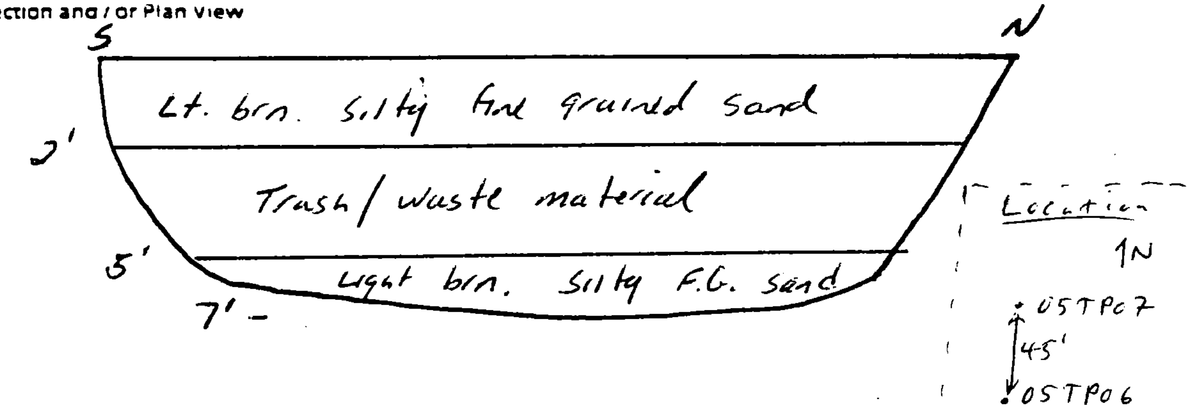
PROJECT NO.: CTO - 289 DATE: 6/23/97

LOCATION: Colts Neck, N.J.

FIELD GEOLOGIST: PAUL M. DAVIS

DEPTH (ft.)	LITHOLOGY CHANGE (Depth,ft.)	MATERIAL DESCRIPTION (Soil Density / Consistency, Color)	USCS	REMARKS
		Light brown silty fine grained		
2'		sand		
		Trash/waste material - lumber,		
		metal straps, burnt lumber		"Burnt odors"
		dark olive green silty/clayey sand		
5'				
		Light brown silty F.G. sand		
7'				

Test Pit Cross Section and/or Plan View



REMARKS 2' x 7' x 8' long

Test pit located in northeastern area of landfill within shooters club near northern rifle range.

PHOTO LOG

TEST PIT 05-TP-07

PAGE 1 OF 1

TEST PIT LOG

Brown & Root Environmental

PROJECT: NWS - EARLE TEST PIT NO.: 05-TP-08

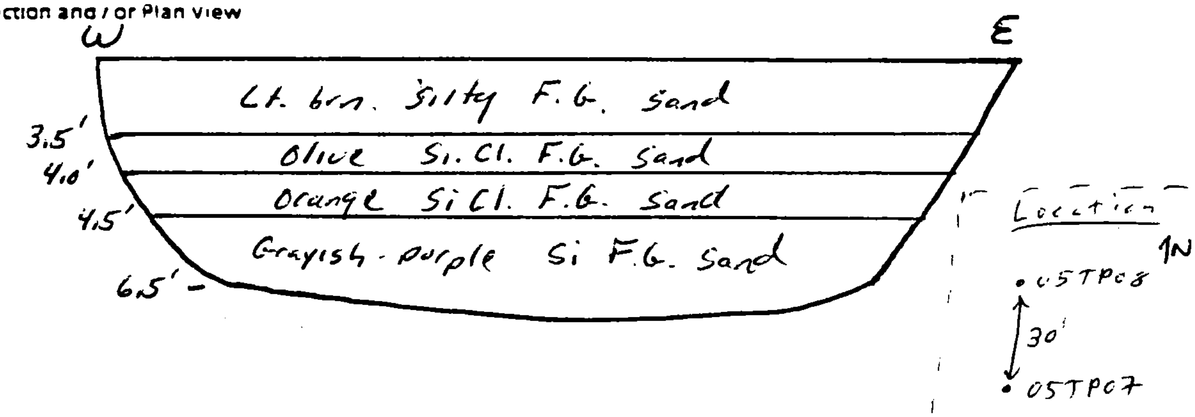
PROJECT NO.: CTO - 289 DATE: 1/23/97

LOCATION: Colts Neck, NJ.

FIELD GEOLOGIST: PAUL M. DAVIS

DEPTH (ft.)	LITHOLOGY CHANGE (Depth,ft.)	MATERIAL DESCRIPTION (Soil Density / Consistency, Color)	USCS	REMARKS
		Light brown silty fine grained sand		
3.5'		↓		
		Olive - silty clayey F.G. sand		
4.0'				
		orange - silty clayey FG sand		
4.5'				
		Grayish-purple silty F.G. sand		
6.5'				

Test Pit Cross Section and / or Plan view



REMARKS 7'x 6.5' x 17' long

- No obvious Trash/waste -

Test pit is located outside of northeastern edge of landfill w

Shooters club near northern rifle range.

PHOTO LOG

TEST PIT 05-TP-08

PAGE 1 OF 1

TEST PIT LOG

Brown & Root Environmental

PROJECT: NWS - EARLE

TEST PIT NO.: 05-TP-09

PROJECT NO.: CTO - 289

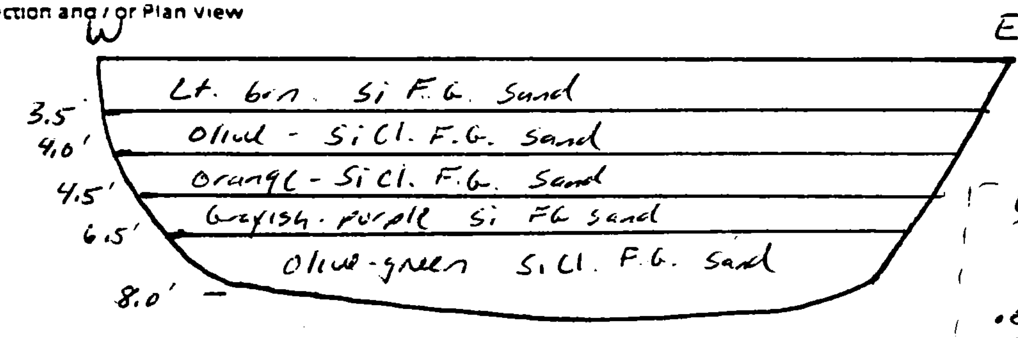
DATE: 6/23/97

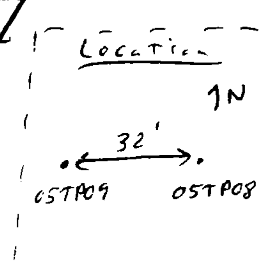
LOCATION: Colts Neck, NJ.

FIELD GEOLOGIST: PAUL M. DAVIS

DEPTH (ft.)	LITHOLOGY CHANGE (Depth,ft.)	MATERIAL DESCRIPTION (Soil Density / Consistency, Color)	USCS	REMARKS
		Light brown silty fine grained		
		Sand		
3.5'				
		Olive - silty clayey fine grained sand		
4.0'				
		Orange - silty clayey F.G. Sand		
4.5'				
		Grayish - purple silty F.G. sand		
6.5'				
		Olive green silty clayey fine		
		grained Sand		
8'		↓		

Test Pit Cross Section and / or Plan View





REMARKS: 2' x 8' x 10' long — No obvious Trash / waste — Test pit located outside of northern area of landfill at southern edge of rifle range.

PHOTO LOG

TEST PIT 05-TP-09

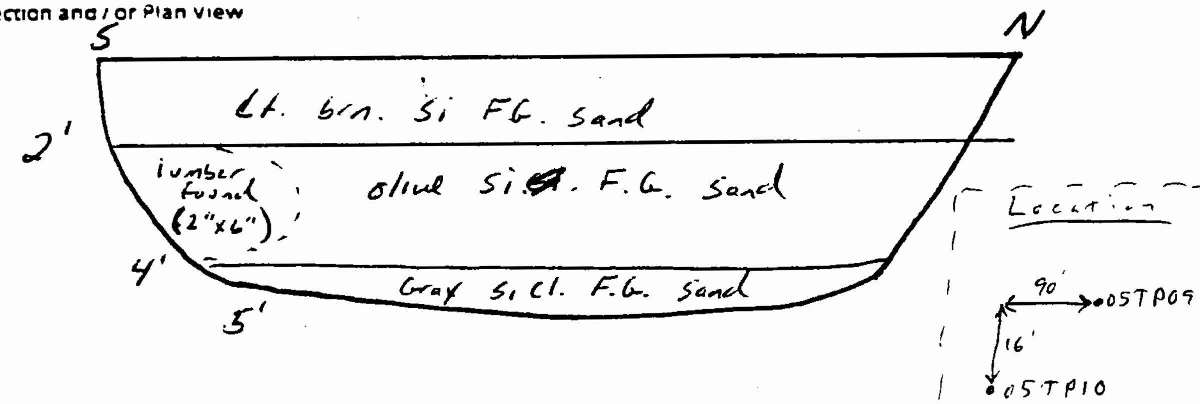
PAGE 1 OF 1

TEST PIT LOG — **Brown & Root Environmental**

PROJECT: NWS - EARLE   TEST PIT NO.: 05-TP-10
PROJECT NO.: CTO - 289   DATE: 6/23/97
LOCATION: Colts Neck, NJ.
FIELD GEOLOGIST: PAUL M. DAVIS

DEPTH (ft.)	LITHOLOGY CHANGE (Depth, ft.)	MATERIAL DESCRIPTION (Soil Density / Consistency, Color)	USCS	REMARKS
		Light brown silty fine grained		
		sand		
2'				
		Olive silty fine grained sand		
4'				
		Gray silty clayey fine grained		
		sand		
		At southern end of test pit		
		a piece of 2x6 lumber was found.		

Test Pit Cross Section and / or Plan view



REMARKS 2' x 5' x 22' long

Test pit located in northern edge of land fill (north side clearing for Shooters Club).

PHOTO LOG

TEST PIT 05-TP-10

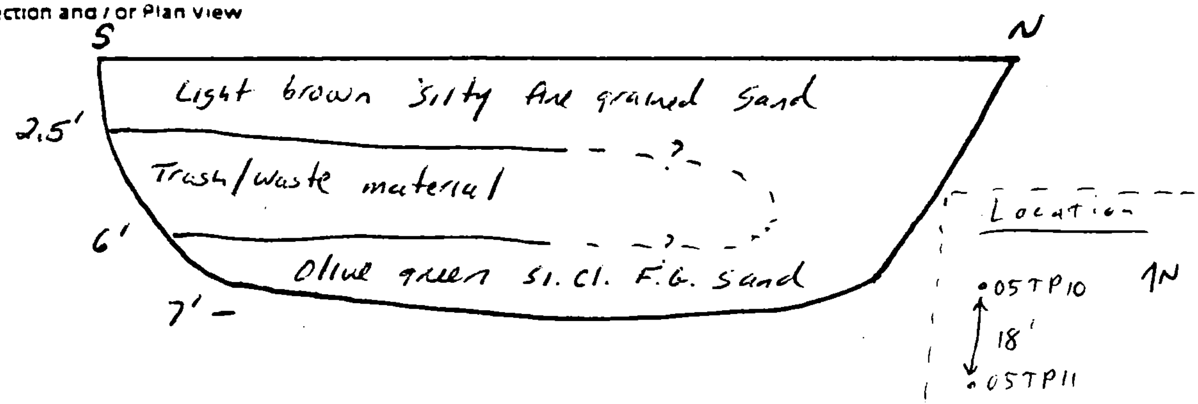
PAGE 1 OF 1

TEST PIT LOG — **Brown & Root Environmental**

PROJECT: NWS-EARLE TEST PIT NO.: 05-TP-11
PROJECT NO.: CTO-289 DATE: 6/23/97
LOCATION: Colts Neck, NJ.
FIELD GEOLOGIST: PAUL M. DAVIS

DEPTH (ft.)	LITHOLOGY CHANGE (Depth,ft.)	MATERIAL DESCRIPTION (Soil Density / Consistency, Color)	USCS	REMARKS
		Light brown silty fine grained sand		
2.5'				
		Trash/waste material - lumber, olive green Si Cl. FG sand mix metal pallet, paper/plastic, glass, aluminum cans, glass		strong landfill odors
6'				
		Olive green silty clayey fine grained sand		
7'				

Test Pit Cross Section and / or Plan View



REMARKS 2' x 7' x 14' long

Test pit is located in northern central area/edge of landfill. (North side of clearing for shooters club).

PHOTO LOG Photo 3

TEST PIT 05-TP-11

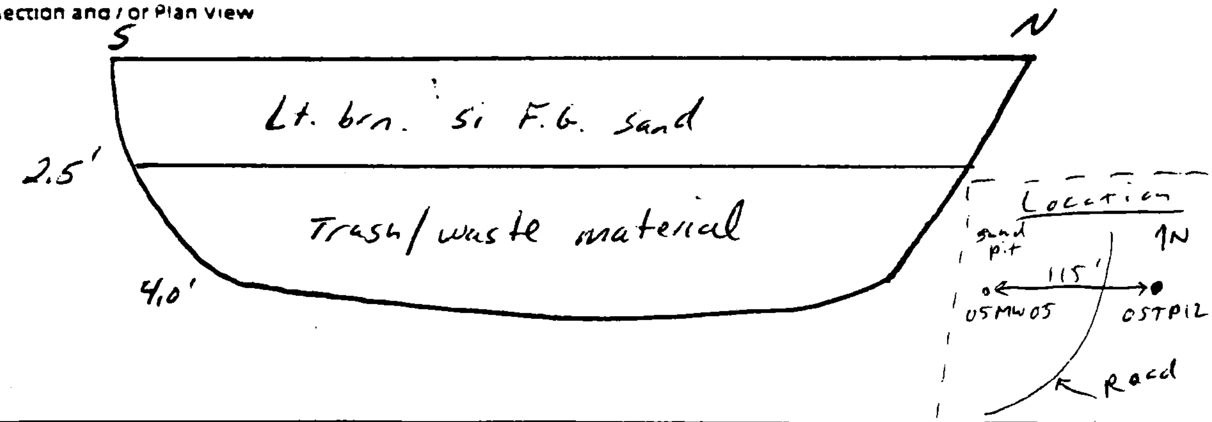
PAGE 1 OF 1

TEST PIT LOG **Brown & Root Environmental**

PROJECT: NWS-EARLE TEST PIT NO.: 05-TP-12
PROJECT NO.: CTO-289 DATE: 6/23/97
LOCATION: Colts Neck, NJ.
FIELD GEOLOGIST: PAUL M. DAVIS

DEPTH (ft.)	LITHOLOGY CHANGE (Depth,ft.)	MATERIAL DESCRIPTION (Soil Density / Consistency, Color)	USCS	REMARKS
		Light brown silty fine		
		grained sand		
2.5'		↓		
		Trash/waste material - mixed		
		with olive green si Cl. F.G. sand.		
		metal pallet, burnt lumber, plastic		A form dated 11/28/72
		sheeting, metal straps, lumber,		was found
		NWS-Earle vehicle inspection Form		
		dated 11/28/1972		
4.0'				

Test Pit Cross Section and / or Plan View



REMARKS 2'x 4'x 8' long
Test pit located in north central area of landfill near sand pi

PHOTO LOG

TEST PIT 05-TP-12

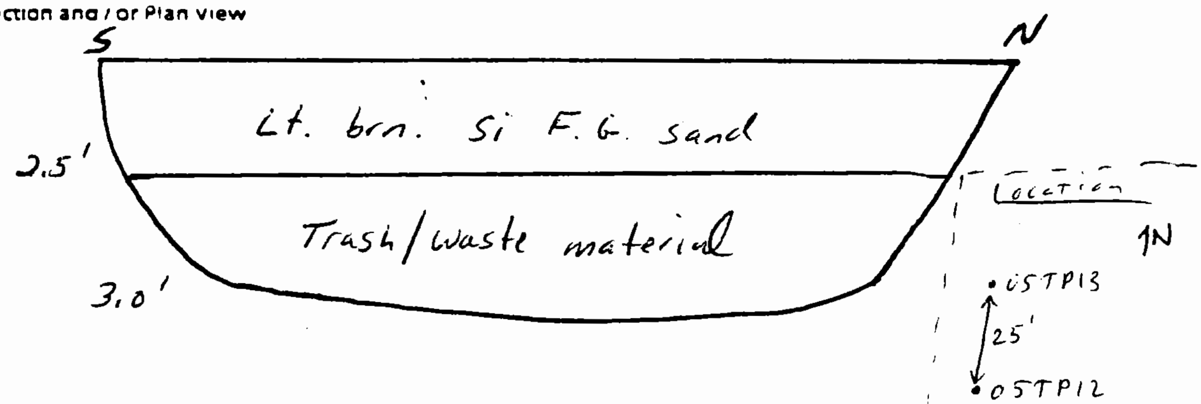
PAGE 1 OF 1

TEST PIT LOG — **Brown & Root Environmental**

PROJECT: NWS - EARLE TEST PIT NO.: 05-TP-13
PROJECT NO.: CTO - 289 DATE: 6/23/97
LOCATION: Colts Neck, NJ.
FIELD GEOLOGIST: PAUL M. DAVIS

DEPTH (ft.)	LITHOLOGY CHANGE (Depth,ft.)	MATERIAL DESCRIPTION (Soil Density / Consistency, Color)	USCS	REMARKS
		Light brown silty fine grained		
		sand		
2.5'				
		Trash/waste material - metal		
		pallet, metal straps, lumber		
3'				

Test Pit Cross Section and / or Plan view



REMARKS 2'x 3'x 6' long
Test pit is located in north central area of landfill near the sand pit

PHOTO LOG

TEST PIT 05-TP-13

PAGE 1 OF 1

TEST PIT LOG

Brown & Root Environmental

PROJECT: NWS - EARLE

TEST PIT NO.: 05-TP-14

PROJECT NO.: CTO - 289

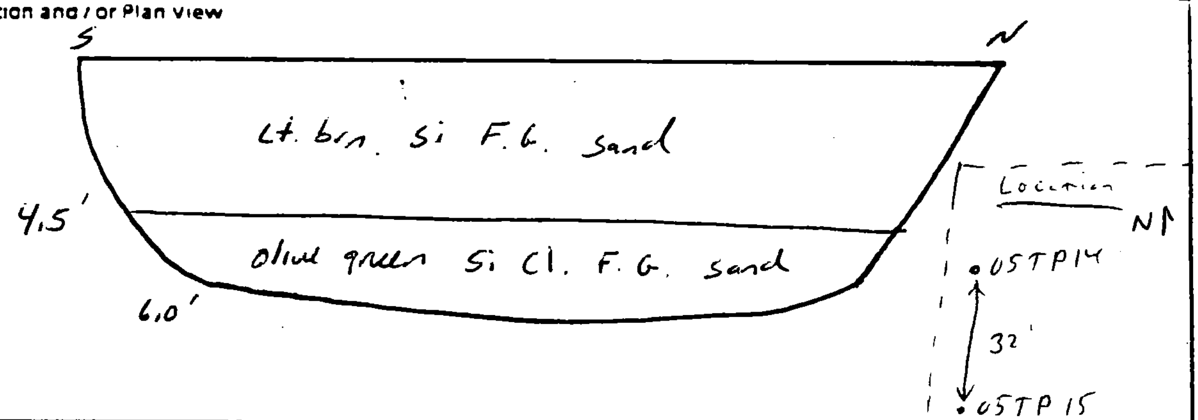
DATE: 6/23/97

LOCATION: Colts Neck, NJ.

FIELD GEOLOGIST: PAUL M. DAVIS

DEPTH (ft.)	LITHOLOGY CHANGE (Depth, ft.)	MATERIAL DESCRIPTION (Soil Density / Consistency, Color)	USCS	REMARKS
		Light brown silty fine grained		
		sand		
3.0'				
4.5'		↓		
		Olive green silty clayey fine		
		grained sand		
6'		↓		

Test Pit Cross Section and / or Plan View



REMARKS 2' x 6' x 8' long - NO obvious Trash / waste material. Test pit located outside of north central area of landfill near the Sand pit

PHOTO LOG

TEST PIT 05-TP-14

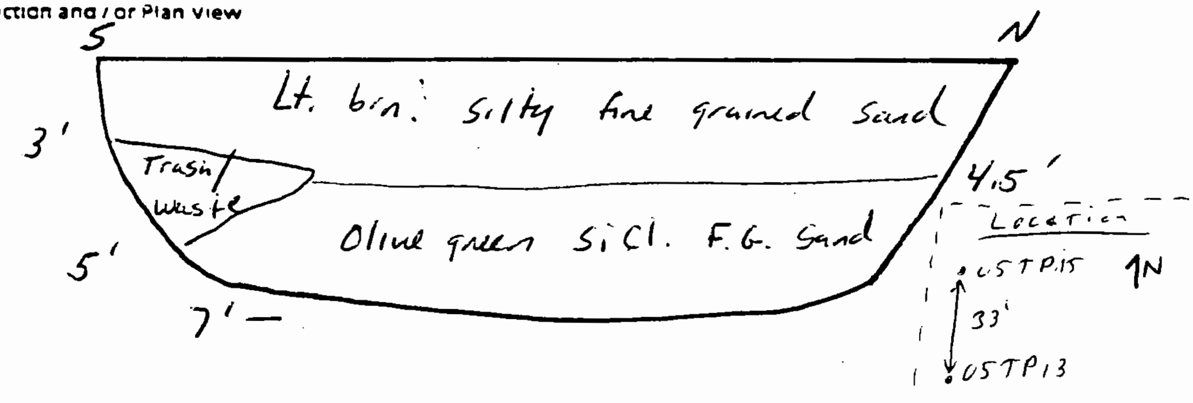
PAGE 1 OF 1

TEST PIT LOG — **Brown & Root Environmental**

PROJECT: NWS - EARLE — TEST PIT NO.: 05-TP-15
PROJECT NO.: CTO - 289 — DATE: 6/23/97
LOCATION: Colts Neck, NJ.
FIELD GEOLOGIST: PAUL M. DAVIS

DEPTH (ft.)	LITHOLOGY CHANGE (Depth,ft.)	MATERIAL DESCRIPTION (Soil Density / Consistency, Color)	USCS	REMARKS
		Light brown silty fine grained		
		Sand		
3.0'		↓		
		Trash / waste material - (At southern end		
		of test pit) Some lumber and		
		branches / logs.		
		Olive green silty clayey fine		
		grained sand.		
7'		↓		

Test Pit Cross Section and / or Plan View



REMARKS 2' x 7' x 25' long

Test pit located in north central edge of landfill near the sand pit.

PHOTO LOG

TEST PIT 05-TP-15

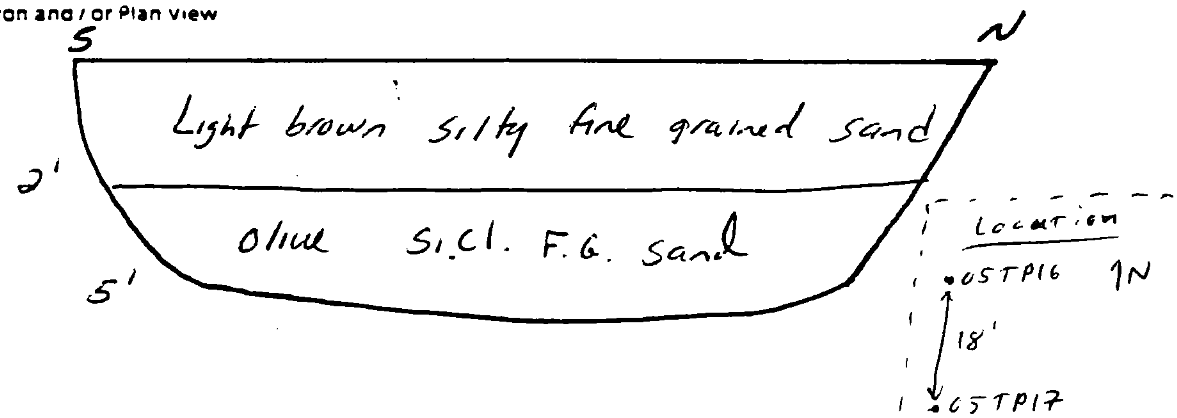
PAGE 1 OF 1

TEST PIT LOG | **Brown & Root Environmental**

PROJECT: NWS - EARLE TEST PIT NO.: 05-TP-16
PROJECT NO. CTO - 289 DATE: 6/24/97
LOCATION: Colts Neck, NJ.
FIELD GEOLOGIST: PAUL M. DAVIS

DEPTH (ft.)	LITHOLOGY CHANGE (Depth.ft.)	MATERIAL DESCRIPTION (Soil Density / Consistency, Color)	USCS	REMARKS
		Light brown silty fine		
		grained sand		
2'		↓		
		Olive - silty clayey fine		
		grained sand		
5'		↓		

Test Pit Cross Section and / or Plan view



REMARKS 2'x 5'x 12' long

Test pit located outside of northwestern area of landfill along access road.

PHOTO LOG

TEST PIT 05-TP-16

PAGE 1 OF 1

TEST PIT LOG — **Brown & Root Environmental**

PROJECT: NWS - EARLE — TEST PIT NO.: 05-TP-17

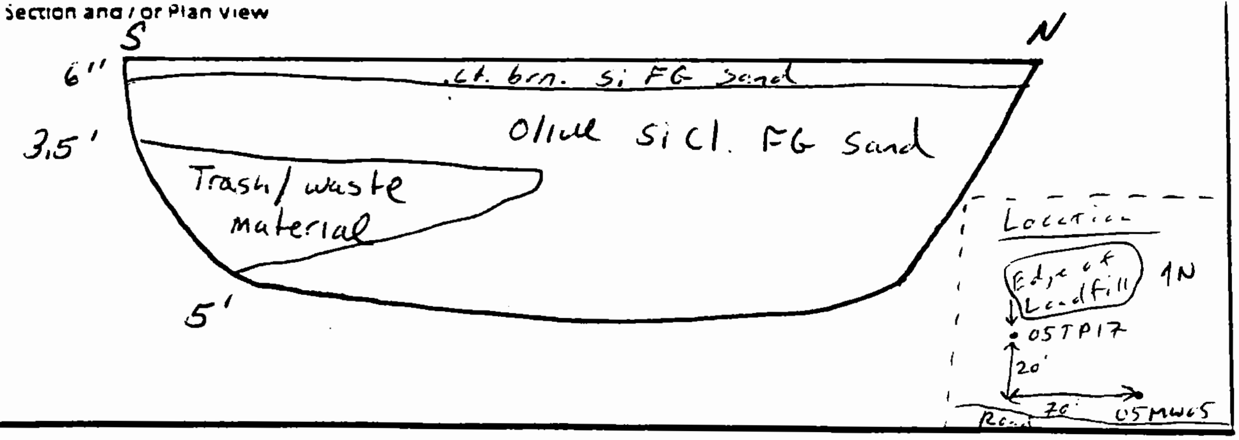
PROJECT NO.: CTO - 289 — DATE: 6/24/97

LOCATION: Colts Neck, NJ.

FIELD GEOLOGIST: PAUL M. DAVIS

DEPTH (ft.)	LITHOLOGY CHANGE (Depth,ft.)	MATERIAL DESCRIPTION (Soil Density / Consistency, Color)	USCS	REMARKS
		Light brown silty fine		
6"		grained Sand		
		Olive silty Clayey fine		
		grained sand		
3.5'	---	Trash / waste material - paper,		
		plastic, fiberglass pipe, wood		waste material at
		↓		southern end of test
5.0'				pit only.

Test Pit Cross Section and / or Plan View



REMARKS 2' x 5' x 12' long

Test pit located at northwestern edge of landfill (north of dirt road)

PHOTO LOG

TEST PIT 05-TP-17

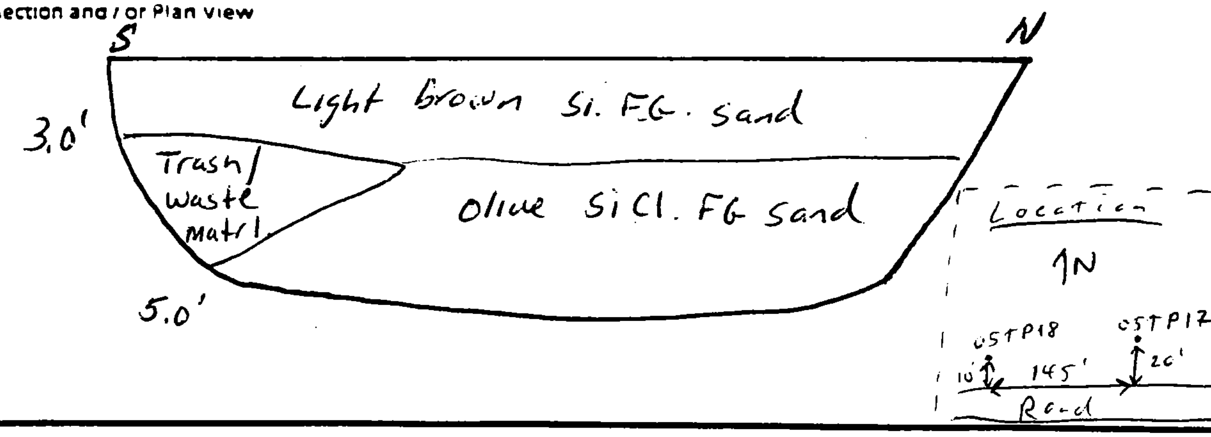
PAGE 1 OF 1

TEST PIT LOG — **Brown & Root Environmental**

PROJECT: NWS - EARLE — TEST PIT NO.: 05-TP-18
PROJECT NO.: CTO - 289 — DATE: 6/24/97
LOCATION: Colts Neck, NJ.
FIELD GEOLOGIST: PAUL M. DAVIS

DEPTH (ft.)	LITHOLOGY CHANGE (Depth, ft.)	MATERIAL DESCRIPTION (Soil Density / Consistency, Color)	USCS	REMARKS
		Light brown silty fine grained Sand		
3.0'				
		Olive silty clayey fine grained sand		(Trash at southern end
		Trash/waste material - paper,		of Test pit, only)
		plastic, wood (lumber), styro foam		
5'		↓		

Test Pit Cross Section and / or Plan view



REMARKS 2' x 5' x 15' long
Test pit is located at north western edge of land fill

PHOTO LOG

TEST PIT 05-TP-18

PAGE 1 OF 1

TEST PIT LOG | **Brown & Root Environmental**

PROJECT: NWS - EARLE TEST PIT NO.: 05-TP-19

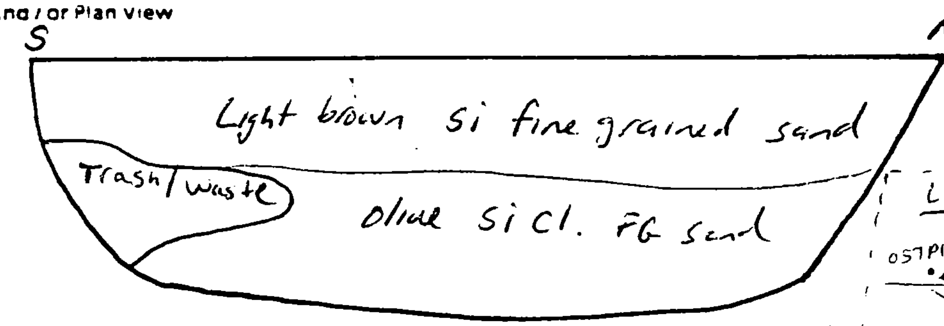
PROJECT NO.: CTO - 289 DATE: 6/24/97

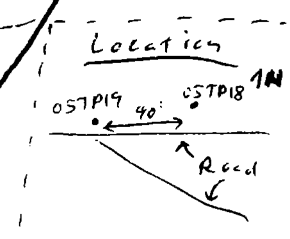
LOCATION: Colts Neck, NJ.

FIELD GEOLOGIST: PAUL M. DAVIS

DEPTH (ft.)	LITHOLOGY CHANGE (Depth,ft.)	MATERIAL DESCRIPTION (Soil Density / Consistency, Color)	USCS	REMARKS
		Light brown silty fine		
		grained sand		
3.0'				No Trash/waste
		olive silty clayey fine grained sand		material in northern
		Trash/waste material - paper, plastic,		end of test pit -
		-General garbage -		only in southern end
5.0'				of Test Pit.

Test Pit Cross Section and / or Plan View





REMARKS 2'x 5'x 12' long

Test pit located at northwestern edge of landfill (north of dirt rd.)

PHOTO LOG

TEST PIT 05-TP-19

PAGE 1 OF 1

TEST PIT LOG — **Brown & Root Environmental**

PROJECT: NWS - EARLE TEST PIT NO.: 05-TP-20

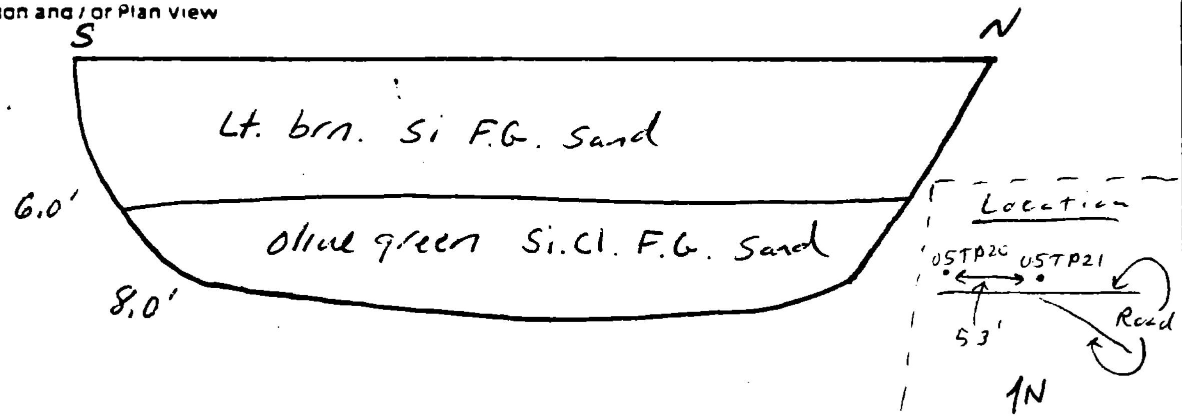
PROJECT NO.: CTO - 289 DATE: 6/24/97

LOCATION: Colts Neck, N.J.

FIELD GEOLOGIST: PAUL M. DAVIS

DEPTH (ft.)	LITHOLOGY CHANGE (Depth, ft.)	MATERIAL DESCRIPTION (Soil Density / Consistency, Color)	USCS	REMARKS
		Light brown silty fine		
		grained Sand		
		↓		
6.0'				
		Olive green silty Clayey		
		fine grained Sand		
8.0'		↓		

Test Pit Cross Section and / or Plan View



REMARKS: 2' x 8' x 14' long — No Trash/waste material —
Test pit located ~~on~~ outside north western edge of landfill

PHOTO LOG

TEST PIT 05-TP-20

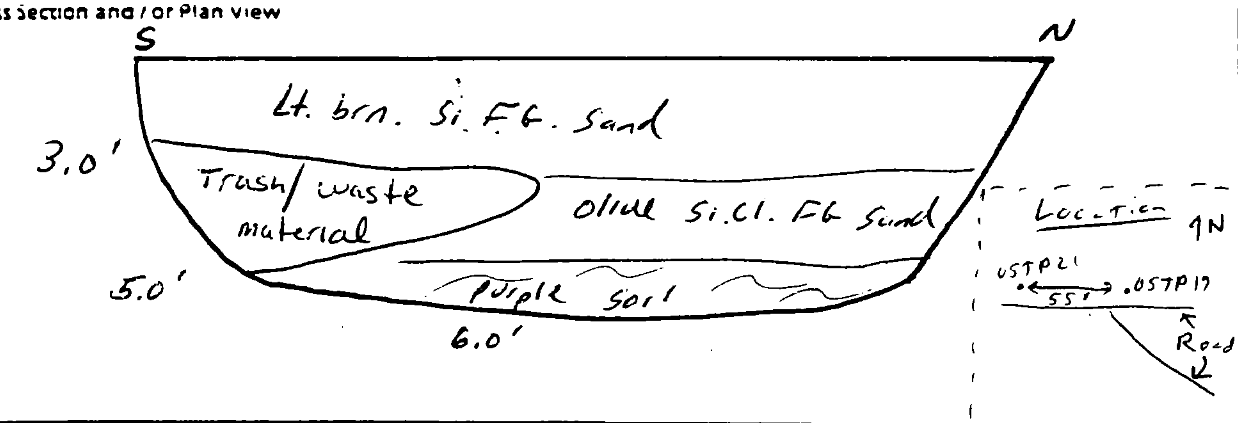
PAGE 1 OF 1

TEST PIT LOG — **Brown & Root Environmental**

PROJECT: NWS - EARLE TEST PIT NO.: 05-TP 21
PROJECT NO.: CTO - 289 DATE: 6/24/97
LOCATION: Colts Neck, NJ.
FIELD GEOLOGIST: PAUL M. DAVIS

DEPTH (ft.)	LITHOLOGY CHANGE (Depth,ft.)	MATERIAL DESCRIPTION (Soil Density / Consistency, Color)	USCS	REMARKS
		Light brown silty Fine grained		
		Sand		
3.0'		↓		- waste material at
		olive silty clayey fine grained		southern end of test
		Sand mixed with		pit only -
		Trash/waste material - lumber,		
		metal straps, white powdered chrystalline		
		material in paper bags.		
5'		Purple - disturbed soil		The white powder Sub-
		↓		stance was collected in
				a Jar and given to
				Greg Goepfert for possible
				chemical analysis.

Test Pit Cross Section and / or Plan view



REMARKS 2' x 6' x 12' long

Test Pit is located in northwestern edge of landfill (north of road)

PHOTO LOG

TEST PIT 05-TP-21

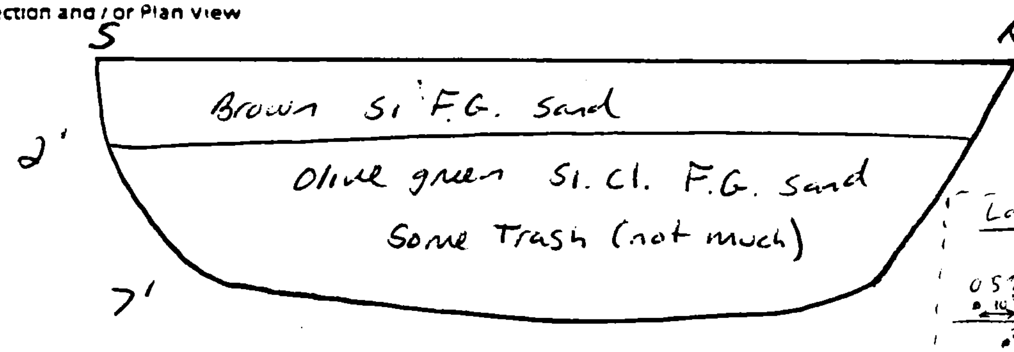
PAGE 1 OF 1

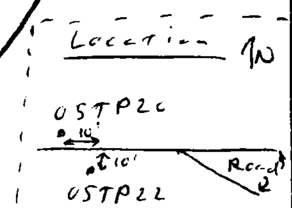
TEST PIT LOG **Brown & Root Environmental**

PROJECT: NWS - EARLE TEST PIT NO.: 05-TP-22
PROJECT NO.: CTO - 289 DATE: 6/24/97
LOCATION: Colts Neck, NJ.
FIELD GEOLOGIST: PAUL M. DAVIS

DEPTH (ft.)	LITHOLOGY CHANGE (Depth.ft.)	MATERIAL DESCRIPTION (Soil Density / Consistency, Color)	USCS	REMARKS
		Brown silty fine grained Sand		
		↓		
2.0'				
		Olive green silty clayey fine grained Sand		
		Some Trash (not much) Sucrets lozenges container, plastic, burnt lumber - olive green si, cl Fine grained Sand		
7'				

Test Pit Cross Section and / or Plan View





REMARKS 2'x7'x 11' long
Test Pit located near northwest area of landfill (SW of dirt rd.)

PHOTO LOG

TEST PIT 05-TP-22

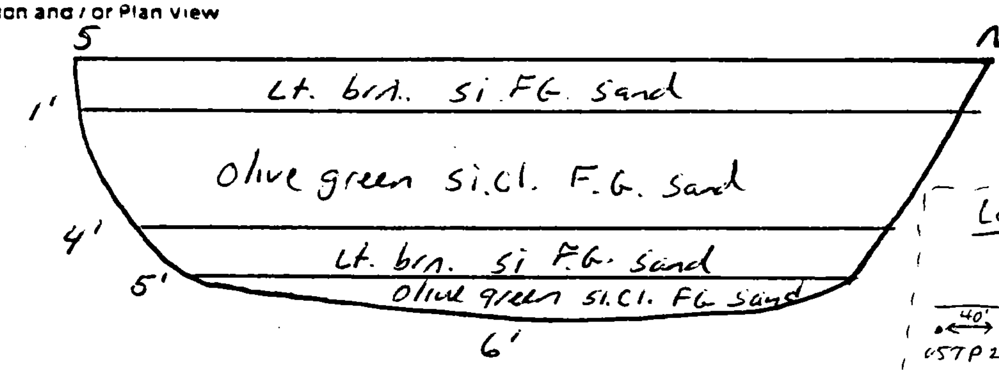
PAGE 1 OF 1

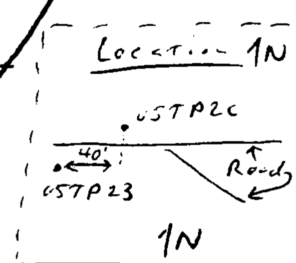
TEST PIT LOG | **Brown & Root Environmental**

PROJECT: NWS - EARLE TEST PIT NO.: 05-TP-23
PROJECT NO.: CTO - 289 DATE: 6/24/97
LOCATION: Colts Neck, N.J.
FIELD GEOLOGIST: PAUL M. DAVIS

DEPTH (ft.)	LITHOLOGY CHANGE (Depth, ft.)	MATERIAL DESCRIPTION (Soil Density / Consistency, Color)	USCS	REMARKS
		Lt. Brown silty fine grained Sand		
1'		↓		
		Olive green silty clayey fine grained Sand		
4'				
		Light brown silty F.G. Sand		
5'				
		Olive green silty clayey fine grained Sand		
6'				

Test Pit Cross Section and / or Plan View





REMARKS 2' x 6' x 10' long — No obvious Trash / waste —
Test Pit located outside of NW section of landfill

PHOTO LOG

TEST PIT 05-TP-23

PAGE 1 OF 1

TEST PIT LOG

Brown & Root Environmental

PROJECT: NWS - EARLE TEST PIT NO.: 05-TP-24

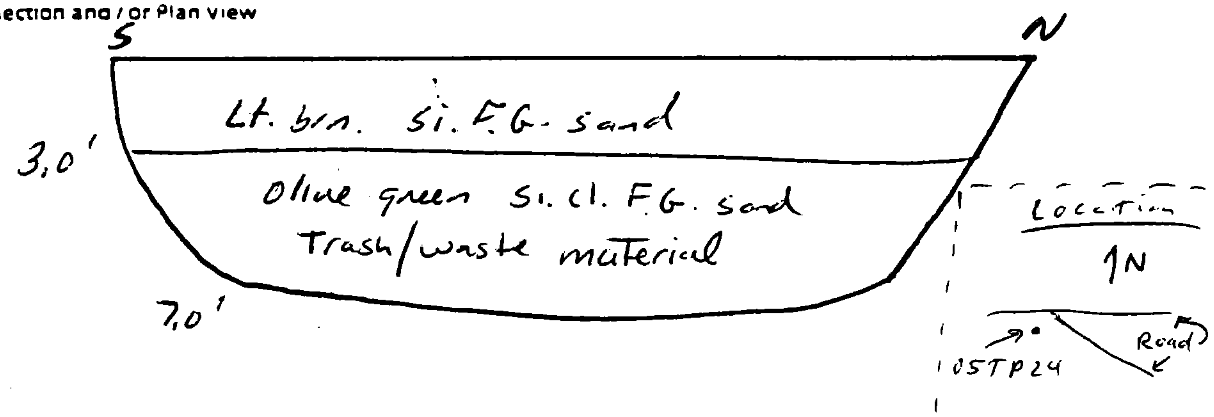
PROJECT NO.: CTO - 289 DATE: 6/24/97

LOCATION: Colts Neck, NJ.

FIELD GEOLOGIST: PAUL M. DAVIS

DEPTH (ft.)	LITHOLOGY CHANGE (Depth,ft.)	MATERIAL DESCRIPTION (Soil Density / Consistency, Color)	USCS	REMARKS
		Light Brown Silty fine		
		grained Sand		
3.0'		↓		
		Olive green Silty Clayey fine		
		grained Sand - Trash/waste		
		material - lumber, metal straps,		
		plastic, paper, wrought iron		
		Chair		
7.0'				

Test Pit Cross Section and / or Plan view



REMARKS 2' x 7' x 10' long

Test Pit located in northwest area of landfill (SW of fork)

PHOTO LOG

TEST PIT 05-TP-24

PAGE 1 OF 1

TEST PIT LOG — **Brown & Root Environmental**

PROJECT: NWS-EARLE — TEST PIT NO.: 05-TP-25

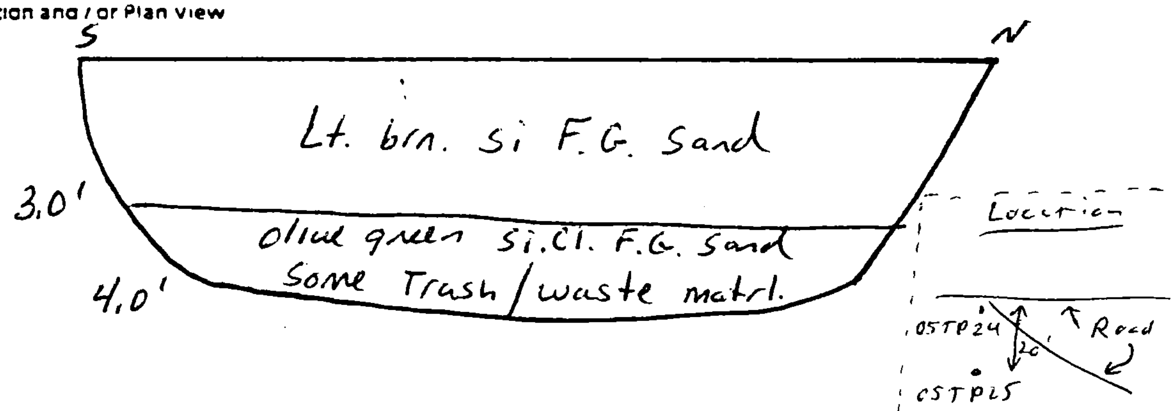
PROJECT NO.: CTO - 289 — DATE: 6/24/97

LOCATION: Colts Neck, NJ.

FIELD GEOLOGIST: PAUL M. DAVIS

DEPTH (ft.)	LITHOLOGY CHANGE (Depth,ft.)	MATERIAL DESCRIPTION (Soil Density / Consistency, Color)	USCS	REMARKS
		Light brown silty fine grained Sand		
3.0'		↓		
		Olive green silty clayey fine grained Sand - some Trash/waste material - lumber, paper, plastic ↓		
4.0'				

Test Pit Cross Section and / or Plan View



REMARKS 2'x4'x10' long

Test pit located in northwest area of landfill

PHOTO LOG

TEST PIT 05-TP-25

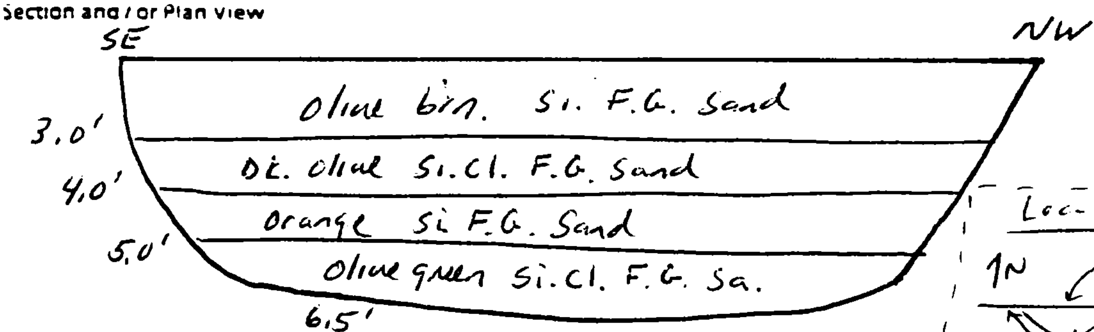
PAGE 1 OF 1

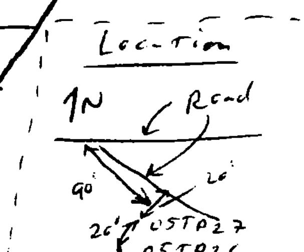
TEST PIT LOG | **Brown & Root Environmental**

PROJECT: NWS - EARLE TEST PIT NO.: 05-TP-26
PROJECT NO.: CTO - 289 DATE: 6/24/97
LOCATION: Colts Neck, NJ.
FIELD GEOLOGIST: PAUL M. DAVIS

DEPTH (ft.)	LITHOLOGY CHANGE (Depth, ft.)	MATERIAL DESCRIPTION (Soil Density / Consistency, Color)	USCS	REMARKS
		Olive brown - silty fine		
		grained sand		
3.6'		↓		
		Dark olive silty clayey fine		
4.0'		grained sand		
		Orange silty fine grained		
5.0'		sand		
		Olive green silty clayey fine		
		grained sand.		
6.5'		↓		

Test Pit Cross Section and / or Plan View





REMARKS 2' x 6.5' x 9' long - No obvious Trash/waste - Test pit located outside of northwest area of landfill.

PHOTO LOG

TEST PIT 05-TP-26

PAGE 1 OF 1

TEST PIT LOG

Brown & Root Environmental

PROJECT: NWS - EARLE

TEST PIT NO.: 05-TP-27

PROJECT NO.: CTO - 289

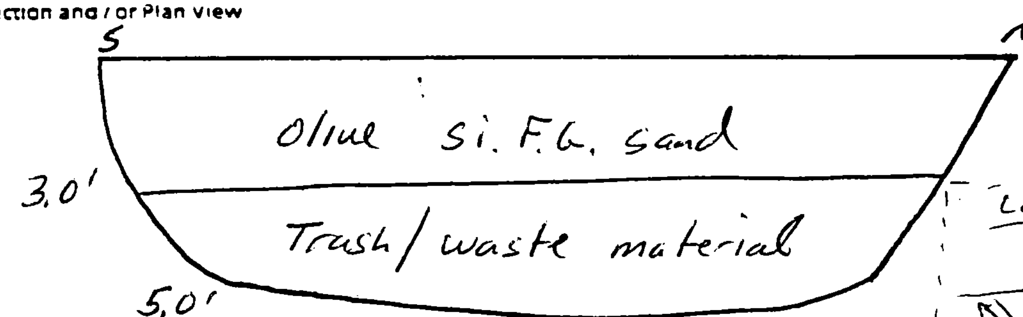
DATE: 6/24/97

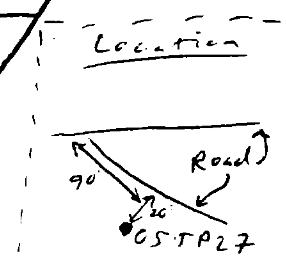
LOCATION: Colts Neck, NJ.

FIELD GEOLOGIST: PAUL M. DAVIS

DEPTH (ft.)	LITHOLOGY CHANGE (Depth, ft.)	MATERIAL DESCRIPTION (Soil Density / Consistency, Color)	USCS	REMARKS
		Olive - Silty fine grained		
		Sand		
3.0'		↓		
		Olive green silty clayey fine		strong landfill odors
		grained Sand - Trash / waste		
		material - metal debris, plastic,		
		paper, lumber, cloth, milk carton.		
5.0'				

Test Pit Cross Section and / or Plan View





REMARKS 2' x 5' x 9' long

Test Pit is located in western area of landfill

PHOTO LOG Photo # 4

TEST PIT 05-TP-27

PAGE 1 OF 1

TEST PIT LOG — **Brown & Root Environmental**

PROJECT: NWS - EARLE — TEST PIT NO.: 05-TP 28

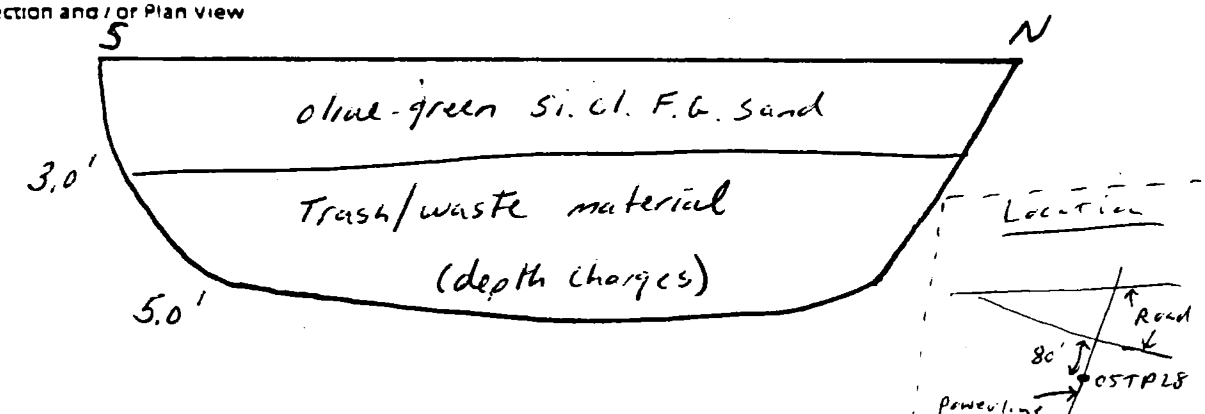
PROJECT NO.: CTO - 289 — DATE: 6/24/97

LOCATION: Colts Neck, NJ.

FIELD GEOLOGIST: PAUL M. DAVIS

DEPTH (ft.)	LITHOLOGY CHANGE (Depth, ft.)	MATERIAL DESCRIPTION (Soil Density / Consistency, Color)	USCS	REMARKS
		olive-green silty clayey fine grained sand		
3.0'		↓		Strong landfill odors
		Trash/waste material - stumps, branches, logs, rubber gasket, aluminum cans, metal straps, lumber, cables, Styrofoam, (3) depth charges (intact) empty, lumber		
5.0'		↓		

Test Pit Cross Section and / or Plan View



REMARKS: 2' x 5' x 9' long

Test Pit located in western area of landfill (in Tree clearing path (Power line)

PHOTO LOG: Photo's 5 and 6

TEST PIT 05-TP-28

PAGE 1 OF 1

TEST PIT LOG

Brown & Root Environmental

PROJECT: NWS - EARLE   TEST PIT NO.: 05-TP-29

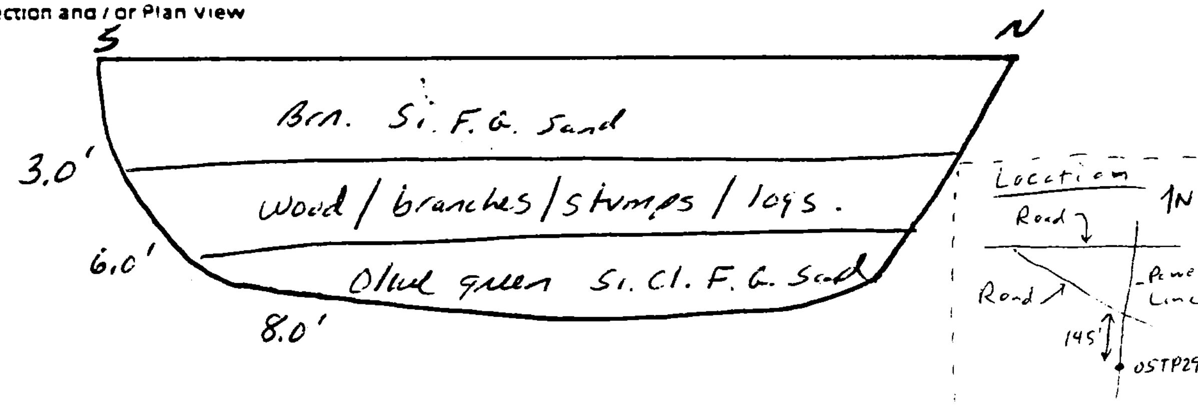
PROJECT NO. CTO - 289   DATE: 6/24/97

LOCATION: Colts Neck, NJ.

FIELD GEOLOGIST: PAUL M. DAVIS

DEPTH (ft.)	LITHOLOGY CHANGE (Depth, ft.)	MATERIAL DESCRIPTION (Soil Density / Consistency, Color)	USCS	REMARKS
		Brown silty fine grained sand		
		↓		
3.0'				
		waste material - Wood, branches,		
		stumps, logs mixed with		NO Trash/garbage
		gray-black silty fine grained sand		
6.0'		↓		
		Olive green silty clayey fine		
		grained sand		
8.0'				

Test Pit Cross Section and / or Plan View



REMARKS 2' x 8' x 11' long

Test pit located in western edge of landfill (in Tree clearing path)
(Power Line Clearing)

PHOTO LOG

TEST PIT 05-TP-29

PAGE 1 OF 1

TEST PIT LOG — **Brown & Root Environmental**

PROJECT: NWS - EARLE TEST PIT NO.: 05-TP-30

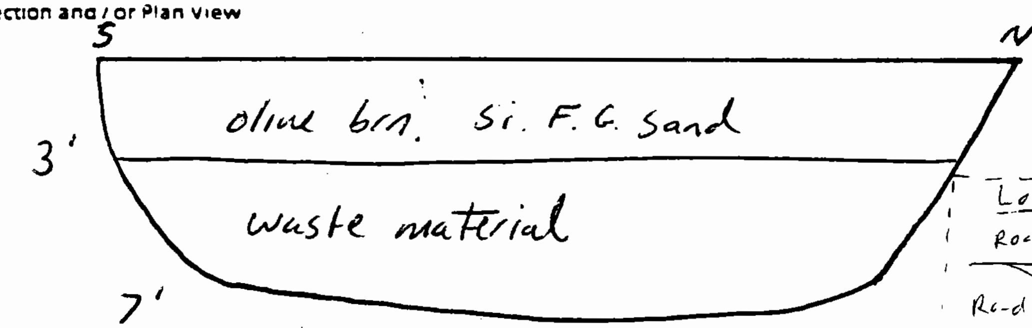
PROJECT NO.: CTO - 289 DATE: 6/24/97

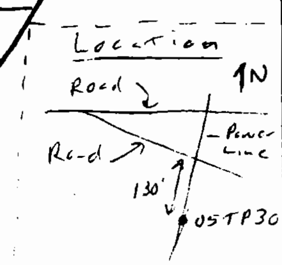
LOCATION: Colts Neck, NJ.

FIELD GEOLOGIST: PAUL M. DAVIS

DEPTH (ft.)	LITHOLOGY CHANGE (Depth, ft.)	MATERIAL DESCRIPTION (Soil Density / Consistency, Color)	USCS	REMARKS
		olive brown silty fine		
		grained sand		
3.0'		↓		Landfill odors
		Olive green silty clayey fine		
		grained sand - waste		
		material - branches, logs, stumps,		
		plastic sheeting & lumber		
7.0'				

Test Pit Cross Section and / or Plan view





REMARKS 2'x 7'x 10' long

Test Pit located in western area of landfill (in Tree clearing area)
(Power Line clearing)

PHOTO LOG

TEST PIT 05-TP-3

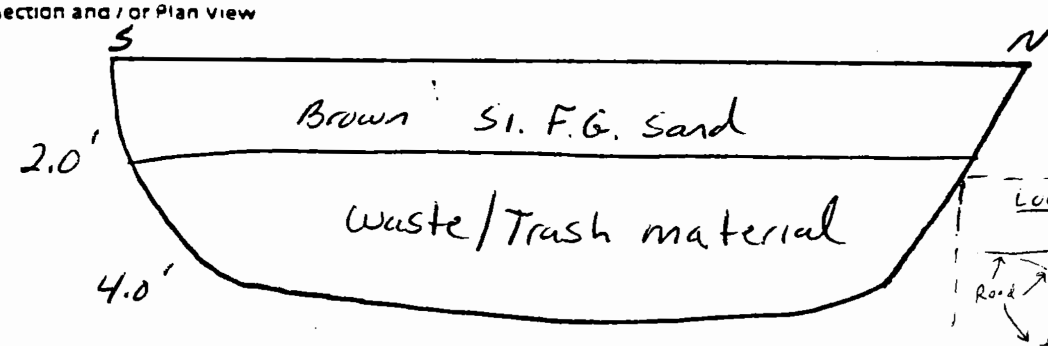
PAGE 1 OF 1

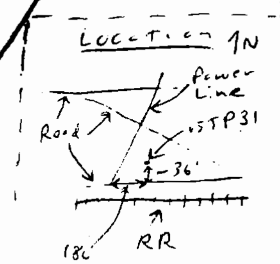
TEST PIT LOG — **Brown & Root Environmental**

PROJECT: NWS - EARLE TEST PIT NO.: 05-TP-31
PROJECT NO.: CTO - 289 DATE: 6/24/97
LOCATION: Colts Neck, NJ.
FIELD GEOLOGIST: PAUL M. DAVIS

DEPTH (ft.)	LITHOLOGY CHANGE (Depth, ft.)	MATERIAL DESCRIPTION (Soil Density / Consistency, Color)	USCS	REMARKS
		Brown Silty fine grained Sand		
		↓		
2.0'				
		Trash/waste material - metal straps,		
		lumber, wires, metal objects,		
		fabric, cloth, bricks		
4.0'				
		Olive gray silty clayey fine		
		grained sand (mixed w/ trash)		

Test Pit Cross Section and / or Plan View





REMARKS 3'x 4'x 8' long
Located along abandoned road parallel to railroad tracks.

PHOTO LOG

TEST PIT 05-TP-31

PAGE 1 OF 1

TEST PIT LOG — **Brown & Root Environmental**

PROJECT: NWS - EARLE

TEST PIT NO.: 05-TP-32

PROJECT NO.: CTO - 289

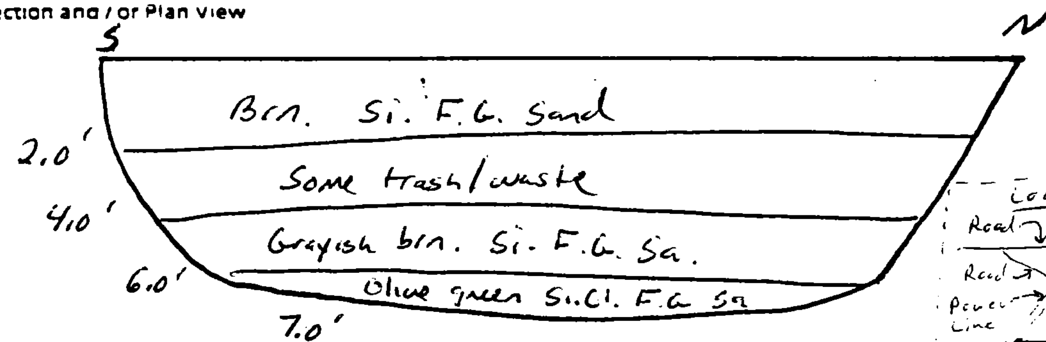
DATE: 6/24/97

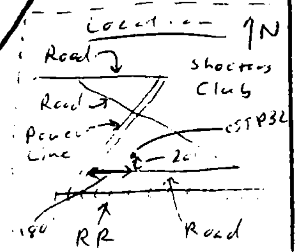
LOCATION: Colts Neck, N.J.

FIELD GEOLOGIST: PAUL M. DAVIS

DEPTH (ft.)	LITHOLOGY CHANGE (Depth,ft.)	MATERIAL DESCRIPTION (Soil Density / Consistency, Color)	USCS	REMARKS
		Brown silty fine grained sand		
		↓		
2.0'				
		Some metal straps (debris)		
4.0'				
		Grayish brown silty fine grained sand		
6.0'				
		Olive green silty clayey fine grained sand		
7.0'				

Test Pit Cross Section and / or Plan View





REMARKS: 2' x 7' x 10' long

Located along abandoned road parallel to railroad Tracks

PHOTO LOG

TEST PIT 05-TP-32

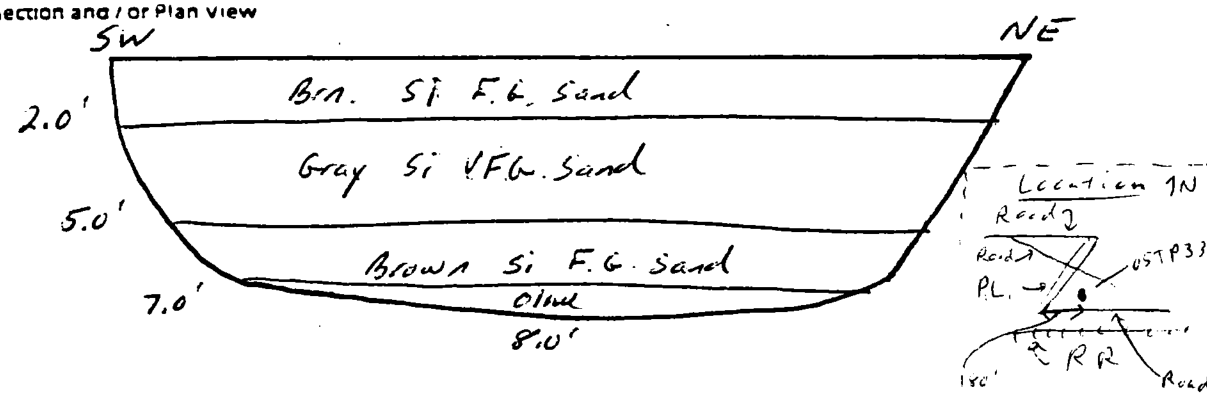
PAGE 1 OF 1

TEST PIT LOG — **Brown & Root Environmental**

PROJECT: NWS - EARLE TEST PIT NO.: 05-TP-33
PROJECT NO.: CTO - 289 DATE: 6/24/97
LOCATION: Colts Neck, NJ.
FIELD GEOLOGIST: PAUL M. DAVIS

DEPTH (ft.)	LITHOLOGY CHANGE (Depth,ft.)	MATERIAL DESCRIPTION (Soil Density / Consistency, Color)	USCS	REMARKS
		Brown silty fine grained sand		
2.0'				
		Gray silty very fine grained sand		
5.0'				
		Brown silty fine grained sand		
7.0'				
		Olive green silty clayey fine grained sand.		

Test Pit Cross Section and / or Plan View



REMARKS 2' x 8' x 12' long - NO obvious waste -
Located along abandoned road parallel to the railroad tracks.

PHOTO LOG

TEST PIT 05-TP-33

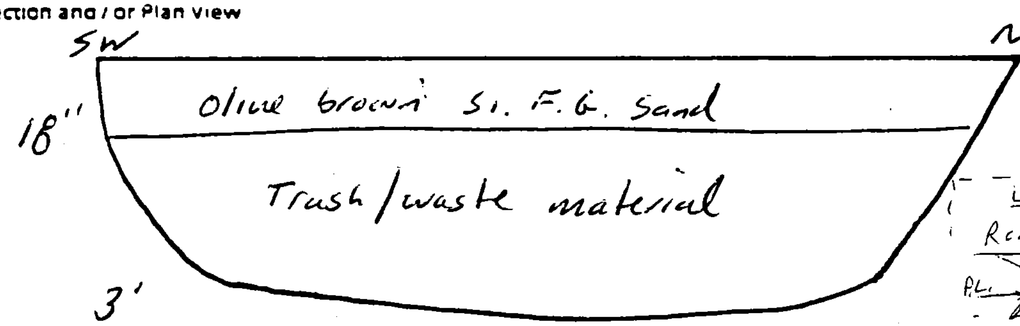
PAGE 1 OF 1

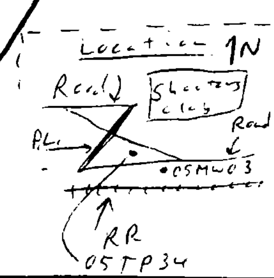
TEST PIT LOG — **Brown & Root Environmental**

PROJECT: NWS - EARLE TEST PIT NO.: 05-TP-34
PROJECT NO.: CTO - 289 DATE: 6/24/97
LOCATION: Colts Neck, N.J.
FIELD GEOLOGIST: PAUL M. DAVIS

DEPTH (ft.)	LITHOLOGY CHANGE (Depth,ft.)	MATERIAL DESCRIPTION (Soil Density / Consistency, Color)	USCS	REMARKS
		Olive brown silty fine grained		
18"		Sand		
		Trash/waste material - metal		
		objects, lumber, paper, plastic,		
		Soda cans, General Trash, a lot of		
		lumber		
3.0'	~~	Trash mixed with olive green		
		silty clayey fine grained sand		

Test Pit Cross Section and / or Plan View





REMARKS 2' x 3' x 10' long
Located along the abandoned road parallel to the railroad tracks.

PHOTO LOG Photo #7

TEST PIT 05-TP-34

PAGE 1 OF 1

TEST PIT LOG — **Brown & Root Environmental**

PROJECT: NWS-EARLE TEST PIT NO.: 05-TP-35

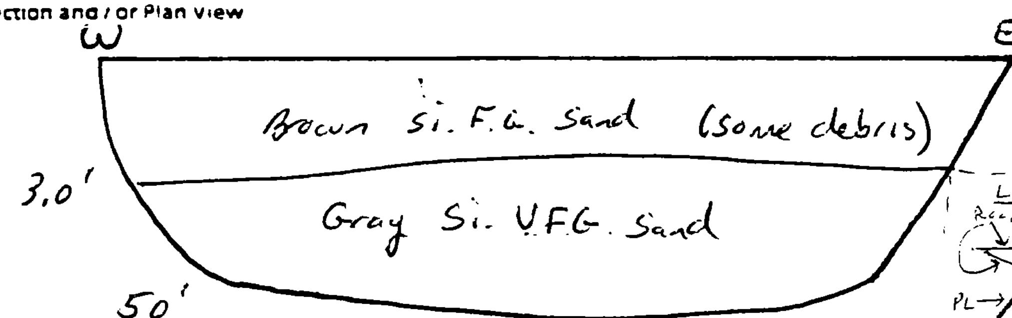
PROJECT NO.: CTO-289 DATE: 6/24/97

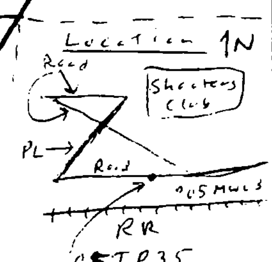
LOCATION: Colts Neck, NJ.

FIELD GEOLOGIST: PAUL M. DAVIS

DEPTH (ft.)	LITHOLOGY CHANGE (Depth, ft.)	MATERIAL DESCRIPTION (Soil Density / Consistency, Color)	USCS	REMARKS
		Brown silty fine grained Sand		
		(Some metal straps & lumber)		
3.0'		↓		
		Gray silty very fine grained		
		Sand		
5.0'				

Test Pit Cross Section and / or Plan View





REMARKS 2'x5'x9' long

Located within the abandoned road parallel to the railroad tracks.

PHOTO LOG

TEST PIT 05-TP-35

PAGE 1 OF 1

TEST PIT LOG — **Brown & Root Environmental**

PROJECT: NWS - EARLE TEST PIT NO.: 05-TP-36

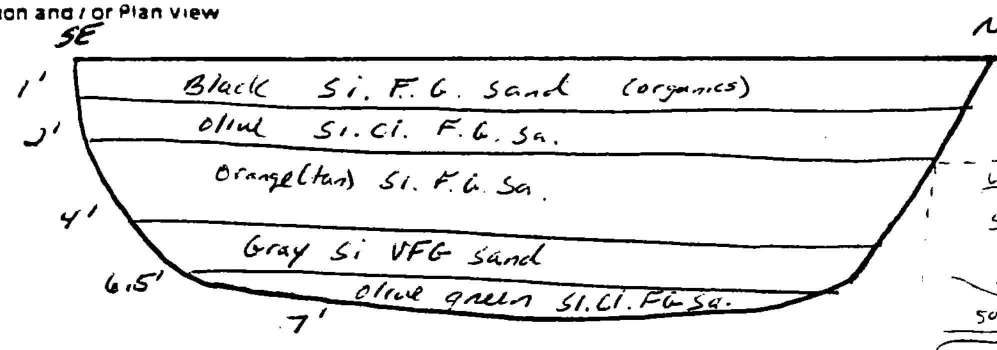
PROJECT NO.: CTO - 289 DATE: 6/25/97

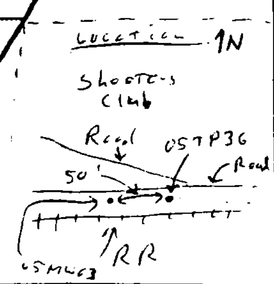
LOCATION: Colts Neck, NJ.

FIELD GEOLOGIST: PAUL M. DAVIS

DEPTH (ft.)	LITHOLOGY CHANGE (Depth, ft.)	MATERIAL DESCRIPTION (Soil Density / Consistency, Color)	USCS	REMARKS
		Black silty fine grained		
1'		sand (organics)		
		Olive silty clayey fine		
2'		grained sand		
		Orange (tan) silty fine		
		grained sand		
		↓		
4'				
		Gray silty very fine		
		grained sand		
6.5'		↓		
		Olive green silty clayey		
7'		fine grained sand		

Test Pit Cross Section and / or Plan view





REMARKS 2' x 7' x 10' long -No obvious waste or Trash- Test pit located outside of the southwestern edge of landfill. Near 05MW03 along abandoned Rd.

PHOTO LOG Photo #8

TEST PIT 05-TP-36

PAGE 1 OF 1

TEST PIT LOG — **Brown & Root Environmental**

PROJECT: NWS - EARLE

TEST PIT NO.: 05-TP-37

PROJECT NO.: CTO - 289

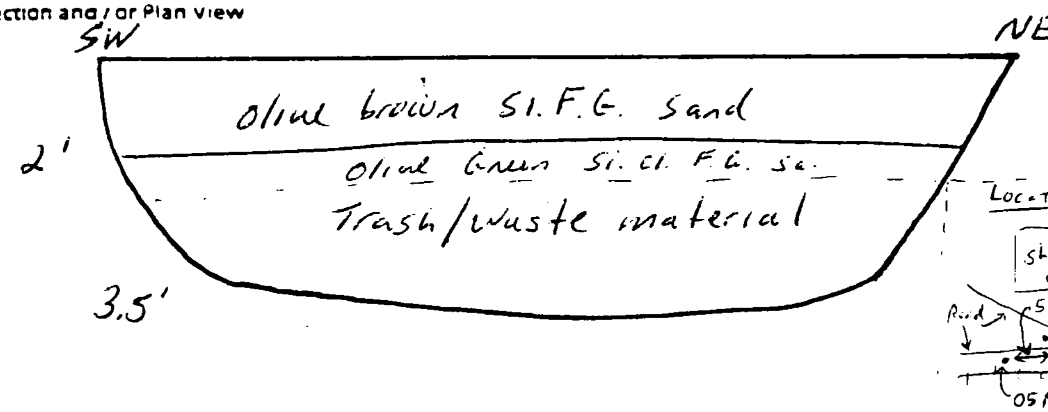
DATE: 6-25-97

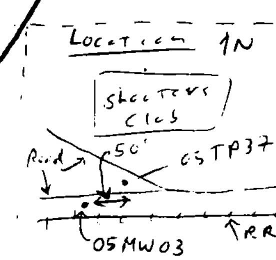
LOCATION: Colts Neck, NJ.

FIELD GEOLOGIST: PAUL M. DAVIS

DEPTH (ft.)	LITHOLOGY CHANGE (Depth, ft.)	MATERIAL DESCRIPTION (Soil Density / Consistency, Color)	USCS	REMARKS
		Olive brown silty fine		
		grained sand		
2'		↓		
		Olive green silty clayey fine		
		grained sand - Trash/waste		
		material metal straps, plastic, paper,		
3.5'		logs, wood, cans, & bottles		

Test Pit Cross Section and / or Plan View





REMARKS 2' x 3.5' x 8' long

Test pit located in SW area of landfill. East of 05MW03.

PHOTO LOG Photo #9

TEST PIT 05-TP-37

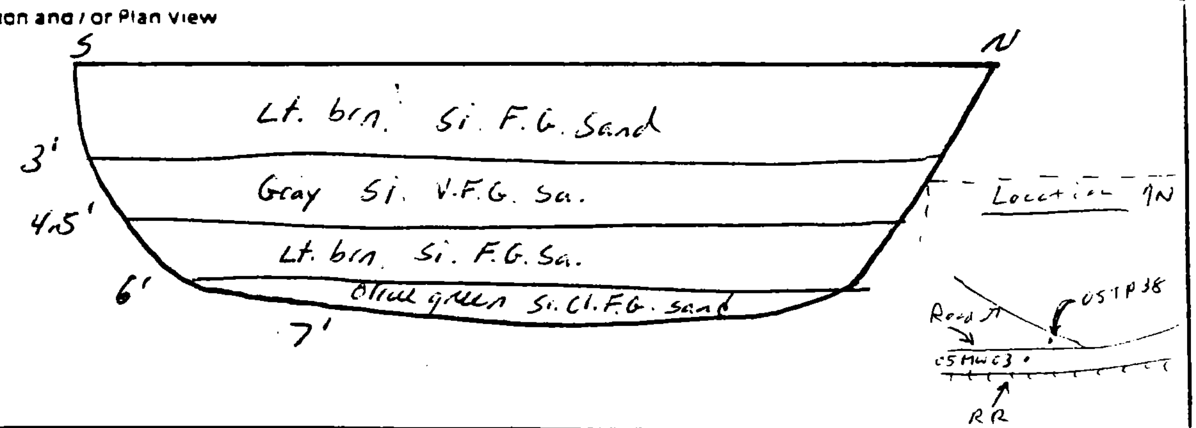
PAGE 1 OF 1

TEST PIT LOG — **Brown & Root Environmental**

PROJECT: NWS-EARLE TEST PIT NO.: 05-TP-38
PROJECT NO. CTO - 289 DATE: 6-25-97
LOCATION: Colts Neck, NJ.
FIELD GEOLOGIST: PAUL M. DAVIS

DEPTH (ft.)	LITHOLOGY CHANGE (Depth.ft.)	MATERIAL DESCRIPTION (Soil Density / Consistency, Color)	USCS	REMARKS
		Light brown silty fine		
		grained Sand		
		↓		
3'				
		Gray silty very fine		
		grained Sand		
4.5'		↓		
		Light brown silty fine		
		grained Sand		
6'				
		Olive green silty clayey		
		fine grained Sand		
7'				

Test Pit Cross Section and / or Plan View



REMARKS 2'x 7'x 11' long - No obvious waste or trash
Test pit is located outside of Southern boundary of landfill.

PHOTO LOG

TEST PIT 05-TP-38

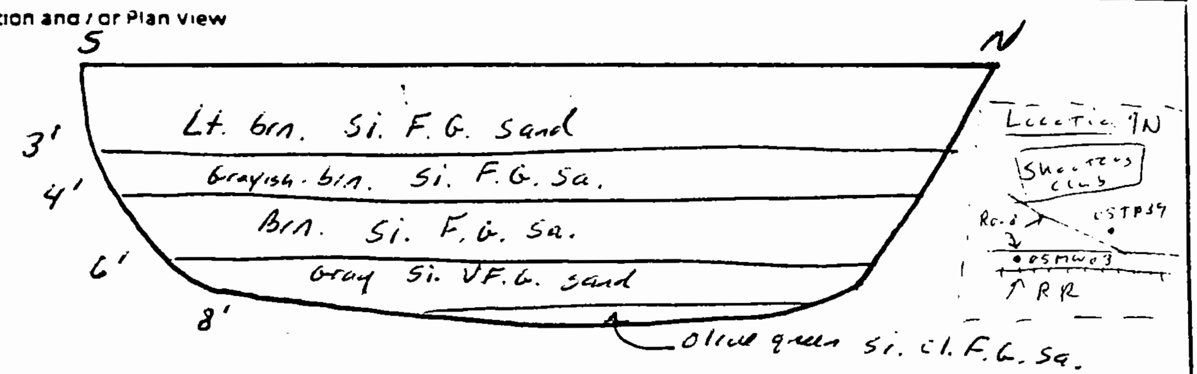
PAGE 1 OF 1

TEST PIT LOG — **Brown & Root Environmental**

PROJECT: NWS-EARLE TEST PIT NO.: 05-TP-39
PROJECT NO.: CTO-289 DATE: 6/25/97
LOCATION: Colts Neck, NJ.
FIELD GEOLOGIST: PAUL M. DAVIS

DEPTH (ft.)	LITHOLOGY CHANGE (Depth, ft.)	MATERIAL DESCRIPTION (Soil Density / Consistency, Color)	USCS	REMARKS
		Light brown silty fine		
		grained sand		
3'				
		Grayish-brown silty fine		
4'		grained sand		
		Brown silty fine		
		grained sand		
6'				
		Gray silty very fine grained		
		sand		
8'				
		Olive green silty clayey		
		fine grained sand		

Test Pit Cross Section and / or Plan View



REMARKS 2' x 8' x 10' long — NO obvious waste / trash —

PHOTO LOG

TEST PIT 05-TP-39

PAGE 1 OF 1

TEST PIT LOG — **Brown & Root Environmental**

PROJECT: NWS - EARLE — TEST PIT NO.: 05-TP-40

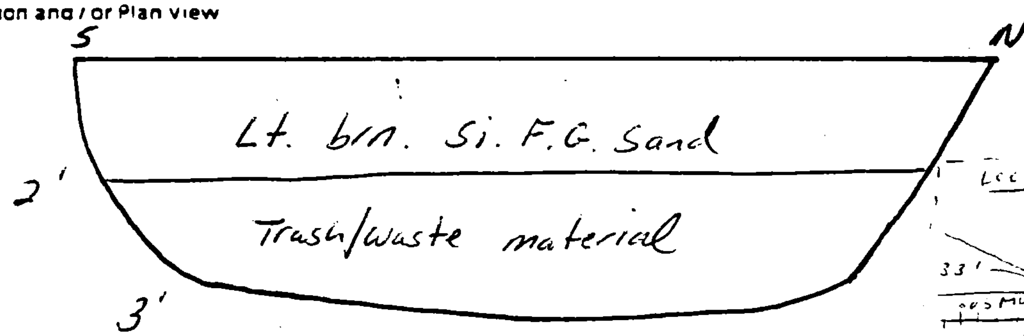
PROJECT NO.: CTO - 289 — DATE: 6/25/97

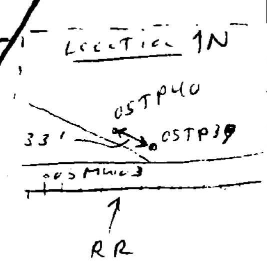
LOCATION: Colts Neck, NJ.

FIELD GEOLOGIST: PAUL M. DAVIS

DEPTH (ft.)	LITHOLOGY CHANGE (Depth, ft.)	MATERIAL DESCRIPTION (Soil Density / Consistency, Color)	USCS	REMARKS
		Light brown silty fine		
		grained sand		
2'		↓		
		waste / Trash material - paper,		
		plastic, beer cans, fiberglass		
		pipe,		
3'				

Test Pit Cross Section and / or Plan View





REMARKS: 2' x 3' x 9' long

PHOTO LOG: Photo #10

TEST PIT 05-TP-40

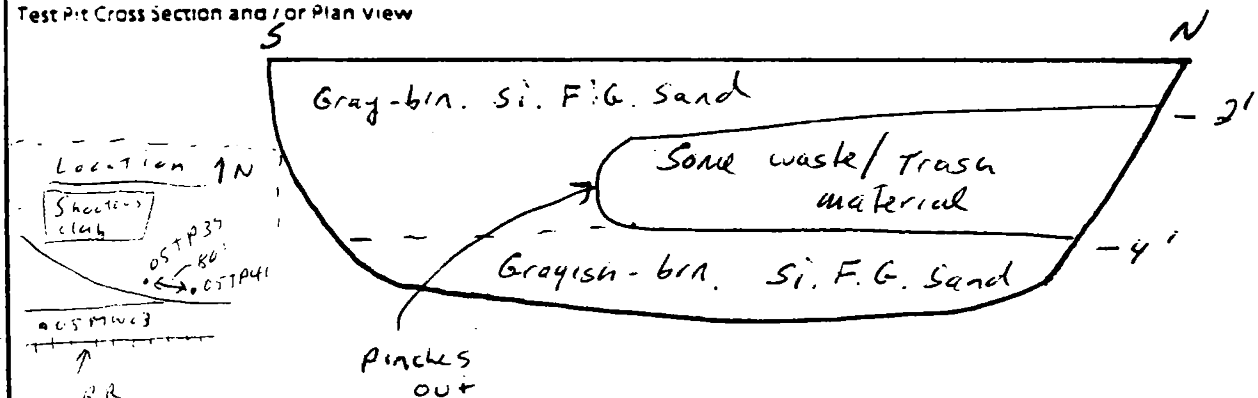
PAGE 1 OF 1

TEST PIT LOG — **Brown & Root Environmental**

PROJECT: NWS - EARLE　　TEST PIT NO.: 05-TP-41
PROJECT NO.: CTO - 289　　DATE: 6/25/97
LOCATION: Colts Neck, NJ.
FIELD GEOLOGIST: PAUL M. DAVIS

DEPTH (ft.)	LITHOLOGY CHANGE (Depth,ft.)	MATERIAL DESCRIPTION (Soil Density / Consistency, Color)	USCS	REMARKS
		Grayish-brown silty fine grained sand		
2'				
		Waste/Trash material - wood, logs, branches, some paper & plastic, a bowling pin		
4'				
		Grayish-brown silty fine grained sand		
7'				

Test Pit Cross Section and / or Plan view



REMARKS 2'x 7'x 10' long
Test pit located in southern edge of landfill

PHOTO LOG

TEST PIT 05-TP-41

PAGE 1 OF 1

TEST PIT LOG — **Brown & Root Environmental**

PROJECT: NWS - EARLE — TEST PIT NO.: 05-TP-42

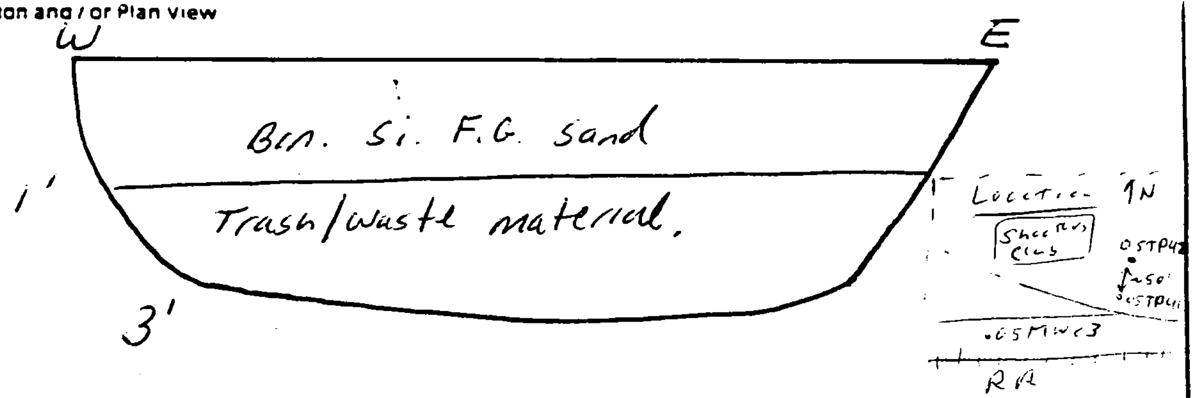
PROJECT NO.: CTO - 289 — DATE: 6/25/97

LOCATION: Colts Neck, N.J.

FIELD GEOLOGIST: PAUL M. DAVIS

DEPTH (ft.)	LITHOLOGY CHANGE (Depth,ft.)	MATERIAL DESCRIPTION (Soil Density / Consistency, Color)	USCS	REMARKS
		Brown silty fine grained		
		sand		
1'		↓		
		Trash/waste material - cables		
		wires, metal straps, mechanical		
		control box, lumber, electrical		
		type equipment.		
3'				

Test Pit Cross Section and / or Plan View



REMARKS: 3'x 3'x 9' long Test pit located in "wetland" area
Test pit located in southeastern area of landfill.

PHOTO LOG: Photo #11

TEST PIT 05-TP-42

PAGE 1 OF 1

TEST PIT LOG **Brown & Root Environmental**

PROJECT: NWS - EARLE TEST PIT NO.: 05-TP-43

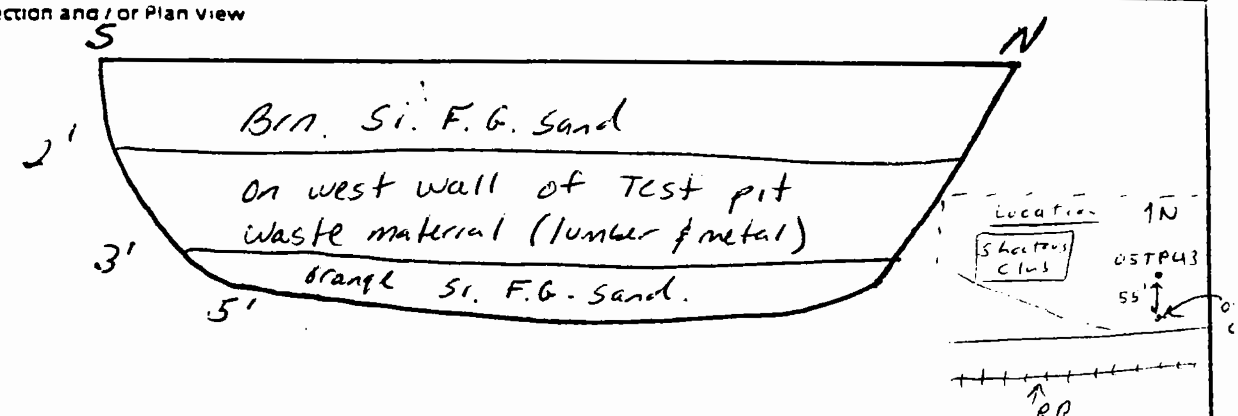
PROJECT NO.: CTO - 289 DATE: 6/25/97

LOCATION: Colts Neck, NJ.

FIELD GEOLOGIST: PAUL M. DAVIS

DEPTH (ft.)	LITHOLOGY CHANGE (Depth, ft.)	MATERIAL DESCRIPTION (Soil Density / Consistency, Color)	USCS	REMARKS
		Brown silty fine grained		
		sand		
2'		↓		
		Gray silty very fine grained		
		Sand - On west wall of Test pit		
		Waste material - lumber & metal		
		debris		
3'		orange silty fine grained		
		sand.		
5'				

Test Pit Cross Section and / or Plan View



REMARKS 2' X 5' X 10' long

Waste material along west wall of test pit.
Test pit located in SE edge of landfill

PHOTO LOG

TEST PIT 05-TP-43

PAGE 1 OF 1

TEST PIT LOG — **Brown & Root Environmental**

PROJECT: NWS - EARLE — TEST PIT NO.: 05-TP-44

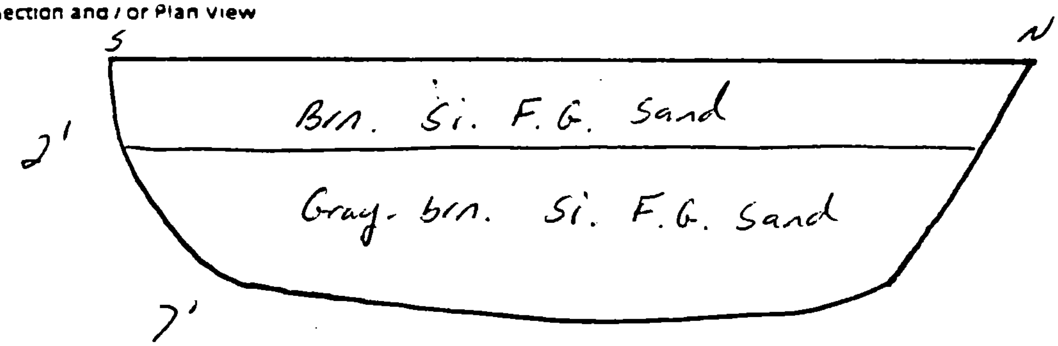
PROJECT NO.: CTO - 289 — DATE: 6/25/97

LOCATION: Colts Neck, NJ.

FIELD GEOLOGIST: PAUL M. DAVIS

DEPTH (ft.)	LITHOLOGY CHANGE (Depth,ft.)	MATERIAL DESCRIPTION (Soil Density / Consistency, Color)	USCS	REMARKS
		Brown silty fine grained		
		sand		
2'		↓		
		Gray brown silty fine		
		grained sand		
7'		↓		

Test Pit Cross Section and / or Plan View



REMARKS 2' x 7' x 7' long

— NO obvious waste or Trash —

Test pit located outside of southeastern edge of landfill.

PHOTO LOG

TEST PIT 05-TP-44

PAGE 1 OF 1

TEST PIT LOG — **Brown & Root Environmental**

PROJECT: NWS - EARLE　　TEST PIT: 05-TP-45

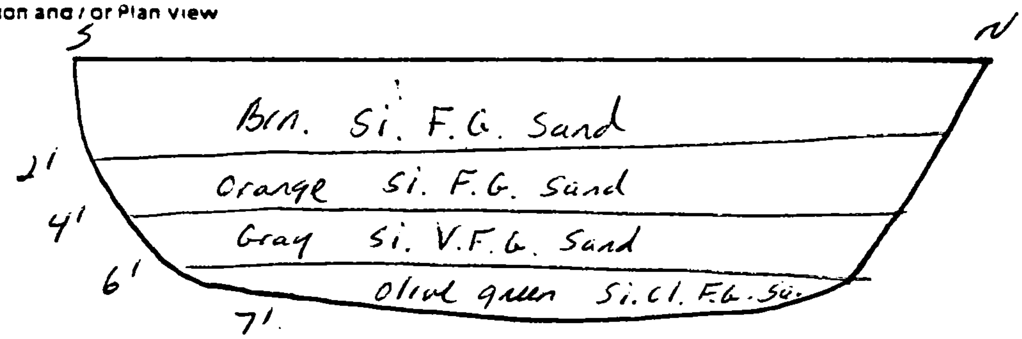
PROJECT NO.: CTO - 289　　DATE: 6/25/97

LOCATION: Colts Neck, NJ.

FIELD GEOLOGIST: PAUL M. DAVIS

DEPTH (ft.)	LITHOLOGY CHANGE (Depth, ft.)	MATERIAL DESCRIPTION (Soil Density / Consistency, Color)	USCS	REMARKS
		Brown silty fine grained		
		sand		
2'		↓		
		Orange silty fine grained		
		sand		
4'		↓		
		Gray silty very fine grained		
		Sand		
6'		↓		
		Olive green silty clayey		
7'		fine grained sand		

Test Pit Cross Section and / or Plan view



REMARKS: 2' x 7' x 8' long — NO obvious waste or trash —

PHOTO LOG:

TEST PIT 05-TP-45

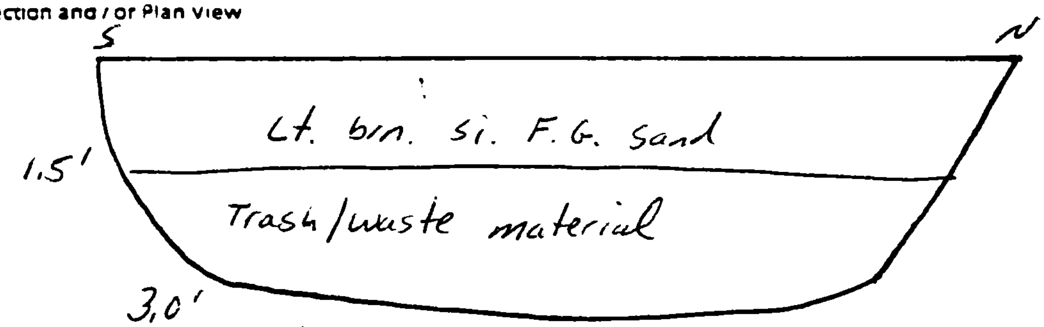
PAGE 1 OF 1

TEST PIT LOG — **Brown & Root Environmental**

PROJECT: NWS - EARLE TEST PIT NO.: 05-TP-46
PROJECT NO.: CTO - 289 DATE: 6/25/97
LOCATION: Colts Neck, NJ.
FIELD GEOLOGIST: PAUL M. DAVIS

DEPTH (ft.)	LITHOLOGY CHANGE (Depth, ft.)	MATERIAL DESCRIPTION (Soil Density / Consistency, Color)	USCS	REMARKS
		Light brown silty fine grained sand		
1.5'				
		Trash / waste material - glass bottles, wood, lumber, cables, and metal straps		
3'				

Test Pit Cross Section and / or Plan View



REMARKS 2' x 3' x 8' long

PHOTO LOG Photo #12

TEST PIT 05-TP-46

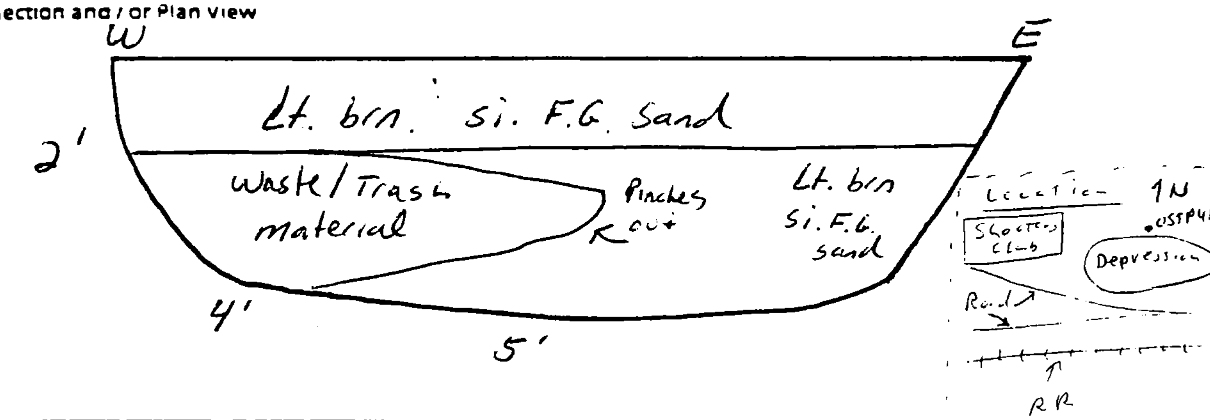
PAGE 1 OF 1

TEST PIT LOG **Brown & Root Environmental**

PROJECT: NWS-EARLE TEST PIT NO.: 05-TP-48
PROJECT NO.: CTO-289 DATE: 6/25/97
LOCATION: Colts Neck, NJ.
FIELD GEOLOGIST: PAUL M. DAVIS

DEPTH (ft.)	LITHOLOGY CHANGE (Depth,ft.)	MATERIAL DESCRIPTION (Soil Density / Consistency, Color)	USCS	REMARKS
		Light brown silty fine		
		grained sand		
2'				
		Waste/Trash material - wood,		
		lumber, metal, paper, plastic,		
		fabric ... (On west side of		
		test pit, only)		
5'				
		Light brown silty fine		
		grained sand		

Test Pit Cross Section and / or Plan View



REMARKS 2'x 5'x 20' long
Located north of the existing depression

PHOTO LOG

TEST PIT 05-TP-48

PAGE 1 OF 1

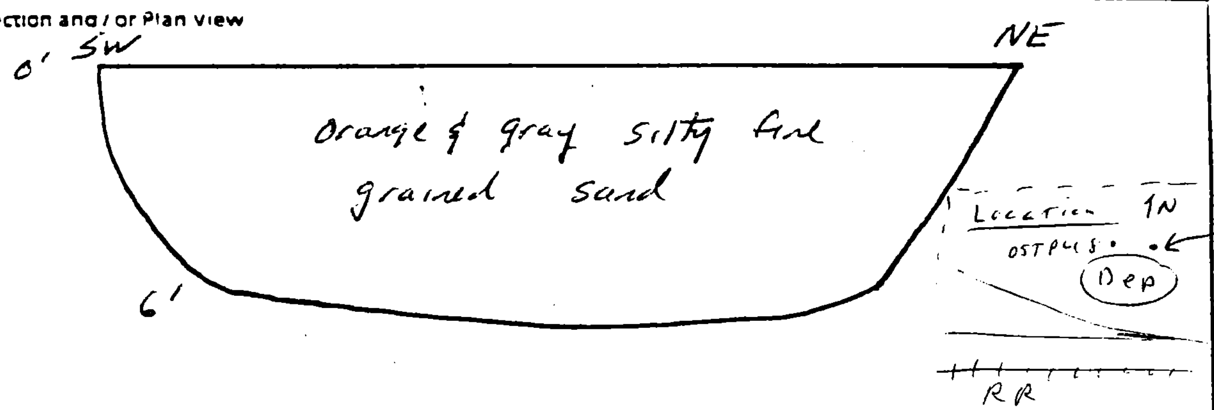
TEST PIT LOG

Brown & Root Environmental

PROJECT: NWS - EARLE TEST PIT NO.: 05-TP-49
PROJECT NO.: CTO - 289 DATE: 6/25/97
LOCATION: Colts Neck, NJ.
FIELD GEOLOGIST: PAUL M. DAVIS

DEPTH (ft.)	LITHOLOGY CHANGE (Depth, ft.)	MATERIAL DESCRIPTION (Soil Density / Consistency, Color)	USCS	REMARKS
0'		Orange & gray silty fine grained sand		
6'				

Test Pit Cross Section and / or Plan View



REMARKS 2' x 6' x 10' long -No obvious waste/trash - Located north along the existing depression.

PHOTO LOG

TEST PIT 05-TP-49

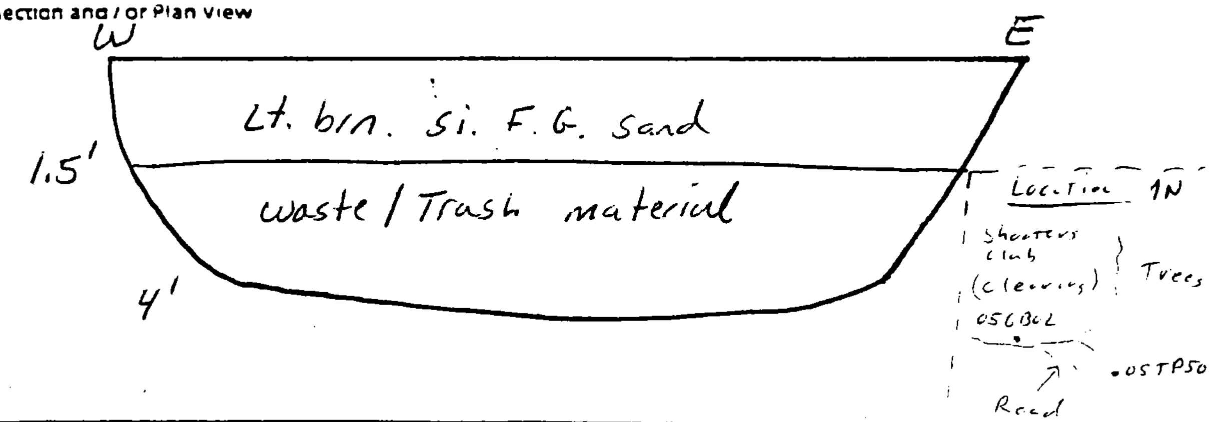
PAGE 1 OF 1

TEST PIT LOG	Brown & Root Environmental

PROJECT: NWS - EARLE TEST PIT I.D.: 05-TP-50
PROJECT NO.: CTO - 289 DATE: 6/25/97
LOCATION: Colts Neck, N.J.
FIELD GEOLOGIST: PAUL M. DAVIS

DEPTH (ft.)	LITHOLOGY CHANGE (Depth, ft.)	MATERIAL DESCRIPTION (Soil Density / Consistency, Color)	USCS	REMARKS
		Light brown silty fine grained sand		
1.5'				
		Waste / Trash material - 55-gal. drum filled with garbage and electrical equipment, lumber, paper, plastic, glass, and general trash.		
4'				

Test Pit Cross Section and / or Plan View



REMARKS 2' x 4' x 10' long
Located in the abandoned road SE of skeet club clearing.

PHOTO LOG Photo #13

TEST PIT 05-TP-50

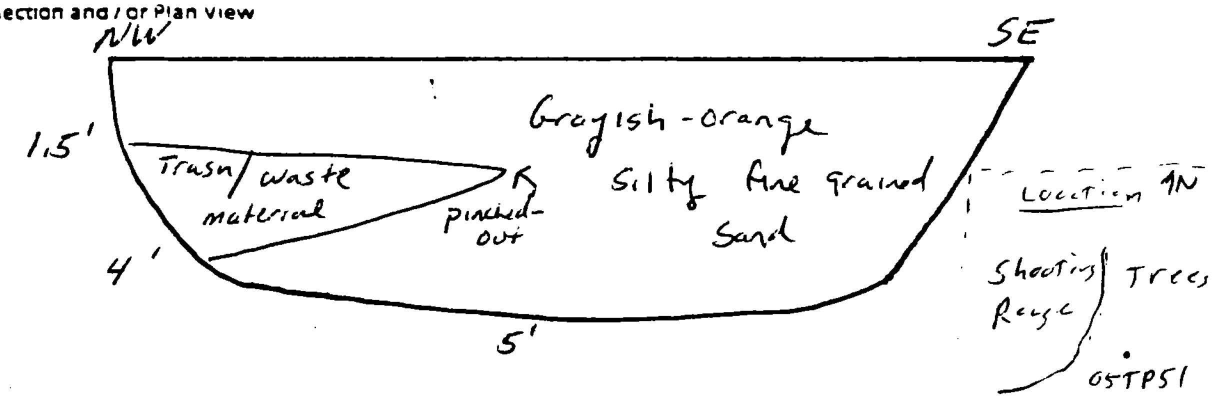
PAGE 1 OF 1

TEST PIT LOG — **Brown & Root Environmental**

PROJECT: NWS - EARLE — TEST PIT NO.: 05-TP-51
PROJECT NO.: CTO - 289 — DATE: 6/25/97
LOCATION: Colts Neck, NJ.
FIELD GEOLOGIST: PAUL M. DAVIS

DEPTH (ft.)	LITHOLOGY CHANGE (Depth, ft.)	MATERIAL DESCRIPTION (Soil Density / Consistency, Color)	USCS	REMARKS
		Grayish - orange silty fine grained		
		sand		
1.5'		↓		
		Trash / waste material - lumber		
		plywood, metal straps, bed spring,		(perched water)
		(at NW end of pit, only)		
5'				

Test Pit Cross Section and / or Plan view



REMARKS 2' x 5' x 22' long

PHOTO LOG Photo # 14

TEST PIT 05-TP-51

PAGE 1 OF 1

TEST PIT LOG **Brown & Root Environmental**

PROJECT: NWS - EARLE TEST PIT NO.: 05-TP-52

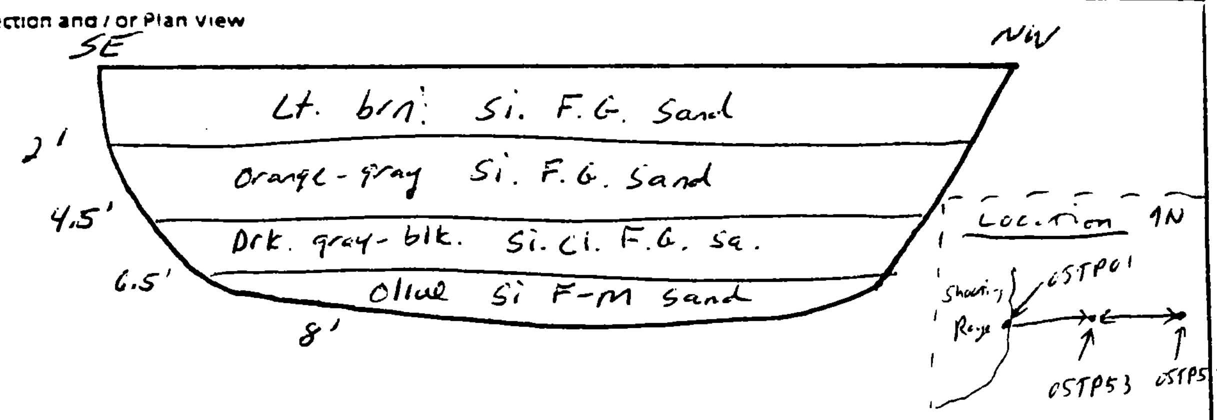
PROJECT NO. CTO - 289 DATE: 6/25/97

LOCATION: Colts Neck, N.J.

FIELD GEOLOGIST: PAUL M. DAVIS

DEPTH (ft.)	LITHOLOGY CHANGE (Depth,ft.)	MATERIAL DESCRIPTION (Soil Density / Consistency, Color)	USCS	REMARKS
		Light brown silty fine grained sand.		
2'		↓		
		Orange-gray silty fine grained sand		
4.5'				
		Dark grayish-black silty clayey fine graind sand		
6.5'				
		Olive silty fine to medium grained sand		
8'				

Test Pit Cross Section and / or Plan View



REMARKS 2' x 8' x 10' long

— No obvious waste / Trash —

PHOTO LOG

TEST PIT 05-TP-52

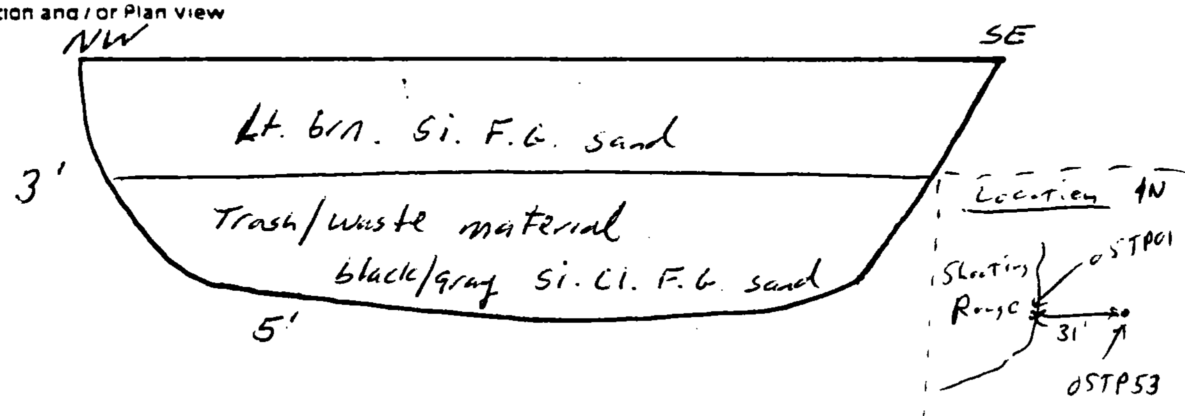
PAGE 1 OF 1

TEST PIT LOG **Brown & Root Environmental**

PROJECT: NWS - EARLE TEST PIT NO.: 05-TP-53
PROJECT NO.: CTO - 289 DATE: 6/25/97
LOCATION: Colts Neck, NJ.
FIELD GEOLOGIST: PAUL M. DAVIS

DEPTH (ft.)	LITHOLOGY CHANGE (Depth, ft.)	MATERIAL DESCRIPTION (Soil Density / Consistency, Color)	USCS	REMARKS
		Light brown silty fine		
		grained sand		
		↓		
3'				
		Trash/waste material - lumber,		January 1968 stamped
		paper, plastic, metal debris,		on plastic bag.
		Tin cans		
		Black-gray silty clayey		
		fine grained sand.		
5'				

Test Pit Cross Section and / or Plan View



REMARKS 2' x 5' x 15' long

PHOTO LOG Photo #15

TEST PIT 05-TP-53

PAGE 1 OF 1

TEST PIT LOG — **Brown & Root Environmental**

PROJECT: NWS - EARLE TEST PIT NO.: 05-TP-54

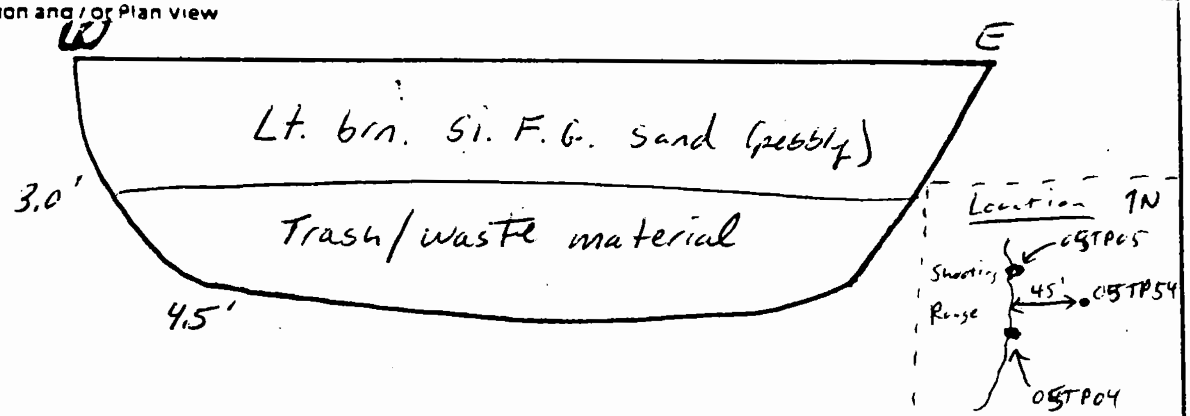
PROJECT NO.: CTO - 289 DATE: 6/26/97

LOCATION: Colts Neck, NJ.

FIELD GEOLOGIST: PAUL M. DAVIS

DEPTH (ft.)	LITHOLOGY CHANGE (Depth.ft.)	MATERIAL DESCRIPTION (Soil Density / Consistency, Color)	USCS	REMARKS
		Light brown silty		
		fine grained Sand (pebbly)		
		↓		
3.0'				
		Trash/waste material - plywood,		Asbury Park Press
		lumber, paper, plastic, glass		news paper dated
		bottles, alum. cans, etc..		6/6/75
4.5'				

Test Pit Cross Section and / or Plan view



REMARKS 2' x 4.5' x 10' long

PHOTO LOG Photo # 16

TEST PIT 05-TP-54

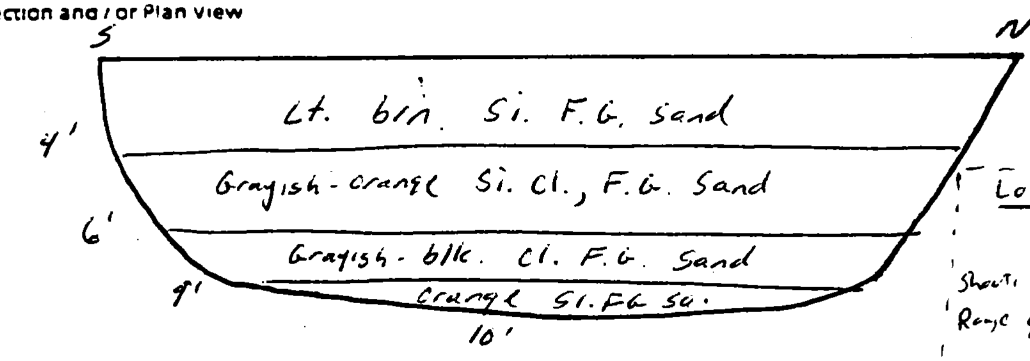
PAGE 1 OF 1

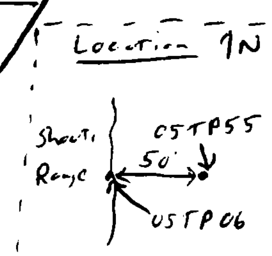
TEST PIT LOG — **Brown & Root Environmental**

PROJECT: NWS - EARLE TEST PIT NO.: 05-TP-55
PROJECT NO.: CTO - 289 DATE: 6/26/97
LOCATION: Colts Neck, NJ.
FIELD GEOLOGIST: PAUL M. DAVIS

DEPTH (ft.)	LITHOLOGY CHANGE (Depth.ft.)	MATERIAL DESCRIPTION (Soil Density / Consistency, Color)	USCS	REMARKS
		Light brown silty fine grained sand (pebbly)		
4.0'		↓		
		Grayish-orange silty clayey fine grained sand		
6.0'		↓		
		Grayish-black clayey fine grained sand		
9.0'		↓		
		Orange silty fine grained sand		
10'				

Test Pit Cross Section and / or Plan View





REMARKS 2' X 10' X 10' long - NO obvious trash/waste

PHOTO LOG

TEST PIT 05-TP-5

PAGE 1 OF 1

TEST PIT LOG — **Brown & Root Environmental**

PROJECT: NWS - EARLE TEST PIT NO.: 05-TP-56

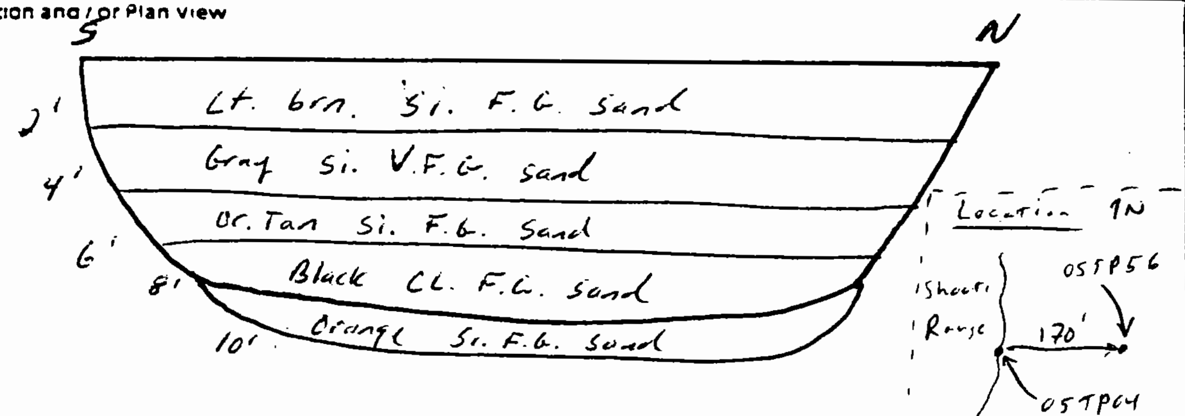
PROJECT NO.: CTO - 289 DATE: 6/26/97

LOCATION: Colts Neck, NJ.

FIELD GEOLOGIST: PAUL M. DAVIS

DEPTH (ft.)	LITHOLOGY CHANGE (Depth,ft.)	MATERIAL DESCRIPTION (Soil Density / Consistency, Color)	USCS	REMARKS
		Light brown silty fine		
		grained sand		
2.0'		↓		
		Gray silty very fine		
		grained sand		
4.0'		↓		
		Orange-Tan silty fine		
		grained sand		
6.0'		↓		
		Black Clayey fine grained		
		sand		
8.0'		↓		
		Orange silty fine grained		
		sand		
10.0'		↓		

Test Pit Cross Section and / or Plan View



REMARKS 2' x 10' x 11' — NO obvious Trash / waste —

PHOTO LOG

TEST PIT 05-TP-56

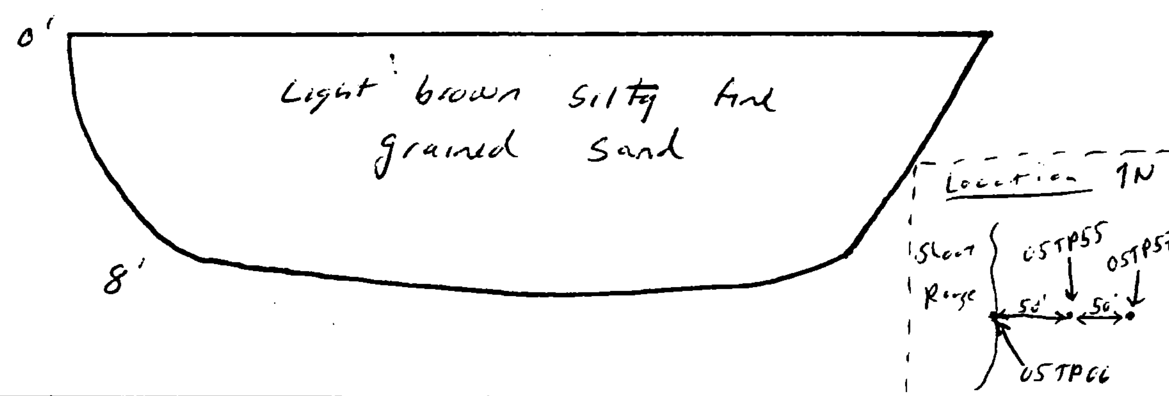
PAGE 1 OF 1

TEST PIT LOG — **Brown & Root Environmental**

PROJECT: NWS - EARLE TEST PIT NO.: 05-TP-57
PROJECT NO.: CTO - 289 DATE: 6/26/97
LOCATION: Colts Neck, NJ.
FIELD GEOLOGIST: PAUL M. DAVIS

DEPTH (ft.)	LITHOLOGY CHANGE (Depth, ft.)	MATERIAL DESCRIPTION (Soil Density / Consistency, Color)	USCS	REMARKS
0'		Light brown silty fine grained sand		
8'				

Test Pit Cross Section and / or Plan view



REMARKS 2' X 8' X 10' long
- NO Obvious waste / Trash -

PHOTO LOG

TEST PIT 05-TP-57

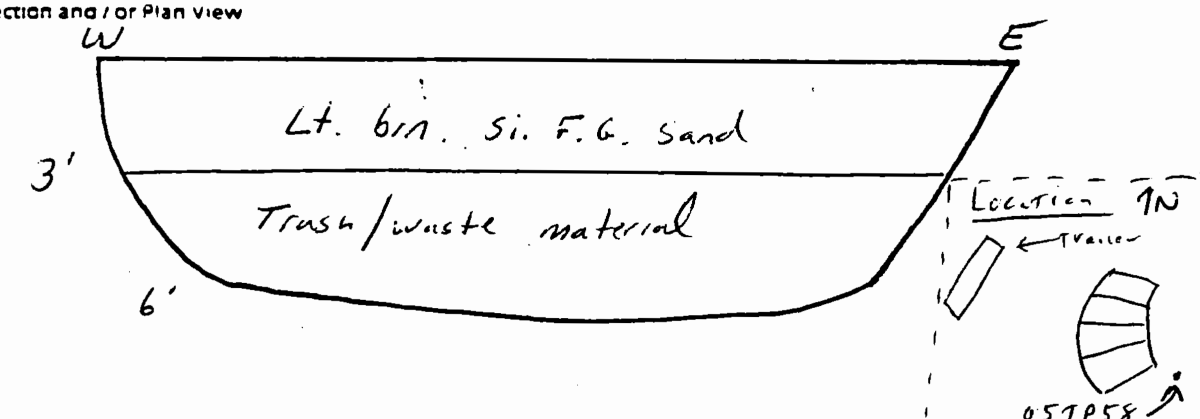
PAGE 1 OF 1

TEST PIT LOG — **Brown & Root Environmental**

PROJECT: NWS - EARLE TEST PIT NO.: 05-TP-58
PROJECT NO.: CTO - 289 DATE: 6/26/97
LOCATION: Colts Neck, NJ.
FIELD GEOLOGIST: PAUL M. DAVIS

DEPTH (ft.)	LITHOLOGY CHANGE (Depth,ft.)	MATERIAL DESCRIPTION (Soil Density / Consistency, Color)	USCS	REMARKS
		Light brown silty fine		
		grained sand		
		↓		
3'				
		Trash/waste material - lumber,		Strong land fill
		paper, plastic, fabric, foam		odors
		padding, alum. cans, metal straps		
6'				

Test Pit Cross Section and / or Plan View



REMARKS 2' x 6' x 9' long

PHOTO LOG Photo # 21

TEST PIT 05-TP-58

PAGE 1 OF 1

TEST PIT LOG **Brown & Root Environmental**

PROJECT: NWS - EARLE TEST PIT NO.: 05-TP-59

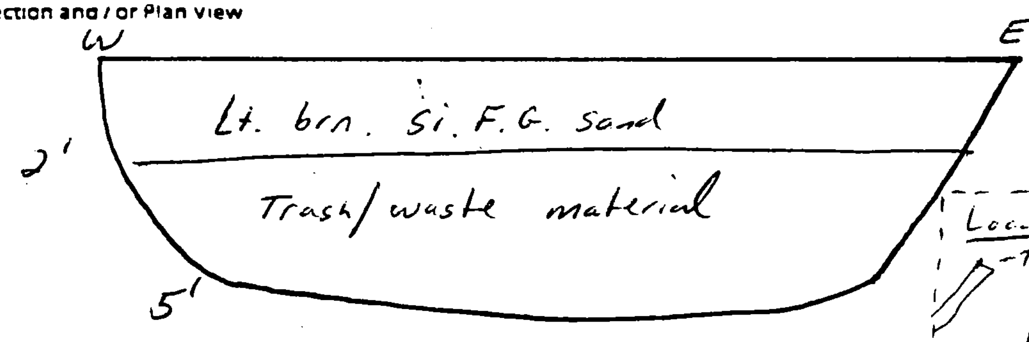
PROJECT NO.: CTO - 289 DATE: 6/26/97

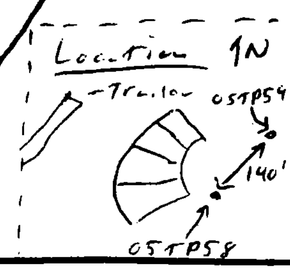
LOCATION: Colts Neck, NJ.

FIELD GEOLOGIST: PAUL M. DAVIS

DEPTH (ft.)	LITHOLOGY CHANGE (Depth.ft.)	MATERIAL DESCRIPTION (Soil Density / Consistency, Color)	USCS	REMARKS
		Light brown silty fine		
		grained sand		
2'		↓		
		Trash/waste material - stumps,		
		branches, car tire, bicycle seat,		
		metal objects, plastic, paper,		
		aluminum cans, & metal straps		
5'				

Test Pit Cross Section and / or Plan view





REMARKS 2'x 5'x 7' long Center of Shooting Range.

PHOTO LOG photo # 22

TEST PIT 05-TP-59

PAGE 1 OF 1

APPENDIX J

STABILITY ANALYSES

CLIENT NAVY, NWS EARLE		JOB NUMBER 7602-0201	
SUBJECT HELP MODEL CALCULATIONS			
BASED ON		DRAWING NUMBER	
BY DCW	CHECKED BY MEA 10/30/97	APPROVED BY	DATE 10/30/97

OBJECTIVE

The objective of this calculation is to estimate the amount of percolation through the low permeability barrier in the landfill caps at Sites 4 and 5. Also the HELP model calculations will be used to determine the amount of head which can be expected to build up on the drainage layer. The depth of the head will then be used in the infinite slope stability calculations. The New Jersey sanitary landfill regulations indicate that the hydrostatic head on the cap should not exceed the thickness of the drainage layer during a 25-yr, 24-hr storm event.

APPROACH

The proposed cap configuration at Site 4 includes a steep portion of the cap (4:1 maximum slope) and the top, plateau portion (3.5-5% slope). The cap configuration of Site 5 will be similar except in the Trap/Skeet range area where the vegetative layers will be replaced with the asphalt paving structure. Figure 1, presents the proposed cap configuration and layers of the cap for the steep portions of the cap (Site 4), and the plateau portion of the caps (Sites 4 and 5). The paved portion of the Site 5 landfill cap is not evaluated with the HELP model because it is assumed that the paved surface will be relatively impervious and the vegetated sections will represent a worst case.

The procedures outlined in the HELP Model Users Guide to Version 3 will be followed in the calculation (ref 1).

The 24-hr, 25-yr will be incorporated into the HELP model by entering the total rainfall amount for a 24-hr, 25-yr storm event (6.0 inches) in to the daily input precipitation input file. The peak daily values presented in the HELP output will represent the 24-hr, 25-yr storm event.

The Site 4 landfill cap has a relatively small plateau portion. Because the amount of area of the plateau portion of the cap which drains toward the steep slope is small, a lateral drain in the drainage layer is not needed at the break in slope between the plateau and the steep portion. The plateau portion and the side slopes will be modeled as with two separate HELP runs with the flow out of the lateral drainage layer in the plateau portion input into the lateral drainage layer in the side slope portion as subsurface inflow. Figures 2 and 3 show the representative flow lengths for Sites 4 and 5, respectively.

ASSUMPTIONS

The following section describes the selection of the assumed soil properties.

TOPSOIL/ SELECT FILL MATERIAL. The topsoil and select cover material are assumed to be similar to soils currently at the sites. The soils at the sites are classified as silty sands. The default soil #7 in the HELP model Users guide was chosen for the these layers. This soil is a silty sand and has a hydraulic conductivity of 5.2×10^{-4} cm/sec. The hydraulic conductivity of the soils in the aquifer at Sites 4 and 5 range between 6.46×10^{-4} and 2.08×10^{-4} cm/sec, as presented in the RI report (ref. 4).

BEDDING SOIL / GAS MANAGEMENT LAYER The gas management layer is assumed to be a poorly graded sand to provide adequate gas flow. An SP soil, as classified by the USCS, represents a poorly graded clean sand. This would correspond to HELP default soil #1 with a hydraulic conductivity of 1×10^{-2} cm/sec.

GRANULAR DRAINAGE MATERIAL The 12 inch thick drainage layer must meet the following gradation requirements based on the New Jersey Administrative Code:

$$D_2 > 0.1 \text{ inch } (2.54 \text{ mm})$$
$$D_{85} > 4\, D_{15}$$

Because of potential puncture of the geomembrane, the maximum size of the drainage material will be

CLIENT NAVY, NWS EARLE	JOB NUMBER 7602-0201
SUBJECT HELP MODEL CALCULATIONS	
BASED ON	DRAWING NUMBER
BY DCW / CHECKED BY MOA 10/30/97	APPROVED BY / DATE 10/30/97

limited to 1 inch (25.4 mm). Figure 4 from Ref. 2 shows the hydraulic conductivity (coefficient of permeability) of drainage material based on gradation. Curve no. 6 most closely matches the drainage material to be used in the landfill caps. This material has a hydraulic conductivity of 2.08 ft/min (1.0 cm/sec).

The conductivity can also be estimated using the D_{10} of the soil and the following equation proposed by Hazen (REF. 3).

$$k = CD_{10}^2$$

where k is the hydraulic conductivity in cm/sec, C is a constant with the average value being 1, and D_{10} is in mm. Based on the required gradation the D_2 is at least 2.5 mm so the D_{10} would also be at least 2.5 mm. This results in a hydraulic conductivity of 6.25 cm/sec.

To be conservative assume that the hydraulic conductivity of the drainage layer is 1 cm/sec.

GEOMEMBRANE The geomembrane is a 40 mil (0.04 inch) LDPE liner. It is assumed that the membrane has 1 pinhole per acre, good to fair installation with 4 defects per acre, and good placement quality. Assuming a good placement quality is reasonable since the contractor for this project is known and is experienced in this type of construction.

CALCULATIONS

The HELP model outputs are attached for the three cases that were evaluated:

1) Site 5 landfill cap
2) Site 4 plateau
3) Site 4 side slope (with subsurface inflow)

CONCLUSIONS

The yearly average infiltration (inches) and the average peak daily head on the geomembrane is summarized in the following table. The maximum head is assumed to be twice the average head on the geomembrane. The maximum head on the geomembrane during the 24-hr, 25-yr storm event nearly equals the drainage layer thickness of 12 inches but is below.

Case	Average yearly percolation through the geomembrane (in)	Average Peak daily head on the geomembrane (in)	Maximum Daily Head on the geomembrane (in)
Site 5	0.15	5.97	11.94
Site 4 Plateau	0.07	3.67	7.34
Site 4 Side Slope	0.01	0.49	0.98

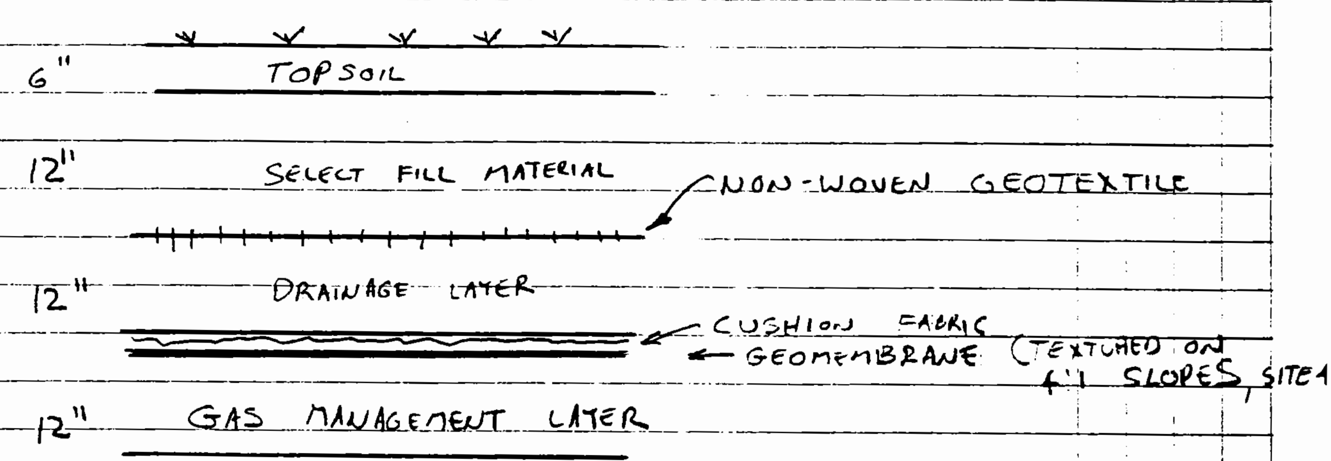
REFERENCES

1) Schroeder, P.R., et al., "The Hydrologic Evaluation of Landfill Performance (HELP) Model: Users guide for Version 3," EPA/600/R-94/168a, U.S. EPA Risk Reduction Engineering Laboratory, Cincinnati OH, 1994.
2) Design Manual-Soil Mechanics, Foundations and Earth Structures, NAVFAC DM-7, March 1971.
3) Holtz, R.D., and Kavacs, W.D., *An Introduction to Geotechnical Engineering*, Prentice -Hall, Englewood Cliffs NJ, 1981.
4) Brown & Root Environmental, Remedial Investigation Report for NWS Earle, Northern Division, Naval Engineering Facilities Command, July 1996.

CALCULATION WORKSHEET Order No. 19116 (01-91)

CLIENT	JOB NUMBER
SUBJECT	
BASED ON	DRAWING NUMBER

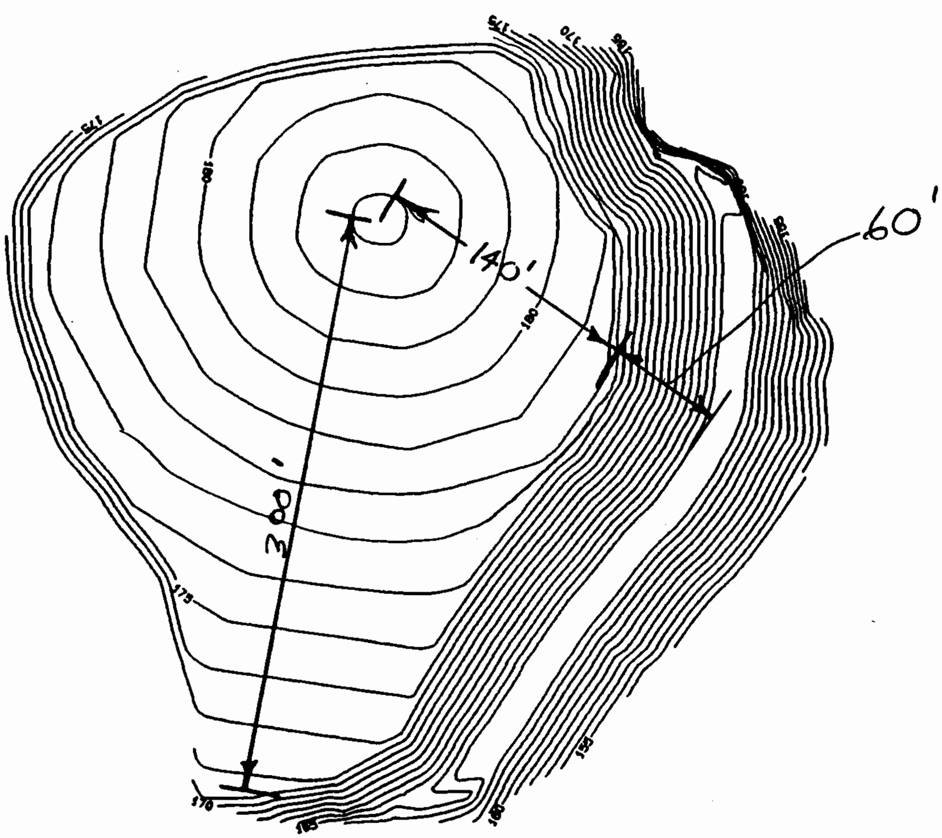
BY	CHECKED BY	APPROVED BY	DATE



VEGETATED PORTION OF CAP

FIGURE 1

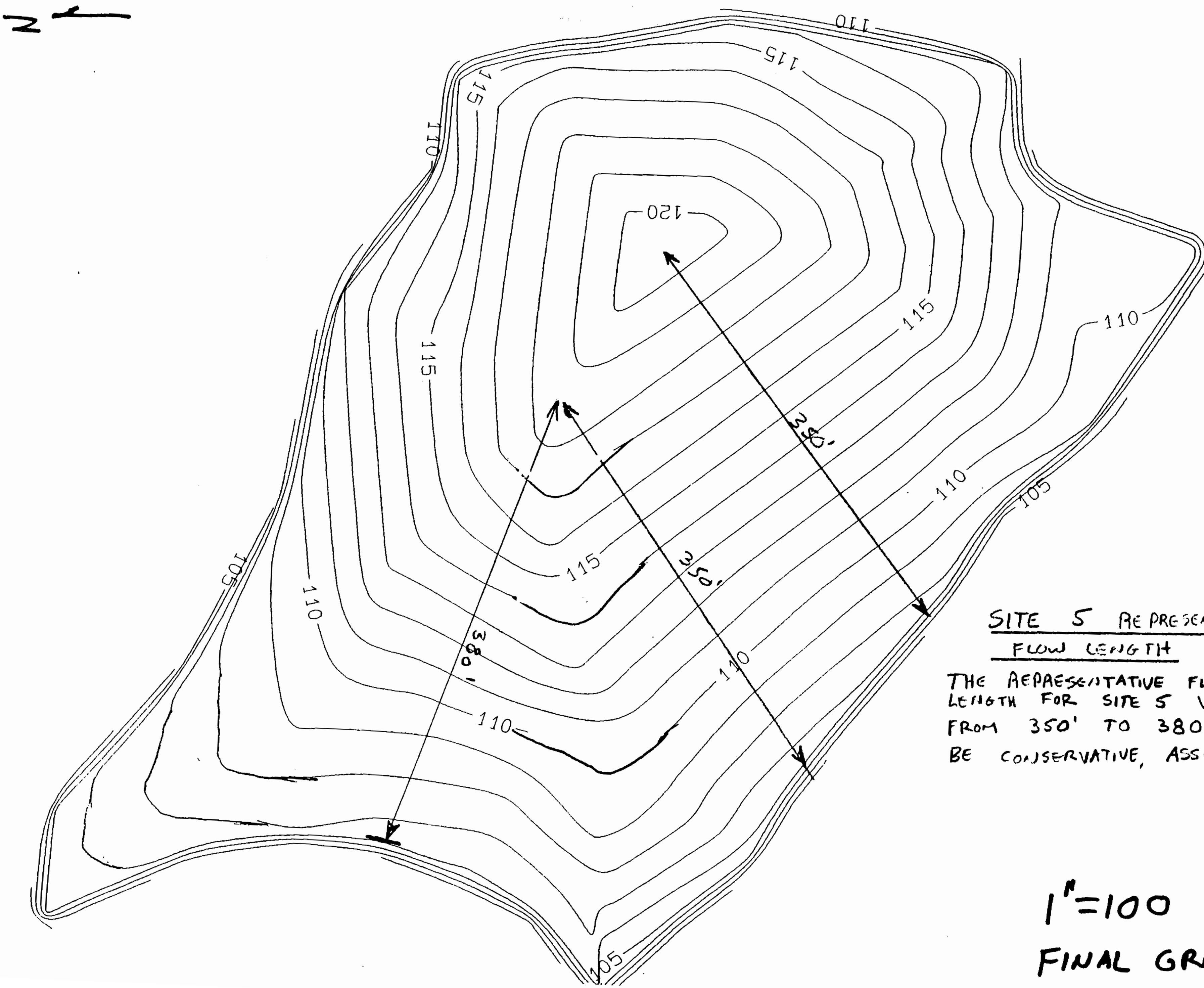
SITE 4
FINAL GRADE
1" = 100'



<u>REPRESENTATIVE FLOW LENGTHS USED IN HELP MODEL, SITE 4</u>

(DRAINAGE LAYER OUTLETS TO BENCH SO USE 60' AS MAXIMUM SLOPE LENGTH FOR THE STEEP SECTION)

THE LONG GRADE FLOWING FROM THE HIGH POINT TO SOUTH WOULD BE SIMILIAR TO SITE 5 (3.5% GRADE), HOWEVER THIS FLOW LENGTH IS SHORTER THAN THE FLOW LENGTHS AT SITE 5. SITE 5 IS CRITICAL FOR THE FLAT PORTION, SO USE SITE 5 RESU TO DETERMINE IF A CRITICAL CONDITIO FOR FLAT PORTIONS AT SITE



SITE 5 REPRESENTATIVE FLOW LENGTH

THE REPRESENTATIVE FLOW LENGTH FOR SITE 5 VARIES FROM 350' TO 380'. TO BE CONSERVATIVE, ASSUME 400.'

1" = 100

FINAL GRADE

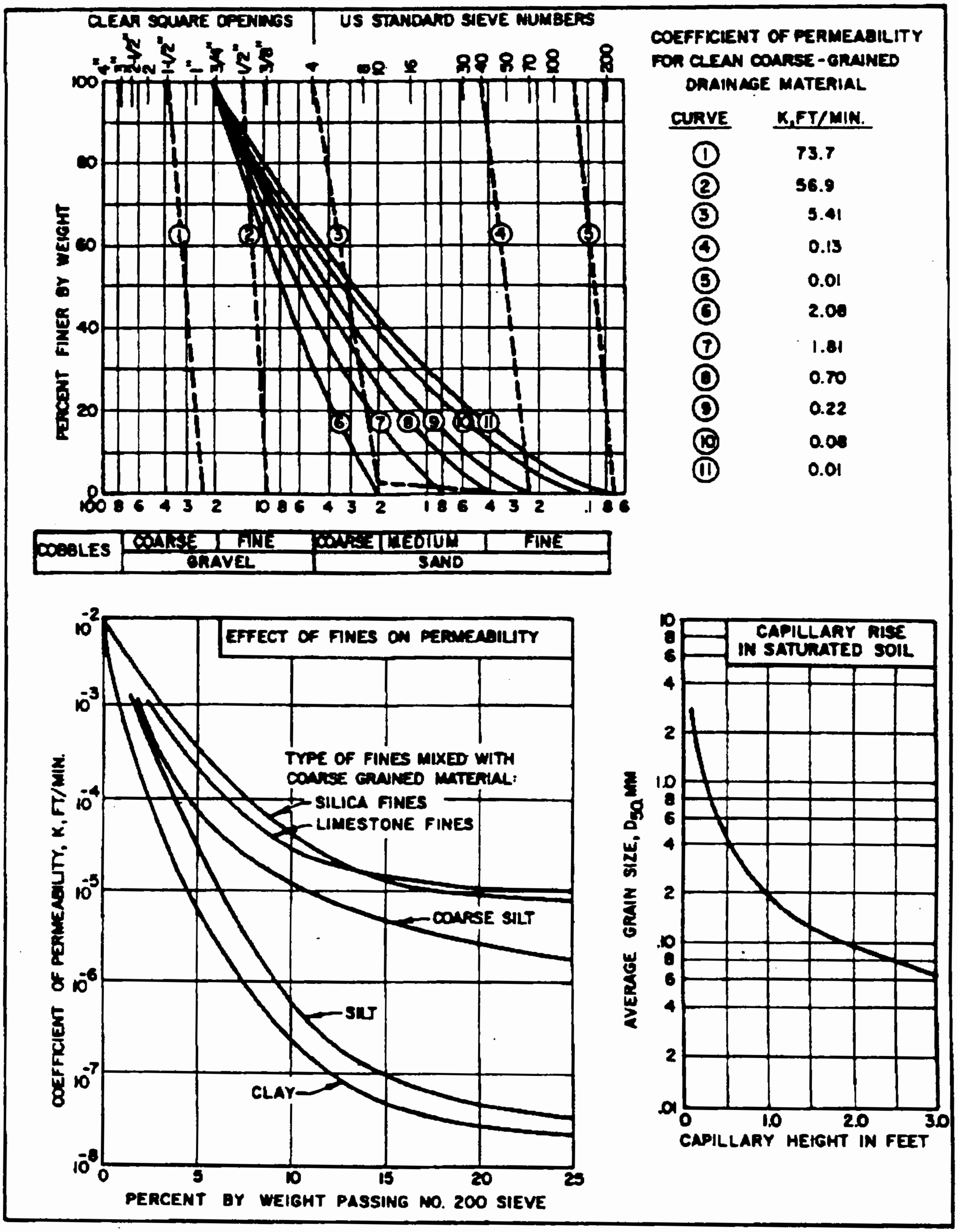


FIGURE 6
Permeability and Capillarity of Drainage Materials

```
******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**             HELP MODEL VERSION 3.03  (31 DECEMBER 1994)                  **
**              DEVELOPED BY ENVIRONMENTAL LABORATORY                       **
**                USAE WATERWAYS EXPERIMENT STATION                         **
**           FOR USEPA RISK REDUCTION ENGINEERING LABORATORY                **
**                                                                          **
**                                                                          **
******************************************************************************
******************************************************************************


PRECIPITATION DATA FILE:     C:\HELP3\earl2.D4
TEMPERATURE DATA FILE:       C:\HELP3\earle.D7
SOLAR RADIATION DATA FILE:   C:\HELP3\earle.D13
EVAPOTRANSPIRATION DATA:     C:\HELP3\earle.D11
SOIL AND DESIGN DATA FILE:   C:\HELP3\EARL51.D10
OUTPUT DATA FILE:            C:\HELP3\earl5_24.OUT
```

J'd INPUT MOS 10/28/97

```
TIME:  14:19     DATE:  10/22/1997


******************************************************************************

     TITLE:  NWS EARLE SITE 5

******************************************************************************


     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                LAYER  1
                                --------

                  TYPE 1 - VERTICAL PERCOLATION LAYER
                      MATERIAL TEXTURE NUMBER   7
          THICKNESS                  =       6.00    INCHES
          POROSITY                   =       0.4730 VOL/VOL
          FIELD CAPACITY             =       0.2220 VOL/VOL
          WILTING POINT              =       0.1040 VOL/VOL
          INITIAL SOIL WATER CONTENT =       0.1791 VOL/VOL
          EFFECTIVE SAT. HYD. COND.  =   0.520000001000E-03 CM/SEC
        NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  4.63
                FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.


                                LAYER  2
                                --------

                  TYPE 1 - VERTICAL PERCOLATION LAYER
                      MATERIAL TEXTURE NUMBER   7
          THICKNESS                  =      12.00    INCHES
          POROSITY                   =       0.4730 VOL/VOL
          FIELD CAPACITY             =       0.2220 VOL/VOL
          WILTING POINT              =       0.1040 VOL/VOL
          INITIAL SOIL WATER CONTENT =       0.2431 VOL/VOL
```

EFFECTIVE SAT. HYD. COND. = 0.520000001000E-03 CM/SEC

LAYER 3

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	12.00	INCHES
POROSITY	=	0.3970	VOL/VOL
FIELD CAPACITY	=	0.0320	VOL/VOL
WILTING POINT	=	0.0130	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0471	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	1.00000000000	CM/SEC
SLOPE	=	3.50	PERCENT
DRAINAGE LENGTH	=	400.0	FEET

LAYER 4

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 36

THICKNESS	=	0.04	INCHES
POROSITY	=	0.0000	VOL/VOL
FIELD CAPACITY	=	0.0000	VOL/VOL
WILTING POINT	=	0.0000	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0000	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.399999993000E-12	CM/SEC
FML PINHOLE DENSITY	=	1.00	HOLES/ACRE
FML INSTALLATION DEFECTS	=	4.00	HOLES/ACRE
FML PLACEMENT QUALITY	=	3 - GOOD	

LAYER 5

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 1

THICKNESS	=	12.00	INCHES
POROSITY	=	0.4170	VOL/VOL
FIELD CAPACITY	=	0.0450	VOL/VOL
WILTING POINT	=	0.0180	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0555	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.999999978000E-02	CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE # 7 WITH A GOOD STAND OF GRASS, A SURFACE SLOPE OF 3.% AND A SLOPE LENGTH OF 500. FEET.

SCS RUNOFF CURVE NUMBER	=	66.30	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	8.000	ACRES
EVAPORATIVE ZONE DEPTH	=	20.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	4.208	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	9.308	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	1.898	INCHES

INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	5.223	INCHES
TOTAL INITIAL WATER	=	5.223	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
EDISON NEW JERSEY

MAXIMUM LEAF AREA INDEX	= 3.50
START OF GROWING SEASON (JULIAN DATE)	= 109
END OF GROWING SEASON (JULIAN DATE)	= 299
AVERAGE ANNUAL WIND SPEED	= 10.20 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	= 64.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	= 61.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	= 66.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	= 68.00 %

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR NEWARK NEW JERSEY

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
3.13	3.05	4.15	3.57	3.59	2.94
3.85	4.30	3.66	3.09	3.59	3.42

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR EDISON NEW JERSEY

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
31.20	32.80	40.60	51.60	61.40	70.20
74.90	73.10	66.70	56.50	45.60	33.90

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR EDISON NEW JERSEY

STATION LATITUDE = 40.50 DEGREES

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 20

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	2.93	3.46	4.30	3.24	4.28	2.73
	3.80	4.46	3.64	2.31	3.11	3.74

STD. DEVIATIONS	1.32	1.40	2.19	1.87	2.36	1.34
	1.81	2.19	1.78	1.10	1.36	1.49

RUNOFF

TOTALS	0.851	1.144	1.129	0.045	0.001	0.000
	0.000	0.011	0.006	0.000	0.000	0.128
STD. DEVIATIONS	1.032	0.777	1.573	0.202	0.006	0.002
	0.001	0.049	0.025	0.000	0.000	0.330

EVAPOTRANSPIRATION

TOTALS	1.104	1.212	2.584	2.947	3.916	3.294
	3.371	3.129	3.167	2.153	1.121	0.882
STD. DEVIATIONS	0.215	0.249	0.325	0.731	1.442	1.413
	1.498	1.265	0.687	0.791	0.267	0.161

LATERAL DRAINAGE COLLECTED FROM LAYER 3

TOTALS	0.6167	0.6504	2.1101	1.3506	0.7312	0.1700
	0.0815	0.3480	0.6813	0.2714	0.6021	1.9840
STD. DEVIATIONS	0.6510	1.1925	1.2064	1.6998	0.8924	0.3412
	0.2330	0.6298	1.0471	0.3661	0.8581	1.4143

PERCOLATION/LEAKAGE THROUGH LAYER 4

TOTALS	0.0111	0.0092	0.0309	0.0229	0.0127	0.0030
	0.0014	0.0056	0.0108	0.0052	0.0096	0.0307
STD. DEVIATIONS	0.0103	0.0165	0.0154	0.0224	0.0141	0.0055
	0.0037	0.0090	0.0147	0.0070	0.0123	0.0194

PERCOLATION/LEAKAGE THROUGH LAYER 5

TOTALS	0.0120	0.0123	0.0079	0.0100	0.0155	0.0195
	0.0174	0.0133	0.0099	0.0124	0.0096	0.0052
STD. DEVIATIONS	0.0067	0.0053	0.0063	0.0078	0.0082	0.0075
	0.0062	0.0054	0.0041	0.0067	0.0053	0.0051

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ACROSS LAYER 4

AVERAGES	0.0404	0.0522	0.1428	0.0987	0.0476	0.0114
	0.0053	0.0227	0.0463	0.0177	0.0405	0.1293
STD. DEVIATIONS	0.0432	0.1007	0.0828	0.1433	0.0581	0.0230
	0.0152	0.0410	0.0716	0.0238	0.0577	0.0923

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 20

	INCHES		CU. FEET	PERCENT
PRECIPITATION	42.00	(6.841)	1219709.0	100.00
RUNOFF	3.317	(2.4002)	96323.56	7.897

EVAPOTRANSPIRATION	28.880	(3.1331)	838684.62	68.761
LATERAL DRAINAGE COLLECTED FROM LAYER 3	9.59736	(3.79797)	278707.469	22.85032
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.15314	(0.05150)	4447.193	0.36461
AVERAGE HEAD ACROSS TOP OF LAYER 4	0.055	(0.023)		
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.14482	(0.04711)	4205.694	0.34481
CHANGE IN WATER STORAGE	0.062	(0.8955)	1787.72	0.147

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 20

	(INCHES)	(CU. FT.)
PRECIPITATION	6.00	174240.000
RUNOFF	2.280	66219.2031
DRAINAGE COLLECTED FROM LAYER 3	1.66816	48443.32420
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.023282	676.09619
AVERAGE HEAD ACROSS LAYER 4	5.971	
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.001656	48.10110
SNOW WATER	3.89	112911.9370

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.3810

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.0793

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FINAL WATER STORAGE AT END OF YEAR 20

LAYER	(INCHES)	(VOL/VOL)
1	1.4770	0.2462
2	3.5170	0.2931
3	0.6281	0.0523
4	0.0000	0.0000
5	0.8324	0.0694
SNOW WATER	0.000	

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**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**               HELP MODEL VERSION 3.03  (31 DECEMBER 1994)                **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
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PRECIPITATION DATA FILE:     C:\HELP3\earl2.D4
TEMPERATURE DATA FILE:       C:\HELP3\earle.D7
SOLAR RADIATION DATA FILE:   C:\HELP3\earle.D13
EVAPOTRANSPIRATION DATA:     C:\HELP3\earle.D11
SOIL AND DESIGN DATA FILE:   C:\HELP3\earla.D10
OUTPUT DATA FILE:            C:\HELP3\erl4a24.OUT
```

J'd INPUT MEA 10/28/97

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TIME:  14:31      DATE:  10/22/1997


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     TITLE:  NWS EARLE SITE 4
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TOP

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     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
            COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                  LAYER  1
                                  --------

                 TYPE 1 - VERTICAL PERCOLATION LAYER
                      MATERIAL TEXTURE NUMBER   7
          THICKNESS                  =      6.00    INCHES
          POROSITY                   =      0.4730 VOL/VOL
          FIELD CAPACITY             =      0.2220 VOL/VOL
          WILTING POINT              =      0.1040 VOL/VOL
          INITIAL SOIL WATER CONTENT =      0.1791 VOL/VOL
          EFFECTIVE SAT. HYD. COND.  =  0.520000001000E-03 CM/SEC
        NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  4.63
               FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.


                                  LAYER  2
                                  --------

                 TYPE 1 - VERTICAL PERCOLATION LAYER
                      MATERIAL TEXTURE NUMBER   7
          THICKNESS                  =     12.00    INCHES
          POROSITY                   =      0.4730 VOL/VOL
          FIELD CAPACITY             =      0.2220 VOL/VOL
          WILTING POINT              =      0.1040 VOL/VOL
          INITIAL SOIL WATER CONTENT =      0.2431 VOL/VOL
```

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EFFECTIVE SAT. HYD. COND.    =  0.520000001000E-03 CM/SEC


                         LAYER  3
                         --------

            TYPE 2 - LATERAL DRAINAGE LAYER
              MATERIAL TEXTURE NUMBER   0
THICKNESS                    =      12.00    INCHES
POROSITY                     =       0.3970 VOL/VOL
FIELD CAPACITY               =       0.0320 VOL/VOL
WILTING POINT                =       0.0130 VOL/VOL
INITIAL SOIL WATER CONTENT   =       0.0454 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =   1.00000000000      CM/SEC
SLOPE                        =       3.50    PERCENT
DRAINAGE LENGTH              =     140.0     FEET


                         LAYER  4
                         --------

            TYPE 4 - FLEXIBLE MEMBRANE LINER
              MATERIAL TEXTURE NUMBER  36
THICKNESS                    =       0.04    INCHES
POROSITY                     =       0.0000 VOL/VOL
FIELD CAPACITY               =       0.0000 VOL/VOL
WILTING POINT                =       0.0000 VOL/VOL
INITIAL SOIL WATER CONTENT   =       0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.399999993000E-12 CM/SEC
FML PINHOLE DENSITY          =       1.00    HOLES/ACRE
FML INSTALLATION DEFECTS     =       4.00    HOLES/ACRE
FML PLACEMENT QUALITY        =  3 - GOOD


                         LAYER  5
                         --------

           TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER   1
THICKNESS                    =      12.00    INCHES
POROSITY                     =       0.4170 VOL/VOL
FIELD CAPACITY               =       0.0450 VOL/VOL
WILTING POINT                =       0.0180 VOL/VOL
INITIAL SOIL WATER CONTENT   =       0.0494 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.999999978000E-02 CM/SEC


          GENERAL DESIGN AND EVAPORATIVE ZONE DATA
          ----------------------------------------

NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
         SOIL DATA BASE USING SOIL TEXTURE # 7 WITH A
         GOOD STAND OF GRASS, A SURFACE SLOPE OF  3.%
         AND A SLOPE LENGTH OF  140. FEET.

SCS RUNOFF CURVE NUMBER            =      68.90
FRACTION OF AREA ALLOWING RUNOFF   =     100.0    PERCENT
AREA PROJECTED ON HORIZONTAL PLANE =       2.800  ACRES
EVAPORATIVE ZONE DEPTH             =      20.0    INCHES
INITIAL WATER IN EVAPORATIVE ZONE  =       4.208  INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE =       9.308  INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE =       1.898  INCHES
```

INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	5.130	INCHES
TOTAL INITIAL WATER	=	5.130	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
EDISON NEW JERSEY

MAXIMUM LEAF AREA INDEX	= 3.50
START OF GROWING SEASON (JULIAN DATE)	= 109
END OF GROWING SEASON (JULIAN DATE)	= 299
AVERAGE ANNUAL WIND SPEED	= 10.20 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	= 64.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	= 61.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	= 66.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	= 68.00 %

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR NEWARK NEW JERSEY

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
3.13	3.05	4.15	3.57	3.59	2.94
3.85	4.30	3.66	3.09	3.59	3.42

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR EDISON NEW JERSEY

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
31.20	32.80	40.60	51.60	61.40	70.20
74.90	73.10	66.70	56.50	45.60	33.90

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR EDISON NEW JERSEY

STATION LATITUDE = 40.50 DEGREES

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 20

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	2.93	3.46	4.30	3.24	4.28	2.73
	3.80	4.46	3.64	2.31	3.11	3.74

STD. DEVIATIONS	1.32	1.40	2.19	1.87	2.36	1.34
	1.81	2.19	1.78	1.10	1.36	1.49

RUNOFF

TOTALS	0.851	1.146	1.132	0.056	0.004	0.002
	0.001	0.018	0.012	0.000	0.000	0.129
STD. DEVIATIONS	1.032	0.774	1.574	0.249	0.014	0.007
	0.005	0.071	0.042	0.000	0.001	0.332

EVAPOTRANSPIRATION

TOTALS	1.104	1.212	2.584	2.947	3.916	3.293
	3.372	3.128	3.167	2.153	1.121	0.882
STD. DEVIATIONS	0.215	0.249	0.325	0.731	1.442	1.411
	1.499	1.266	0.687	0.791	0.267	0.161

LATERAL DRAINAGE COLLECTED FROM LAYER 3

TOTALS	0.6032	0.6647	2.1348	1.3416	0.7371	0.1604
	0.0840	0.3542	0.6763	0.2658	0.6288	1.9989
STD. DEVIATIONS	0.6592	1.2002	1.2258	1.6689	0.9012	0.3262
	0.2306	0.6538	1.0215	0.3620	0.8771	1.4193

PERCOLATION/LEAKAGE THROUGH LAYER 4

TOTALS	0.0048	0.0043	0.0143	0.0099	0.0055	0.0012
	0.0006	0.0025	0.0048	0.0022	0.0045	0.0136
STD. DEVIATIONS	0.0047	0.0077	0.0074	0.0099	0.0063	0.0023
	0.0015	0.0042	0.0066	0.0030	0.0057	0.0087

PERCOLATION/LEAKAGE THROUGH LAYER 5

TOTALS	0.0050	0.0051	0.0031	0.0035	0.0056	0.0074
	0.0072	0.0060	0.0048	0.0057	0.0046	0.0025
STD. DEVIATIONS	0.0029	0.0024	0.0022	0.0022	0.0033	0.0028
	0.0023	0.0023	0.0022	0.0025	0.0021	0.0023

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ACROSS LAYER 4

AVERAGES	0.0145	0.0219	0.0580	0.0357	0.0171	0.0038
	0.0019	0.0087	0.0173	0.0061	0.0157	0.0462
STD. DEVIATIONS	0.0170	0.0418	0.0367	0.0544	0.0214	0.0077
	0.0053	0.0166	0.0279	0.0082	0.0233	0.0333

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 20

	INCHES		CU. FEET	PERCENT
PRECIPITATION	42.00	(6.841)	426898.2	100.00
RUNOFF	3.351	(2.3966)	34054.89	7.977

EVAPOTRANSPIRATION	28.879 (3.1318)		293530.78	68.759
LATERAL DRAINAGE COLLECTED FROM LAYER 3	9.64987 (3.78612)		98081.234	22.97532
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.06805 (0.02328)		691.650	0.16202
AVERAGE HEAD ACROSS TOP OF LAYER 4	0.021 (0.009)			
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.06046 (0.01994)		614.552	0.14396
CHANGE IN WATER STORAGE	0.061 (0.8887)		616.67	0.144

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 20

	(INCHES)	(CU. FT.)
PRECIPITATION	6.00	60984.000
RUNOFF	2.280	23176.7129
DRAINAGE COLLECTED FROM LAYER 3	2.59436	26369.09570
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.015704	159.61461
AVERAGE HEAD ACROSS LAYER 4	3.674	
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.000503	5.11752
SNOW WATER	3.89	39519.1797

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.3725
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0793

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FINAL WATER STORAGE AT END OF YEAR 20

LAYER	(INCHES)	(VOL/VOL)
1	1.4770	0.2462
2	3.5170	0.2931
3	0.6049	0.0504
4	0.0000	0.0000
5	0.7449	0.0621
SNOW WATER	0.000	

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**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**               HELP MODEL VERSION 3.03  (31 DECEMBER 1994)                **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
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PRECIPITATION DATA FILE:     C:\HELP3\earl2.D4
TEMPERATURE DATA FILE:       C:\HELP3\earle.D7
SOLAR RADIATION DATA FILE:   C:\HELP3\earle.D13
EVAPOTRANSPIRATION DATA:     C:\HELP3\earle.D11
SOIL AND DESIGN DATA FILE:   C:\HELP3\earl4b2.D10
OUTPUT DATA FILE:            C:\HELP3\erl4b24.OUT


TIME:  14:39     DATE:  10/22/1997


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     TITLE:  NWS EARLE SITE 4        SIDE     SLOPE

******************************************************************************


     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                LAYER  1
                                --------

                   TYPE 1 - VERTICAL PERCOLATION LAYER
                       MATERIAL TEXTURE NUMBER   7
          THICKNESS                   =       6.00    INCHES
          POROSITY                    =       0.4730 VOL/VOL
          FIELD CAPACITY              =       0.2220 VOL/VOL
          WILTING POINT               =       0.1040 VOL/VOL
          INITIAL SOIL WATER CONTENT  =       0.1779 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.520000001000E-03 CM/SEC
        NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  4.63
                 FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.


                                LAYER  2
                                --------

                   TYPE 1 - VERTICAL PERCOLATION LAYER
                       MATERIAL TEXTURE NUMBER   7
          THICKNESS                   =      12.00    INCHES
          POROSITY                    =       0.4730 VOL/VOL
          FIELD CAPACITY              =       0.2220 VOL/VOL
          WILTING POINT               =       0.1040 VOL/VOL
          INITIAL SOIL WATER CONTENT  =       0.2428 VOL/VOL
```

EFFECTIVE SAT. HYD. COND. = 0.520000001000E-03 CM/SEC

LAYER 3

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	12.00 INCHES
POROSITY	=	0.3970 VOL/VOL
FIELD CAPACITY	=	0.0320 VOL/VOL
WILTING POINT	=	0.0130 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0453 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	1.00000000000 CM/SEC
SLOPE	=	25.00 PERCENT
DRAINAGE LENGTH	=	60.0 FEET
SUBSURFACE INFLOW	=	9.60 INCHES/YR

LAYER 4

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 36

THICKNESS	=	0.04 INCHES
POROSITY	=	0.0000 VOL/VOL
FIELD CAPACITY	=	0.0000 VOL/VOL
WILTING POINT	=	0.0000 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.399999993000E-12 CM/SEC
FML PINHOLE DENSITY	=	1.00 HOLES/ACRE
FML INSTALLATION DEFECTS	=	4.00 HOLES/ACRE
FML PLACEMENT QUALITY	=	3 - GOOD

LAYER 5

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 1

THICKNESS	=	12.00 INCHES
POROSITY	=	0.4170 VOL/VOL
FIELD CAPACITY	=	0.0450 VOL/VOL
WILTING POINT	=	0.0180 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0459 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.999999978000E-02 CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE # 7 WITH A GOOD STAND OF GRASS, A SURFACE SLOPE OF 25.% AND A SLOPE LENGTH OF 60. FEET.

SCS RUNOFF CURVE NUMBER	=	72.40
FRACTION OF AREA ALLOWING RUNOFF	=	100.0 PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	2.800 ACRES
EVAPORATIVE ZONE DEPTH	=	20.0 INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	4.198 INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	9.308 INCHES

LOWER LIMIT OF EVAPORATIVE STORAGE	=	1.898	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	5.076	INCHES
TOTAL INITIAL WATER	=	5.076	INCHES
TOTAL SUBSURFACE INFLOW	=	9.60	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
EDISON NEW JERSEY

MAXIMUM LEAF AREA INDEX	= 3.50
START OF GROWING SEASON (JULIAN DATE)	= 109
END OF GROWING SEASON (JULIAN DATE)	= 299
AVERAGE ANNUAL WIND SPEED	= 10.20 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	= 64.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	= 61.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	= 66.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	= 68.00 %

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR NEWARK NEW JERSEY

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
3.13	3.05	4.15	3.57	3.59	2.94
3.85	4.30	3.66	3.09	3.59	3.42

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR EDISON NEW JERSEY

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
31.20	32.80	40.60	51.60	61.40	70.20
74.90	73.10	66.70	56.50	45.60	33.90

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR EDISON NEW JERSEY

STATION LATITUDE = 40.50 DEGREES

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 20

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	2.93	3.46	4.30	3.24	4.28	2.73
	3.80	4.46	3.64	2.31	3.11	3.74

STD. DEVIATIONS	1.32	1.40	2.19	1.87	2.36	1.34
	1.81	2.19	1.78	1.10	1.36	1.49

RUNOFF

TOTALS	0.842	1.141	1.136	0.072	0.011	0.005
	0.004	0.032	0.026	0.000	0.003	0.131
STD. DEVIATIONS	1.025	0.764	1.585	0.322	0.032	0.021
	0.016	0.108	0.075	0.000	0.010	0.337

EVAPOTRANSPIRATION

TOTALS	1.155	1.250	2.649	2.947	3.994	3.422
	3.499	3.236	3.242	2.237	1.224	0.943
STD. DEVIATIONS	0.194	0.261	0.298	0.779	1.424	1.407
	1.504	1.256	0.673	0.758	0.236	0.125

SUBSURFACE INFLOW INTO LAYER 3

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

LATERAL DRAINAGE COLLECTED FROM LAYER 3

TOTALS	1.3301	1.3143	3.0374	2.0618	1.4722	0.8274
	0.7724	1.0493	1.3879	0.9783	1.3495	2.7631
STD. DEVIATIONS	0.6969	1.2325	1.2641	1.5763	0.9429	0.3409
	0.2372	0.6668	1.0316	0.4035	0.9123	1.4297

PERCOLATION/LEAKAGE THROUGH LAYER 4

TOTALS	0.0009	0.0008	0.0015	0.0012	0.0009	0.0006
	0.0006	0.0007	0.0009	0.0007	0.0008	0.0015
STD. DEVIATIONS	0.0003	0.0004	0.0005	0.0005	0.0004	0.0002
	0.0001	0.0003	0.0004	0.0002	0.0004	0.0006

PERCOLATION/LEAKAGE THROUGH LAYER 5

TOTALS	0.0006	0.0006	0.0004	0.0005	0.0006	0.0008
	0.0008	0.0007	0.0006	0.0007	0.0006	0.0004
STD. DEVIATIONS	0.0003	0.0004	0.0003	0.0003	0.0004	0.0003
	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ACROSS LAYER 4

AVERAGES	0.0074	0.0083	0.0177	0.0122	0.0082	0.0047
	0.0043	0.0060	0.0078	0.0054	0.0078	0.0158
STD. DEVIATIONS	0.0040	0.0081	0.0071	0.0094	0.0052	0.0019
	0.0013	0.0040	0.0056	0.0022	0.0051	0.0081

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 20

	INCHES		CU. FEET	PERCENT
PRECIPITATION	42.00	(6.841)	426898.2	100.00
RUNOFF	3.404	(2.4013)	34595.01	8.104
EVAPOTRANSPIRATION	29.796	(3.1993)	302848.50	70.942
SUBSURFACE INFLOW INTO LAYER 3	0.00000		0.000	0.00000
LATERAL DRAINAGE COLLECTED FROM LAYER 3	18.34362	(3.74254)	186444.594	43.67426
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.01093	(0.00146)	111.127	0.02603
AVERAGE HEAD ACROSS TOP OF LAYER 4	0.009	(0.002)		
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.00751	(0.00337)	76.282	0.01787
CHANGE IN WATER STORAGE	0.056	(0.8892)	573.06	0.134

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 20

	(INCHES)	(CU. FT.)
PRECIPITATION	6.00	60984.000
RUNOFF	2.287	23245.0020
DRAINAGE COLLECTED FROM LAYER 3	2.22173	22581.67190
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.000552	5.61136
AVERAGE HEAD ACROSS LAYER 4	0.494	
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.000038	0.39108
SNOW WATER	3.89	39519.1797
MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.3723	
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0794	

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FINAL WATER STORAGE AT END OF YEAR 20

LAYER	(INCHES)	(VOL/VOL)
1	1.4753	0.2459
2	3.5157	0.2930

3	0.5932	0.0494
4	0.0000	0.0000
5	0.6191	0.0516
SNOW WATER	0.000	

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CLIENT NAVY, NWS EARLE		JOB NUMBER 7602-0201	
SUBJECT INFINITE SLOPE STABILITY			
BASED ON		DRAWING NUMBER	
BY DCW	CHECKED BY MOA 10/30/97	APPROVED BY	DATE 10/30/97

OBJECTIVE

The objective of this calculation is to determine the factor of safety against sliding of cap components for the proposed cap configuration for the Landfills at Sites 4 and 5 at the Naval Weapons Station Earle in Colts Neck, New Jersey.

APPROACH

The proposed cap configuration at Site 4 includes a steep portion of the cap (4:1 maximum slope) and the top, plateau portion (3.5-5% slope). The cap configuration of Site 5 will be similar except in the Trap/Skeet range area where the vegetative layers will be replaced with the asphalt paving structure. No steep (4:1 slopes) are present at Site 5. The maximum slopes at Site 5 are 3.5 to 5 %. The cap configuration at Site 4 substitutes a textured geomembrane for the smooth geomembrane on the 4:1 side slopes. Figure 1 presents the cap configurations.

An infinite slope type analysis was performed to determine the factor of safety (Ref 1, and 6) of cap components sliding over each other. The equations presented in these references were modified to allow for the analysis of a variable depth of saturation in the cap components.

INFINITE SLOPE EQUATIONS

A typical free body diagram used for an infinite slope analysis and definition of variables are shown in page 9. The Mohr Coulomb strength envelope is used to evaluate the soil parameters c, cohesion, and ϕ, friction angle. The stability analysis involves determination of shear stress along an assumed failure plane and comparing the stress with the shear strength of the soil and/or strength of component interfaces.

From ref # 6 page 242

$$FS = S/\tau$$

and

$$\tau = W \sin\beta \cos\beta$$

$$Weight = W = b\sum_{i=1}^{n}(\gamma_i * h_i)$$

Where n= the number of soil layers

The factor of safety given the shear strength of a material is then (the complete derivation is given on pages 9-11):

$$FS = Sb /(W \sin\beta \cos\beta)$$

The shear strength of the material or interface is given by:

$$S = c + \theta \tan\phi$$

The factor of safety can then be shown to be (the complete derivation is shown on pages 9-11):

$$FS = \frac{c}{W * \cos(\beta)\sin(\beta)} + \frac{W * \cos(\beta)\tan(\phi)}{W * \cos(\beta)\sin(\beta)} - \frac{\gamma_w * h_{sat} * \cos^2(\beta)\tan(\phi)}{W * \cos(\beta)\sin(\beta)}$$

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Simplifying

$$FS = \frac{c}{W * \cos(\beta) * \sin(\beta)} + \frac{\tan(\phi)}{\tan(\beta)} - \frac{\gamma_w * h_{sat} * \tan(\phi)}{W * \tan(\beta)}$$

ASSUMPTIONS

The following section describes the selection of the assumed soil strengths, interface friction angles, and the level of saturation in the cap configurations.

HEIGHT OF SATURATION IN CAP The height of saturation the cap was calculated in a separate calculation Ref (14) using the HELP model (Ref 15). The HELP model predicts the average peak daily head on the cap (average over the area of the cap). Assume that the maximum head is twice the average head (this assumes a zero head at the highest point in the cap and a uniform gradient in the cap).

Case	Average Peak daily head on the geomembrane (in), ref 14	Maximum Peak daily head on the geomembrane (in)
Site 5	5.97	11.94
Site 4 Plateau	3.67	7.34
Site 4 Side Slope	0.49	0.98

It is assumed that the materials under the geomembrane are unsaturated.

GRANULAR DRAINAGE MATERIAL The 12 inch thick drainage layer must meet the following gradation requirements based on the New Jersey Administrative Code:

$$D_2 > 0.1 \text{ inch } (2.54 \text{ mm})$$
$$D_{85} > 4\ D_{15}$$

Because of potential puncture of the geomembrane the maximum size of the drainage material will be limited to 1 inch (25.4 mm).

The granular drainage material in the cap system is assumed to be a poorly graded gravel based on the above gradation. A GP soil, as classified by the USCS, represents a poorly graded gravel with typical shear strength properties of 0 psf for cohesion and 37 degrees for effective stress friction angle (ref 2, see page 12). A dry unit weight of 120 pcf was judged to be representative for this material (ref 2). The saturated unit weight was calculated using an assumed void ratio of 0.50. Ref 16 gives a range of void ratio for sand and gravel to be between 0.85 and 0.14; the average of these numbers is approximately 0.50. The saturated unit weight was calculated to be 140.8 pcf. The value of 141 pcf was used in the stability analysis for saturated conditions. The saturated unit weight is calculated with the following equation from reference 12.

$$\gamma_{sat} = W_s/V + (e/(1+e))\gamma_{water}$$

Where:

γ_{sat} = saturated unit weight of soil
W_s = dry weight of the soil (pcf)
V = volume of soil (1ft^3)
e = void ratio
γ_{water} = unit weight of water (62.4 pcf)

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The material will be assumed to be moist above the saturated area with a moisture content of 12% (Ref 2, lists the optimum moisture content for this material as 11% and 14%). This equates to a moist unit weight of 134.4. a unit weight of 135 will be used in the calculations.

SELECT FILL MATERIAL/TOPSOIL The 6 inch layer of topsoil and select fill material are assumed to be similar to the native surface soils surrounding the Sites 4 and 5. From the boring logs of borings in the vicinity of Site 2 the surface soil is primarily silty sand (SM), and some poorly graded sands (SP) and clayey sand (SC). Based on reference 2, typical effective strength parameters for this type of soil (SM) are a cohesion of 420 psf and a friction angle of 34° . Also from ref. 2, a typical dry unit weight is 120 pcf. From Ref. 2 the optimum moisture content for this soil is between 16-11 %. Assume that the moisture content is 12% which results in a moist unit weight of 134.4 pcf. Use 135pcf in the calculations. From reference 3, a typical void ratio for this type of soil is 0.48. This equates to a saturated unit weight of 140 pcf.

GAS MANAGEMENT LAYER/BEDDING LAYER The gas management /bedding layer in the cap system is assumed to be a poorly graded sand to provide adequate gas flow. An SP soil, as classified by the USCS, represents a poorly graded clean sand, sand gravel mix with typical shear strength properties of 0 psf for cohesion and 37 degrees for effective stress friction angle (ref 2, see page 12). A dry unit weight of 110 pcf was judged to be representative for this material (ref 2). From Ref. 2 the optimum moisture content for this soil is between 21-12 %. Assume that the moisture content is 15% which results in a moist unit weight of 126.5 pcf. Use 127 pcf in the calculations. The saturated unit weight was calculated using a typical void ratio for this type of material (0.50, ref. 3, see page 13). The saturated unit weight was calculated to be 130.8 pcf. The value of 131 pcf was used in the stability analysis.

ASPHALT PAVEMENT A portion of the Site 5 landfill cap will be paved to facilitate the removal of debris generated from the skeet/trap shooting activities. The strength parameters of the asphalt paving will be conservatively assumed to be the same as the granular drainage material with a cohesion of 0 pcf and a friction angle of 37°. In reality the asphalt will have a high cohesion, and an assumption of no cohesion will be conservative from a stability standpoint. The unit weight of the compacted asphalt paving is assumed to have a bulk specific gravity of 2.344 and a maximum specific gravity of 2.438 based on a typical pavement design in reference 13. This corresponds to an approximate bulk unit weight of 146 pcf and a maximum unit weight of 152 pcf. A value of 150 pcf was assumed in the analysis.

BASE COURSE/SUBBASE The pavement base course will be an aggregate layer. Assume densities and strength properties similar to that of the granular drainage layer.

<u>INTERFACE FRICTION ANGLES</u> Interface friction angles were conservatively chosen from literature values. The normal stress on the cap materials (due to the weight of the soils) will be in the range of 100-400 psf (roughly corresponding soil depths of 1 to 3 feet). Interface friction angles were chosen with tests using similar normal stress ranges.

<u>Non-Woven Geotextile / Select Fill Material</u> The Select Fill Material will likely be a SM type soil (silty and sands respectively). Reference 5, page 15 (trevira tech note) lists interface strength properties for glacial till and non-woven geotextile as 37° and a cohesion of 32 psf. This same reference lists glacial till as CL-ML type of soil which are inorganic silty fine sands to sandy clays. The select fill material is between a sand material and the glacial till soil types. Assume that the interface friction angle for the non-woven to bedding soil is also between the friction angle for sand and glacial till material. The interface friction angle for the Select Fill Material would be between 25° (for mica schist sand, ref. 4, page 14) and 37°. Use the smallest friction angle in this range to be conservative, $\phi = 25°$.

<u>Non-Woven Geotextile/Granular Drainage Material</u> Assume the non-woven geotextile is needle-punched type similar to Trevira 01114. From reference 5, page, 15 the friction angle and cohesion for this material against Ottawa sand within a normal stress range of 100 to 250 psf are 27° and 68 psf respectively.

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Reference 4, table 5.7 (see page 14) gives friction angles between non-woven geotextile and Ottawa sand, concrete sand, and mica schist sand. Of these three, the lowest friction angle is 25° for mica schist sand. Assume a friction angle of 25° and neglect any cohesion to be conservative.

Granular Drainage Material/ Cushion Fabric This interface will be assumed to be have the same frictional charateristics as the non-woven geotextile/granular drainage material interface, since the cushion fabric is a non-woven geotextile.

Cushion Fabric/ Textured LDPE Interface friction data for textured LDPE is very limited. It is assumed that the friction characteristics of textured HDPE and VLDPE would be similar to the LDPE and can be used in choosing LDPE friction angles. The following table summarizes the friction angles and cohesion values reported in literature.

C (psf)	ϕ (degrees)	Normal stress Range (psf)	Peak or Residual Strength	Backing	Type of Materials (All membranes are textured)	Ref.
18	36	---	---	---	Tex HDPE /Trevira 1155	5
116	28	---	---	---	Friction flex/ NW Polyester Geotextile	11
133	33	----	---	----	Friction flex/ NW polypropylene geotextile	11
55	32	432-1296		----	NSC Friction Seal /NW geotextile	17

To be conservative use the lowest peak friction angle and neglect the cohesion. Use $\phi = 28°$ and $c = 0$ psf.

Textured LDPE / Gas Management/Bedding Layer The following table summarizes the friction angles and cohesion values reported in literature.

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C (psf)	ϕ (degrees)	Normal stress Range (psf)	Peak or Residual Strength	Backing	Type of Materials (All membranes are textured)	Ref.
0	25-45	---	---	---	Gundle HDT/ Sand	7
0	40.5	432	---	clamped to plywood	Rough HDPE / Sand	8
---	25	----	peak	----	TVLDPE/Ott. Sand (sat.)	9
---	21	-----	residual	----	TVLDPE/Ott. Sand (sat.)	9
---	39	432-1296	peak	----	NSC THDPE/Ottawa Sand	10
---	37	432-1296	residual	----	NSC THDPE/Ottawa Sand	10
---	26	244-3000	peak	----	NSC THDPE/Ottawa Sand	10
---	26	244-3000	residual	----	NSC THDPE/Ottawa Sand	10
---	29	244-3000	peak	----	NSC THDPE/Ottawa Sand	10
---	25	244-3000	residual	----	NSC THDPE/Ottawa Sand	10
---	27	244-3000	peak	----	NSC THDPE/Ottawa Sand	10
---	25	244-3000	residual	----	NSC THDPE/Ottawa Sand	10
---	30	---	---	---	FrictionFlex/Ottawa sand	11

To be conservative use the lowest peak friction angle and neglect the cohesion. Use $\phi = 25°$ and $c = 0$ psf.

Cushion Fabric/ Smooth LDPE Interface friction data for textured LDPE is very limited. It is assumed that the friction characteristics of textured HDPE and VLDPE would be similar to the LDPE and can be used in choosing LDPE friction angles. Reference 4 lists friction angles for two types of non-woven geotextiles with smooth HDPE liners. To be conservative pick the lowest friction angle which is for non-woven needle punched geotextiles with a friction angle of 8° .

Smooth LDPE / Gas Management/Bedding Layer Reference 4 lists friction angles for three types of sands versus a smooth HDPE geomembrane. To be conservative pick the lowest friction angle which is for mica schist sand, with a friction angle of 17° .

Roadway Stabilization Fabric/ Subbase/Select fill The interfaces between the select cover material (silty sand) and the subbase (course aggregate) are assumed to be similar to sand. The roadway stabilization fabric is assumed to be a woven geotextile similar to a monofilament type geotextile. Woven monofilament geotextiles actually produce larger friction angles than a slit film type as can be seen on the table from reference 4, page 14. To be conservative, a slit film type of woven geotextile will be assumed for this calculation. For a mica schist sand to a woven slit film geotextile, the values of $\phi = 23°$ and $c = 0$ psf (ref. 4) are assumed.

INFINITE SLOPE ANALYSIS Based on the cap configuration and the assumed soil properties discussed above, three possible critical interfaces were evaluated in the infinite slope stability analysis. The first analysis evaluated the interface between the textured LDPE and the Granular Drainage Material for the 4:1 side slopes. The degree of saturation was based on the HELP model calculation (approximately 0.1 foot).

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The saturation in the drainage layer will cause the development of pore pressure at this interface which will have the tendency to lower the factor of safely.

The second analysis evaluated the cushion fabric to smooth geomembrane interface on the flat (5% max) portions of the vegetated cap. The height of saturation again was based on the HELP model calculations and was assumed to be approximately 0.6 ft.

The third interface evaluated was the same as the same as the second case except the paved section of the cap was investigated.

The weight is calculated for the first case as follows:

$$W = (135*2.4)+(141*0.1) = 338 \text{ psf}$$

The factor of safety at the Textured LDPE/Granular Drainage Material interface is calculated by:

$$FS = \frac{0}{338 * \cos(14.03) * \sin(14.03)} + \frac{\tan(25)}{\tan(14.03)} - \frac{62.4 * 0.1 * \tan(25)}{338 * \tan(14.03)}$$

The factor of safety for this interface is 1.83

The factor of safety for the second case (cushion fabric/smooth LDPE interface, vegetated cap) is as follows:

$$W = (135*1.5)+(141*1.0) = 344 \text{ psf}$$

$$FS = \frac{0}{341 * \cos(2.86) * \sin(2.86)} + \frac{\tan(8)}{\tan(2.86)} - \frac{62.4 * 1.0 * \tan(8)}{344 * \tan(2.86)}$$

The factor of safety for this interface is 2.30

The factor of safety for the third case (cushion fabric/smooth LDPE interface, paved cap) is as follows:

$$W = (150*0.167)+(135*1.333)+ (141*1.0) = 346 \text{ psf}$$

$$FS = \frac{0}{344 * \cos(2.86) * \sin(2.86)} + \frac{\tan(8)}{\tan(2.86)} - \frac{62.4 * 1.0 * \tan(8)}{346 * \tan(2.86)}$$

The factor of safety for this interface is 2.30

CONCLUSIONS

The overall minimum factor of safety for the infinite slope stability of the cap components for both sites 4 and 5 is 1.8.

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REFERENCES

1) Das, Braja M., Principles of Geotechnical Engineering, PWS Engineering, Boston, Mass, 1994, p.525.
2) Design Manual-Soil Mechanics, Foundations and Earth Structures, NAVFAC DM-7, March 1971.
3) U.S. Bureau of Reclamation, Design of Small Dams, U.S. Government Printing Office, Revised Reprint 1977.
4) Koerner, R.M., Designing With Geosynthetics, Third Ed., Table 5.7, attached, Prentice Hall, Englewood Cliffs, New Jersey, 1994.
5) Wialliams, N.D., Gallup, Report of " Evaluation of Friction Coefficients Trevira 1114 and 1155 Geotextiles", Georgia Inst. of Technology, prepared for Hoechst Fiber Industries (Trevira), October 15, 1986. Trevira Tech Note 006 summarizes results and is attached.
6) Dunn, I.S., Anderson, L.R., and Kiefer, F. W., Fundamentals of Geotechnical Analysis, John Wiley & Sons, New York, 1980.
7) Gundle Lining Systems, verbal conversation between Steve Echart (Gundle) and K. Smay (HNUS) on February 20, 1995.
8) Koutsourais, M.M., Sprague, C.J., and Pucetas, P.C., "Interfacial Friction Study of Cap and Liner Components For Landfill Design", Proceeding of the 4th Geosynthetic Research Institute Seminar on Landfill Closures: Geosynthetics, Interface Friction and New Developments, Drexel University, Philadelphia, PA, December, 1990. (Table 1 attached)
9) Polyflex, Inc., Literature, attached.
10) National Seal Corporation, Printout of Friction Coefficient Data Base, attached.
11) SLT North America, Inc. Application Data, 09-93/SLT, attached.
12) Lindeburg, Civil Engineering Reference Manual, Professional Publications, Belmont CA., 1992.
13) The Asphalt Institute, Manual Series No.2 (MS-2), Mix Design Methods for Asphalt Concrete, May 1984, p. 72.
14) Calculation by Brown & Root Environmental, Job Number 7602, by DCW "HELP model Calculations for NWS Earle." 10/30/97.
15) Schroeder, P.R., et al., "The Hydrologic Evaluation of Landfill Performance (HELP) Model: Users guide for Version 3," EPA/600/R-94/168a, U.S. EPA Risk Reduction Engineering Laboratory, Cincinnati OH, 1994.
16) Holtz, R.D., and Kavacs, W.D., *An Introduction to Geotechnical Engineering*, Prentice -Hall, Englewood Cliffs NJ, 1981.
17) National Seal Friction Seal literature, attached.

CALCULATION WORKSHEET Order No. 19116 (01-91)

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SUBJECT			
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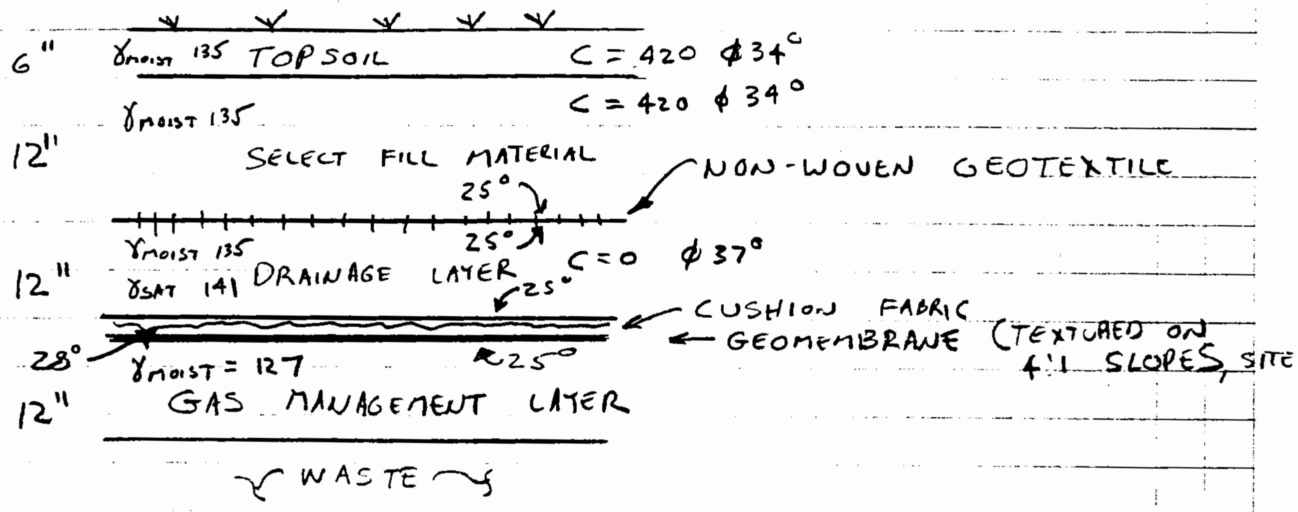
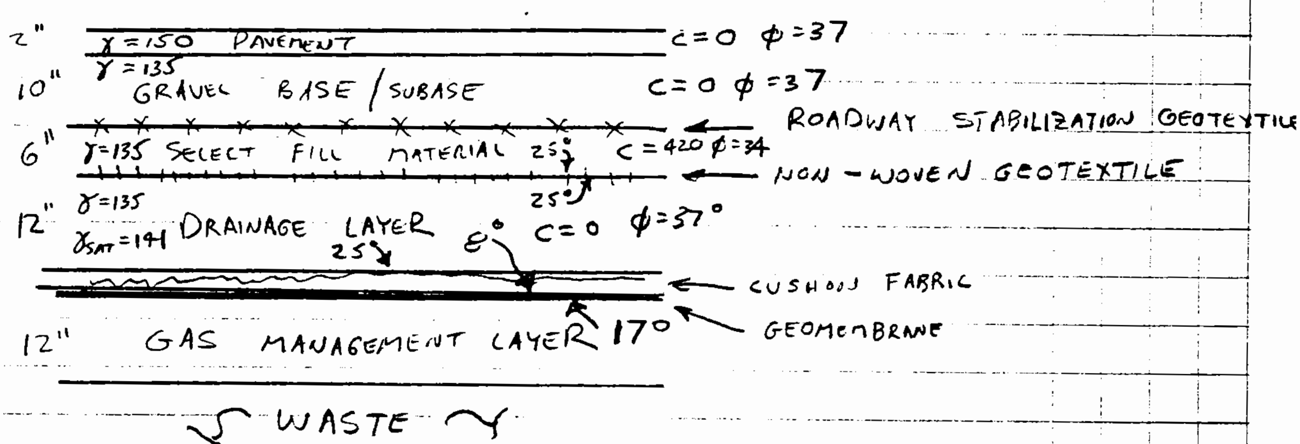


VEGETATED PORTION OF CAP

4:1 SLOPE MAY
3.5% MINIMUM

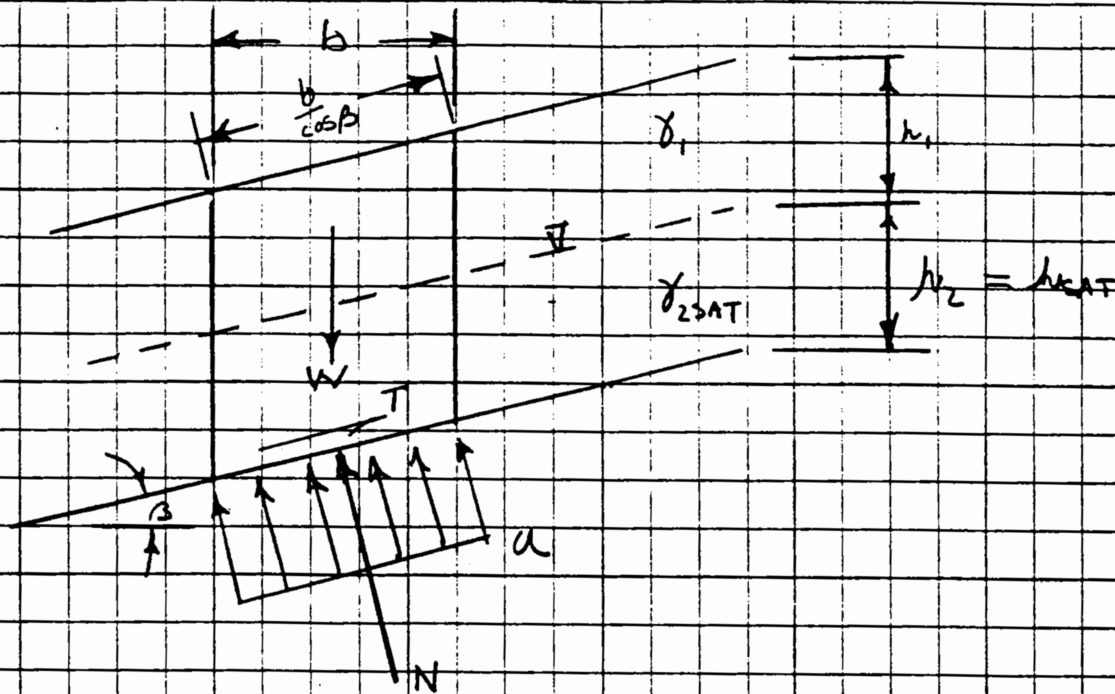


PAVED PORTION OF CAP

ASSUME 5%

FIGURE 1

CLIENT	JOB NUMBER		
SUBJECT			
BASED ON	DRAWING NUMBER		
BY	CHECKED BY	APPROVED BY	DATE



FS = FACTOR OF SAFETY

$$= \frac{S}{\tau}$$

S = SHEAR STRENGTH (PSF)
τ = SHEAR STRESS (PSF)

$$\tau = \frac{T}{\frac{b}{\cos\beta}}$$

T = FORCE = W SIN β
b = WIDTH OF BLOCK = 1 FOOT

$$W = \text{WEIGHT OF BLOCK} = \sum_{i=1}^{n} (\gamma_i h_i)\, b$$

$$= (\gamma_1 h_1 + \gamma_{2SAT} h_2)$$

CLIENT | JOB NUMBER

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$$\tau = \frac{W \sin\beta}{\frac{b}{\cos\beta}}$$

$$\tau = W \sin\beta \cos\beta / b$$

$$FS = \frac{S\,b}{W \sin\beta \cos\beta}$$

$$S = \bar{c} + \bar{\sigma} \tan\phi$$

$\bar{c}$ = EFFECTIVE COHESION
$\bar{\sigma}$ = EFFECTIVE NORMAL STRESS
ϕ = FRICTION ANGLE

$$\bar{\sigma} = \frac{\bar{N}}{\frac{b}{\cos\beta}}$$

$\bar{N}$ = EFFECTIVE NORMAL FORCE

$$\bar{N} = N - U$$

N = NORMAL FORCE = $W \cos\beta$
U = FORCE OF WATER = $\dfrac{u\,b}{\cos\beta}$

u = PORE PRESSURE $\gamma_w h_2 \cos^2\beta$
γ_w = UNIT WIEGHT OF WATER

$$\bar{N} = W \cos\beta - \left[\gamma_w h_2 \cos^2\beta \, b / \cos\beta\right]$$

CLIENT | JOB NUMBER

SUBJECT

BASED ON | DRAWING NUMBER

BY | CHECKED BY | APPROVED BY | DATE

$$\bar{\sigma} = \left[W - \gamma_w h_2 \cos\beta b\right] \frac{\cos\beta}{b}$$

$$S = \bar{c} + \left[W - \gamma_w h_2 \cos\beta b\right] \frac{\cos\beta}{b} \tan\phi$$

$$FS = \frac{\bar{c} + \left[W - \gamma_w h_2 \cos\beta b\right] \frac{\cos\beta}{b} \tan\phi}{W \sin\beta \cos\beta / b}$$

$$= \frac{\bar{c} b + W \cos^2\beta \tan\phi - \gamma_w h_2 \cos^2\beta \tan\phi b}{W \sin\beta \cos\beta}$$

$$= \frac{\bar{c} b}{W \sin\beta \cos\beta} + \frac{\tan\phi}{\tan\beta} - \frac{\gamma_w h_2 \tan\phi b}{W \tan\beta}$$

ASSUME $b = 1$

$$\boxed{FS = \frac{\bar{c}}{W \sin\beta \cos\beta} + \frac{\tan\phi}{\tan\beta} - \frac{\gamma_w h_2 \tan\phi}{W \tan\beta}}$$

EQUATION USED TO CALCULATE INFINITE SLOPE FS GIVE $\bar{c}$ AND ϕ OF INTERFACE AND A SATURATED THICKNESS.

TABLE 1
Typical Properties of Compacted Soils

Group Symbol	Soil Type	Range of Maximum Dry Unit Weight, pcf	Range of Optimum Moisture, Percent	Typical Value of Compression: At 1.4 tsf (20 psi) (Percent of Original Height)	Typical Value of Compression: At 3.6 tsf (50 psi) (Percent of Original Height)	Typical Strength Characteristics: Cohesion (as compacted) psf	Typical Strength Characteristics: Cohesion (saturated) psf	Typical Strength Characteristics: ϕ (Effective Stress Envelope Degrees)	Typical Strength Characteristics: Tan ϕ	Typical Coefficient of Permeability ft./min.	Range of CBR Values	Range of Subgrade Modulus k lbs/cu in.
GW	Well graded clean gravels, gravel-sand mixtures.	125 - 135	11 - 8	0.3	0.6	0	0	>38	>0.79	5×10^{-2}	40 - 80	300 - 500
GP	Poorly graded clean gravels, gravel-sand mix	115 - 125	14 - 11	0.4	0.9	0	0	>37	>0.74	10^{-1}	30 - 60	250 - 400
GM	Silty gravels, poorly graded gravel-sand-silt.	120 - 135	12 - 8	0.5	1.1	.....	.....	>34	>0.67	$>10^{-6}$	20 - 60	100 - 400
GC	Clayey gravels, poorly graded gravel-sand-clay.	115 - 130	14 - 9	0.7	1.6	.....	.....	>31	>0.60	$>10^{-7}$	20 - 40	100 - 300
SW	Well graded clean sands, gravelly sands.	110 - 130	16 - 9	0.6	1.2	0	0	38	0.79	$>10^{-3}$	20 - 40	200 - 300
SP	Poorly graded clean sands, sand-gravel mix.	100 - 120	21 - 12	0.8	1.4	0	0	37	0.74	$>10^{-3}$	10 - 40	200 - 300
SM	Silty sands, poorly graded sand-silt mix.	110 - 125	16 - 11	0.8	1.6	1050	420	34	0.67	$5 \times >10^{-5}$	10 - 40	100 - 300
SM-SC	Sand-silt clay mix with slightly plastic fines.	110 - 130	15 - 11	0.8	1.4	1050	300	33	0.66	$2 \times >10^{-6}$	5 - 30	100 - 300
SC	Clayey sands, poorly graded sand-clay-mix.	105 - 125	19 - 11	1.1	2.2	1550	230	31	0.60	$5 \times >10^{-7}$	5 - 20	100 - 300
ML	Inorganic silts and clayey silts.	95 - 120	24 - 12	0.9	1.7	1400	190	32	0.62	$>10^{-5}$	15 or less	100 - 200
ML-CL	Mixture of inorganic silt and clay.	100 - 120	22 - 12	1.0	2.2	1350	460	32	0.62	$5 \times >10^{-7}$	.....	
CL	Inorganic clays of low to medium plasticity.	95 - 120	24 - 12	1.3	2.5	1800	270	28	0.54	$>10^{-7}$	15 or less	50 - 200
OL	Organic silts and silt-clays, low plasticity.	80 - 100	33 - 21	.....	.....	.....	.....	.....	.....	.....	5 or less	50 - 100
MH	Inorganic clayey silts, elastic silts.	70 - 95	40 - 24	2.0	3.8	1500	420	25	0.47	$5 \times >10^{-7}$	10 or less	50 - 100
CH	Inorganic clays of high plasticity	75 - 105	36 - 19	2.6	3.9	2150	230	19	0.35	$>10^{-7}$	15 or less	50 - 150
OH	Organic clays and silty clays	65 - 100	45 - 21	.....	.....	.....	.....	.....	.....	.....	5 or less	25 - 100

Notes:

1. All properties are for condition of "Standard Proctor" maximum density, except values of k and CBR which are for "modified Proctor" maximum density.
2. Typical strength characteristics are for effective strength [illegible]
3. Compression values are for vertical loading with complete lateral confinement.

(>) indicates that typical property is greater than the value shown.
(..) indicates insufficient data available for an estimate.

REF 2

17

12 of 2

certainties that arise from sampling fluctuations, and they tend to vary from the true averages more widely if the number of observations is small. The plus or minus limits given are determined mathematically from the number of observations and from the standard deviation of the data used to determine the average. These limits imply that the true average, obtained by securing and testing more and more samples under the same essential conditions, lies within the plus or minus values 9 chances

r liquid limits than these will have inferioı engineering properties.

(b) *Permeability.*—The voids in the soil mass provide passages through which water may move. Such passages are variable in size and the paths of flow are tortuous and interconnected. If, however, a sufficiently large number of paths of flow are considered as acting together, an average rate of flow for the soil mass can be determined under controlled conditions that will represent a property of the

TABLE 8.—*Average properties of soils*

Soil classification group	Proctor compaction		Void ratio, e,	Permeability, k, feet per year	Compressibility		Shearing strength		
	Maximum dry density in pounds per cubic foot	Optimum water content, percent			@ 20 p.s.i., percent	@ 50 p.s.i., percent	C_o p.s.i.	C_{sat} p.s.i.	tan ϕ
GW	>119	<13.3	(*)	27,000±13,000	<1.4	(*)	(*)	(*)	>0.79
GP	>110	<12.4	(*)	64,000±34,000	<0.8	(*)	(*)	(*)	>0.74
GM	>114	<14.5	(*)	>0.3	<1.2	<3.0	(*)	(*)	>0.67
GC	>115	<14.7	(*)	>0.3	<1.2	<2.4	(*)	(*)	>0.60
SW	119±5	13.3±2.5	0.37±*	(*)	1.4±*	(*)	5.7±0.6	(*)	0.79±0.02
SP	110±2	12.4±1.0	0.50±0.03	>15.0	0.8±0.3	(*)	3.3±0.9	(*)	0.74±0.02
SM	114±1	14.5±0.4	0.48±0.02	7.5±4.8	1.2±0.1	3.0±0.4	7.4±0.9	2.9±1.0	0.67±0.02
SM-SC	119±1	12.8±0.5	0.41±0.02	0.8±0.6	1.4±0.3	2.9±1.0	7.3±3.1	2.1±0.8	0.66±0.07
SC	115±1	14.7±0.4	0.48±0.01	0.3±0.2	1.2±0.2	2.4±0.5	10.9±2.2	1.6±0.9	0.60±0.07
ML	103±1	19.2±0.7	0.63±0.02	0.59±0.23	1.5±0.2	2.6±0.3	9.7±1.5	1.3±*	0.62±0.04
ML-CL	109±2	16.8±0.7	0.54±0.03	0.13±0.07	1.0±0.2	2.2±0.0	9.2±2.4	3.2±*	0.62±0.06
CL	108±1	17.3±0.3	0.56±0.01	0.08±0.03	1.4±0.2	2.6±0.4	12.6±1.5	1.9±0.3	0.54±0.04
OL	(*)	(*)	(*)	(*)	(*)	(*)	(*)	(*)	(*)
MH	82±4	36.3±3.2	1.15±0.12	0.16±0.10	2.0±1.2	3.8±0.8	10.5±4.3	2.9±1.3	0.47±0.05
CH	94±2	25.5±1.2	0.80±0.04	0.05±0.05	2.6±1.3	3.9±1.5	14.9±4.9	1.6±0.86	0.35±0.09
OH	(*)	(*)	(*)	(*)	(*)	(*)	(*)	(*)	(*)

The ± entry indicates 90 percent confidence limits of the average value. * Denotes insufficient data, > is greater than, < is less than.

REFERENCE 3

REFERENCE 4

Table 5.7 Friction values and efficiencies (in parentheses) for (a) soil-to-geomembrane, (b) geomembrane-to-geotextile, and (c) soil-to-geotextile combinations*

(a) Soil-to-Geomembrane Friction Angles

	Soil Types		
Geomembrane	*Concrete Sand* ($\phi = 30°$)	*Ottawa Sand* ($\phi = 28°$)	*Micha Schist Sand* ($\phi = 26°$)
EPDM-R	24° (0.77)	20° (0.68)	24° (0.91)
PVC			
Rough	27° (0.88)	—	25° (0.96)
Smooth	25° (0.81)	—	21° (0.79)
CSPE-R	25° (0.81)	21° (0.72)	23° (0.87)
HDPE	18° (0.56)	18° (0.61)	17° (0.63)

(b) Geomembrane-to-Geotextile Friction Angles

	Geomembrane				
		PVC			
Geotextile	*EPDM-R*	*Rough*	*Smooth*	*CSPE-R*	*HDPE*
Nonwoven, needle punched	23°	23°	21°	15°	8°
Nonwoven, heat bonded	18°	20°	18°	21°	11°
Woven, monofilament	17°	11°	10°	9°	6°
Woven, slit film	21°	28°	24°	13°	10°

(c) Soil-to-Geotextile Friction Angles

	Soil Types		
Geotextile	*Concrete Sand* ($\phi = 30°$)	*Ottawa Sand* ($\phi = 28°$)	*Mica Schist Sand* ($\phi = 26°$)
Nonwoven, needle punched	30° (1.00)	26° (0.92)	25° (0.96)
Nonwoven, heat bonded	26° (0.84)	—	—
Woven, monofilament	26° (0.84)	—	—
Woven, slit film	24° (0.77)	24° (0.84)	23° (0.87)

*Efficiency values in parentheses are based on the relationship $E = (\tan \delta)/(\tan \phi)$.

Source: After Martin et al. [14].

The frictional behavior of geomembranes placed on clay soils is of considerable importance in the composite liners of waste landfills. ~~Current~~ requirements are for the clay to have a hydraulic conductivity equal to or less than 2×10^{-7} ft./min. (1×10^{-7} cm/sec.) and for the geomembrane to be placed directly on the clay. While an indication of the shear strength parameters has been investigated (e.g., reference 15), the data are so sensitive to the variables listed previously that site-specific and material-specific tests should always be performed. In such cases, literature values should never be used for final design purposes.

5.1.3.9 Geomembrane Anchorage In certain problem situations a geomembrane might be sandwiched between two materials and then tensioned by an external force. The termination of a geomembrane liner within an anchor trench is such a situation. To simulate this behavior in a laboratory environment, one can use an 8.0-in. (200-mm)-wide geomembrane sandwiched between back-to-back channels.

REFERENCE 5

15 of 2

TREVIRA SPUNBOND

TECH NOTE

006-90 (CJS)

Hoechst Celanese Corporation P.O. Box 5887 Spartanburg, SC 29304

SOIL/GEOSYNTHETIC INTERFACE FRICTION by DIRECT SHEAR

Test Procedure: The coefficient of friction between a geosynthetic and soil (see Table 1) or between any combination of geosynthetics selected by the user is determined by placing the geosynthetic and one or more contact surfaces within a 12" x 12" direct shear box. A constant, normal compressive stress is applied to the specimen and a tangential (shear) force is applied to the apparatus so that one section of the box moves in relation to the other section. The shear force is recorded as a function of the deflection of the moving section of the shear box. The test is performed for a minimum of three different, normal stresses selected by the user (100, 200, and 250 psf were used here) to model appropriate field conditions. The peak (or residual) shear stresses recorded are plotted against the applied, normal compressive stresses used for testing. The test data generally forms a straight line whose slope is the coefficient of friction, μ, between the two materials where the shearing occurred. The y-intercept of the plot is the adhesion, a. The equivalent friction angle, δ, is calculated as: $\delta = \tan(\mu)$.

Related Test: Interlock Friction by Pullout is a related test used primarily with geogrids. Generally, for geotextiles, the direct shear test provides more conservative (lower) results than the pullout test.

Results of Tests Performed by Georgia Institute of Technology

SLIDING SURFACE	μ	δ(deg.)	a(psf)
Ottowa Sand/TREVIRA®1114	0.51	27	68
Ottowa Sand/Trevira 1155	0.68	34	21
Glatial Till/Trevira 1114	0.76	37	32
Glatial Till/Trevira 1155	0.75	37	10
Gulf Coast Clay/Trevira 1114	0.96	43	62
Gulf Coast Clay/Trevira 1155	1.26	52	45
HDPE Geonet*/Trevira 1114	0.46	25	29
HDPE Geonet*/Trevira 1114	0.32	18	39
HDPE Geomembrane/Trevira 1155	0.17	10	0
Embossed HDPE Geomembrane/Trevira 1155	0.72	36	18
TREVIRA® 1155/Trevira 1155**	0.33	18	13
Typar 3401/Typar 3401**	0.19	11	- 44
Mirafi 600X/Mirafi 600X**	0.29	16	60

*Avg. of three different confining soils. **Glatial Till used as confining soil.

TABLE 1 -- PROPERTIES of CONFINING SOIL

CONFINING SOIL	USCS CLASSIFI-CATIONS	ATTERBURG LIMITS			COMPACTION CHAR.			SHEAR TEST RESULTS		
		LL	PL	PI	γ Max. (pcf)	W opt. (%)	D100	μ	δ(deg)	a(kPa)
Ottowa Sand	SP	-	-	NP	-	-	104	0.78	38	0
Glatial Till	CL-ML	15-33	15-20	0-13	138†	8†	-	0.73	36	31
Gulf Coast Clay	CL	42	28	14	115†	16††	-	0.38	20	57

† Modified Proctor ††Standard Proctor

Hoechst

TABLE 1
GEOSYNTHETIC VS. SAND INTERFACE FRICTION (EFFICIENCY)

INTERFACE WITH SAND	NORMAL STRESS (PSI)			
	3	5	7	9
SAND	45° (1.0)	35° (1.0)	33° (1.0)	32° (1.0)
NONWOVEN, NEEDLEPUNCHED	40° (0.88)	32.5° (0.92)	30.5° (0.92)	30° (0.93)
NONWOVEN, HEAT BONDED	37° (0.82)	32.5° (0.92)	32.4° (0.98)	32° (1.0)
MONOFILAMENT	31° (0.68)	29° (0.82)	28° (0.84)	28° (0.87)
MULTIFILAMENT	40° (0.88)	33.5° (0.95)	32° (0.96)	31.5° (0.98)
SLIT FILM	34° (0.75)	30.5° (0.87)	30° (0.90)	30° (0.93)
HDPE - SMOOTH	28° (0.62)	27° (0.77)	26° (0.78)	26° (0.81)
HDPE - ROUGH	40.5° (0.90)	33° (0.94)	31.5° (0.95)	30° (0.93)
CSPE	33° (0.73)	31° (0.88)	31° (0.93)	31° (0.96)
VLDPE	28° (0.62)	23° (0.65)	21.5° (0.65)	21.5° (0.67)
PVC	33° (0.73)	30° (0.85)	30° (0.90)	30° (0.93)
FLEXIBLE GRID	42° (0.93)	33° (0.94)	32° (0.96)	31.5° (0.98)

Note: Efficiency ($Eff = \delta/\phi$) values are indicated in parenthesis. Friction values ($\delta°$) were found from the equation $\tau_f = C_a + \sigma_n \tan\delta$ assuming $C_a = 0$ for cohesionless soils.

/

Polyfex Lit.
Ref 9

TABLE 2

Interface Direct Shear Test Results
Measured Peak Strengths

Test Number	Interface Tested	Coefficient of Friction	Interface Friction Angle	Adh((
1	Saturated Ottawa sand/60-mil Poly-Flex Textured VLDPE Geomembrane	0.47	25°	

NOTE: [1] The reported value of adhesion may not be the "true adhesion" of the inter caution should be exercised in using this adhesion value for applications i normal stresses outside the range of stresses covered by the test.

TABLE 3

Interface Direct Shear Test Results
Measured Residual Strengths

Test Number	Interface Tested	Coefficient of Friction	Interface Friction Angle	Adl
1	Saturated Ottawa sand/60-mil Poly-Flex Textured VLDPE Geomembrane	0.38	21°	

NOTE: [1] The reported value of adhesion may not be the "true adhesion" of the inte caution should be exercised in using this adhesion value for applications normal stresses outside the range of stresses covered by the test.

18 of 2
REF 1

Date Tested
11/25/87

Project Reference
R&D

Testing Laboratory
GRI

Geosynthetic Manufacturer
NSC

Upper Interface Material
OTTAWA SAND

Lower Interface Material
NSC TEX HDPE (KNOBS)

Test Normal Stresses (psi)
5.5, 10.9, 16.4

Test Speed (in/min)
0.005

Test Area in Plan (inches)
4X4

Existence of Report
Yes

Reported Peak Angle
27

Reported Residual Angle
0

D-Base Memo
Water Content = 0%

Date Tested
11/25/87

Project Reference
R&D

Testing Laboratory
GRI

Geosynthetic Manufacturer
NSC

Upper Interface Material
OTTAWA SAND

Lower Interface Material
NSC TEX HDPE (KNOBS)

Test Normal Stresses (psi)
5.5, 10.9, 16.4

Test Speed (in/min)
0.005

Test Area in Plan (inches)
4X4

Existence of Report
Yes

Reported Peak Angle
33

Reported Residual Angle
0

D-Base Memo
Water Content = 100 %

Date Tested
8/31/91

Project Reference
R&D

Testing Laboratory
GEOSYNTECH

Geosynthetic Manufacturer
NSC

Upper Interface Material
OTTAWA SAND

Lower Interface Material
NSC TEX HDPE (80)

Test Normal Stresses (psi)
3, 6, 9

Test Speed (in/min)
0.04

Test Area in Plan (inches)
12X12

Existence of Report
Yes

Reported Peak Angle
39

Reported Residual Angle
37

D-Base Memo
Tested under dry conditions.

Date Tested
11/15/92

Project Reference
R&D

Testing Laboratory
GEOSYNTECH

Geosynthetic Manufacturer
NSC

Upper Interface Material
OTTAWA SAND

Lower Interface Material
NSC TEX HDPE (60)

Test Normal Stresses (psi)
1.7, 6.9, 20.8

Test Speed (in/min)
0.04

Test Area in Plan (inches)
12X12

Existence of Report
Yes

Reported Peak Angle
26

Reported Residual Angle
26

ase Memo
ated under dry Conditions.

Date Tested
11/15/92

Project Reference
R&D

Testing Laboratory
GEOSYNTECH

Geosynthetic Manufacturer
NSC

Upper Interface Material
OTTAWA SAND

Lower Interface Material
NSC TEX HDPE (60)

Test Normal Stresses (psi)
1.7, 6.9, 20.8

Test Speed (in/min)
0.04

Test Area in Plan (inches)
6X6

Existence of Report
Yes

Reported Peak Angle
29

Reported Residual Angle
25

D-Base Memo
Tested under dry conditions.

Date Tested
11/15/92

Project Reference
R&D

Testing Laboratory
GEOSYNTECH

Geosynthetic Manufacturer
NSC

Upper Interface Material
OTTAWA SAND

Lower Interface Material
NSC TEX HDPE (60)

Test Normal Stresses (psi)
1.7, 6.9, 20.8

Test Speed (in/min)
0.04

Test Area in Plan (inches)
4X4

Existence of Report
Yes

Reported Peak Angle
27

Reported Residual Angle
25

Base Memo
ated under dry conditions.

Date Tested
11/15/92

Project Reference
R&D

Testing Laboratory
GEOSYNTECH

Geosynthetic Manufacturer
NSC

Upper Interface Material
OTTAWA SAND

Lower Interface Material
NSC TEX HDPE (60)

Test Normal Stresses (psi)
35, 70, 100

Test Speed (in/min)
0.04

Test Area in Plan (inches)
12X12

Existence of Report
Yes

Reported Peak Angle
27

Reported Residual Angle
26

D-Base Memo
Tested under dry conditions.

Date Tested
4/23/93

Project Reference
92777

Testing Laboratory
NSC

Geosynthetic Manufacturer
NSC

Upper Interface Material
OTTAWA SAND

Lower Interface Material
NSC TEX HDPE (60)

Test Normal Stresses (psi)
35, 70, 87

Date
8/16/93

Project I.D.
93164W

Testing Laboratory
NSC

Geosynthetic Manuf.
NSC

Top of Interface
BENTOFIX (ELEPHANT)

Bottom of Interface
NSC TEX HDPE (60)

Normal Stress (in psf)
3.5, 7, 14

Displacement Rate (inches/minute)
0.04

Existence of Report
Yes

Test Size in Plan
12X12

Peak Friction Angle
34

Residual Friction Angle
23

Memo for Database

Date
8/31/93

Project I.D.
SALES

Testing Laboratory
GEOSYNTECH

Geosynthetic Manuf.
NSC

Top of Interface
BENTOFIX (WOVEN)

Bottom of Interface
NSC SMOOTH HDPE (60)

Normal Stress (in psf)
1.5, 4, 10

Displacement Rate (inches/minute)
0.04

Existence of Report
Yes

Test Size in Plan
12X12

Peak Friction Angle
9

Residual Friction Angle
9

Memo for Database

CALCULATION WORKSHEET Order No. 19116 (01-91)

PAGE ____ OF ____

CLIENT NWS EARLE	JOB NUMBER 7602
SUBJECT STABILITY ANALYSES	
BASED ON	DRAWING NUMBER
BY T Allen CHECKED BY MEA 8/28/97	APPROVED BY DATE 8/25/97

STABILITY ANALYSES

SITE 4

NWS EARLE

CALCULATION WORKSHEET Order No. 19116 (01-91)

CLIENT NWS EARLE	JOB NUMBER 7602
SUBJECT STABILITY ANALYSES SITE 4	
BASED ON	DRAWING NUMBER
BY T Allen / CHECKED BY MEA	APPROVED BY / DATE 8/25/97

PURPOSE ASSESS LONG TERM STABILITY OF FINAL LANDFILL CONFIGURATION

APPROACH USE COMPUTER MODEL PCSTABL5 TO EVALUATE CRITICAL FAILURE SURFACES

PROCEDURE 1) DEVELOP SECTION REPRESENTING WORST CASE CONDITIONS (SEE SHEET 2)

2) DEVELOP SOIL PARAMETERS BASED ON LABORATOR DATA, CLASSIFICATION, AND CORRELATIONS (SEE SHEET 3)

3) COMPUTE FACTOR OF SAFETY FOR WORST CASE (SEE ATTACHED PRINTOUT)

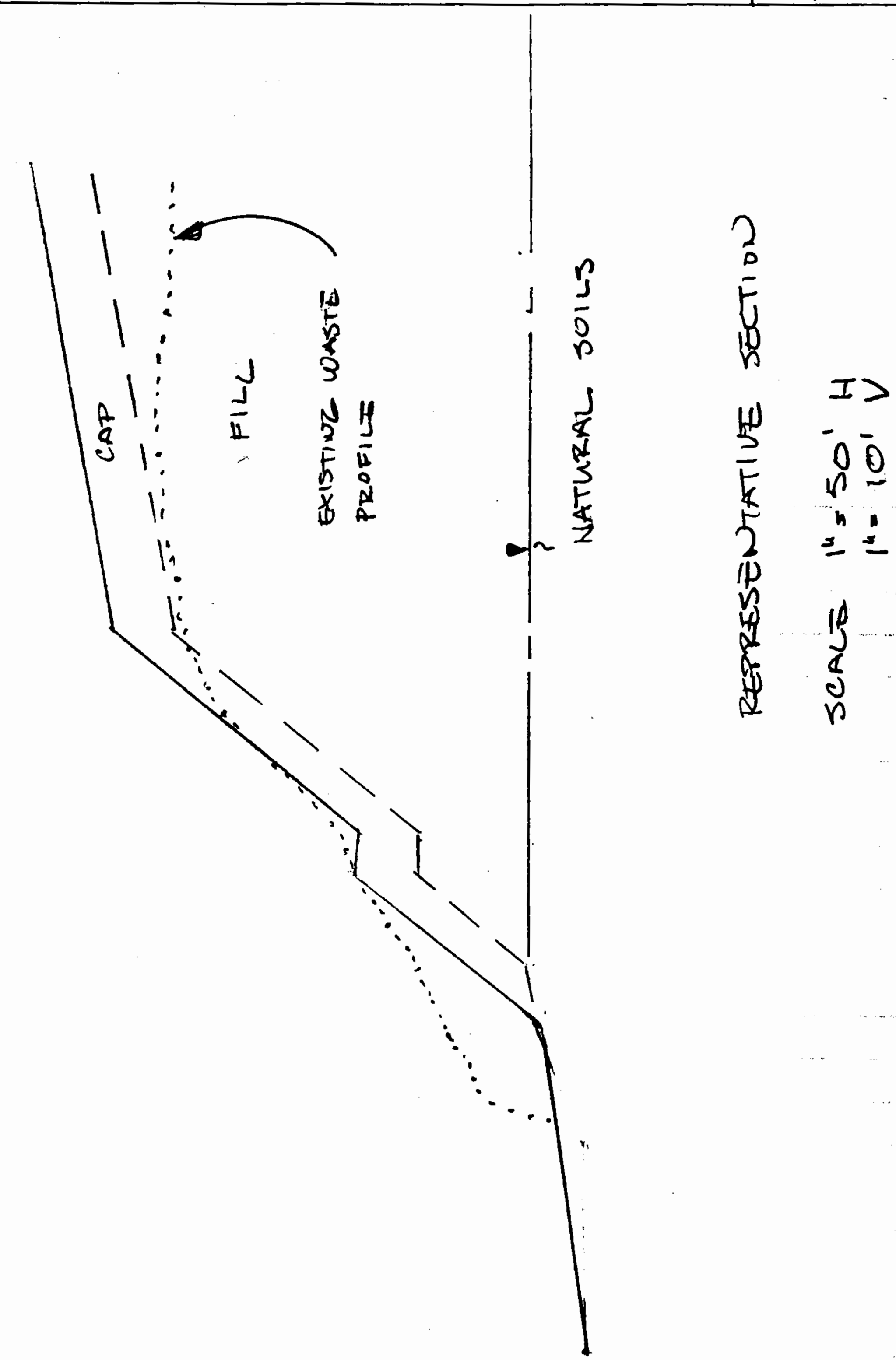
4) ACCEPT DESIGN WHEN FS ≥ 2.0

RESULTS O.K.

CALCULATION WORKSHEET Order No. 19116 (01-91)

CLIENT NWS EARLE	JOB NUMBER 7602
SUBJECT STABILITY ANALYSES SITE 4	
BASED ON	DRAWING NUMBER

BY T Allen	CHECKED BY MEA	APPROVED BY	DATE 8/25/97



CLIENT NWS EARLE	JOB NUMBER 7602
SUBJECT STABILITY ANALYSES SITE 4	
BASED ON	DRAWING NUMBER
BY T Allen / CHECKED BY MBA	APPROVED BY / DATE 8/25/97

SOIL PARAMETERS

CAP - CLAYS -

$\gamma^T = 110$ pcf
$\gamma^s = 115$ pcf
$c = 0$
$\phi = 25°$

FILL - HETEROGENEOUS - PRIMARILY SANDY MATERIAL WITH UNKNOWN PLACEMENT RECORD

$\gamma^T = 110$ pcf
$\gamma^s = 115$ pcf
$c = 0$
$\phi = 20°$

NATURAL SOILS - MEDIUM DENSE SILTY SANDS TO SANDS & GRAVEL, SOME CLAYEY SAND

$\gamma^T = 110$ psf
$\gamma^s = 115$ psf
$c = 0$
$\phi = 30°$

** PCSTABL5M **

by
Purdue University

√'d MEA
8/28/97

1

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer's Method of Slices

Run Date:	82597
Time of Run:	tja
Run By:	tja
Input Data Filename:	earle4-4.in
Output Filename:	earle44.out

PROBLEM DESCRIPTION general stability phi=20 waste, phi=25 cap, phi=30 base

BOUNDARY COORDINATES

5 Top Boundaries
11 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	100.00	95.00	103.00	3
2	95.00	103.00	140.00	113.00	1
3	140.00	113.00	150.00	113.00	1
4	150.00	113.00	210.00	128.00	1
5	210.00	128.00	350.00	133.00	1
6	95.00	103.00	107.00	103.00	3
7	107.00	103.00	140.00	109.50	2
8	140.00	109.50	150.00	109.50	2
9	150.00	109.50	210.00	124.50	2
10	210.00	124.50	350.00	129.50	2
11	107.00	103.00	350.00	103.00	3

1

ISOTROPIC SOIL PARAMETERS

Earle44

3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	110.0	115.0	.0	25.0	.00	.0	1
2	110.0	115.0	.0	20.0	.00	.0	1
3	110.0	115.0	.0	30.0	.00	.0	1

1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 2 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	100.00
2	350.00	100.00

1

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.

300 Trial Surfaces Have Been Generated.

30 Surfaces Initiate From Each Of 10 Points Equally Spaced Along The Ground Surface Between X = 50.00 ft.
and X = 100.00 ft.

Each Surface Terminates Between X = 180.00 ft.
and X = 300.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = 25.00 ft.

10.00 ft. Line Segments Define Each Trial Failure Surface.

1

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	100.00	104.11
2	110.00	104.05
3	120.00	104.35
4	129.97	105.02
5	139.92	106.05
6	149.82	107.45
7	159.67	109.21
8	169.44	111.33
9	179.13	113.81
10	188.72	116.63
11	198.20	119.81
12	207.56	123.34
13	216.78	127.20
14	219.22	128.33

Circle Center At X = 106.8 ; Y = 376.2 and Radius, 272.2

*** 1.808 ***

Individual data on the 18 slices

Slice No.	Width Ft(m)	Weight Lbs(kg)	Water Force Top Lbs(kg)	Water Force Bot Lbs(kg)	Tie Force Norm Lbs(kg)	Tie Force Tan Lbs(kg)	Earthquake Force Hor Lbs(kg)	Earthquake Force Ver Lbs(kg)	Surcharge Load Lbs(kg)
1	10.0	1257.1	.0	.0	.0	.0	.0	.0	.0
2	2.7	768.2	.0	.0	.0	.0	.0	.0	.0
3	7.3	2799.5	.0	.0	.0	.0	.0	.0	.0

4	10.0	5463.8	.0	.0	.0	.0	.0	.0	.
5	9.9	6937.2	.0	.0	.0	.0	.0	.0	.[illegible]
6	.1	61.2	.0	.0	.0	.0	.0	.0	.0
7	9.8	6743.7	.0	.0	.0	.0	.0	.0	.0
8	.2	108.6	.0	.0	.0	.0	.0	.0	.0
9	9.7	6231.7	.0	.0	.0	.0	.0	.0	.0
10	9.8	6845.4	.0	.0	.0	.0	.0	.0	.0
11	9.7	6930.6	.0	.0	.0	.0	.0	.0	.0
12	9.6	6605.3	.0	.0	.0	.0	.0	.0	.0
13	9.5	5883.1	.0	.0	.0	.0	.0	.0	.0
14	9.4	4781.4	.0	.0	.0	.0	.0	.0	.0
15	2.4	1033.0	.0	.0	.0	.0	.0	.0	.0
16	.4	143.4	.0	.0	.0	.0	.0	.0	.0
17	6.4	1602.5	.0	.0	.0	.0	.0	.0	.0
18	2.4	139.5	.0	.0	.0	.0	.0	.0	.0

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	100.00	104.11
2	109.98	104.73
3	119.95	105.55
4	129.90	106.56
5	139.82	107.76
6	149.73	109.16
7	159.60	110.76
8	169.44	112.55
9	179.24	114.53
10	189.00	116.70
11	198.71	119.07
12	208.38	121.63
13	218.00	124.37
14	227.56	127.31
15	232.06	128.79

Circle Center At X = 73.5 ; Y = 612.1 and Radius, 508.7

*** 1.903 ***

1

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)

1	100.00	104.11
2	109.95	103.08
3	119.94	102.65
4	129.94	102.83
5	139.90	103.61
6	149.81	105.01
7	159.61	107.00
8	169.27	109.59
9	178.75	112.76
10	188.03	116.50
11	197.05	120.79
12	205.81	125.63
13	209.23	127.81

Circle Center At X = 122.0 ; Y = 266.9 and Radius, 164.3

*** 2.077 ***

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	88.89	102.81
2	98.87	102.22
3	108.87	101.99
4	118.87	102.12
5	128.86	102.61
6	138.82	103.45
7	148.75	104.64
8	158.63	106.19
9	168.45	108.10
10	178.19	110.35
11	187.85	112.95
12	197.40	115.89
13	206.85	119.17
14	216.17	122.79
15	225.36	126.73
16	229.51	128.70

Circle Center At X = 110.3 ; Y = 381.3 and Radius, 279.3

*** 2.087 ***

1

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	100.00	104.11
2	109.94	105.20
3	119.87	106.39
4	129.79	107.67
5	139.69	109.05
6	149.58	110.53
7	159.46	112.11
8	169.31	113.79
9	179.16	115.56
10	188.98	117.43
11	198.78	119.40
12	208.57	121.46
13	218.33	123.63
14	228.07	125.88
15	237.79	128.24
16	241.28	129.12

Circle Center At X = -4.8 ; Y = 1107.6 and Radius, 1008.9

*** 2.129 ***

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	66.67	102.11
2	76.65	101.48
3	86.64	101.20
4	96.64	101.26
5	106.64	101.67
6	116.61	102.42
7	126.55	103.51
8	136.44	104.95
9	146.29	106.72
10	156.06	108.83
11	165.76	111.28
12	175.36	114.06

13	184.87	117.16
14	194.26	120.60
15	203.53	124.35
16	211.87	128.07

Circle Center At X = 89.8 ; Y = 391.6 and Radius, 290.4

*** 2.166 ***

1

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	77.78	102.46
2	87.73	101.49
3	97.71	100.87
4	107.71	100.61
5	117.71	100.70
6	127.70	101.15
7	137.67	101.95
8	147.60	103.10
9	157.49	104.60
10	167.31	106.45
11	177.07	108.65
12	186.74	111.19
13	196.32	114.07
14	205.79	117.28
15	215.14	120.83
16	224.35	124.71
17	233.25	128.83

Circle Center At X = 110.1 ; Y = 383.4 and Radius, 282.8

*** 2.302 ***

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)

1	88.89	102.81
2	98.85	101.95
3	108.85	101.67
4	118.84	101.98
5	128.80	102.87
6	138.70	104.34
7	148.48	106.39
8	158.14	109.00
9	167.62	112.17
10	176.90	115.89
11	185.95	120.15
12	192.20	123.55

Circle Center At X = 108.6 ; Y = 272.3 and Radius, 170.6

*** 2.318 ***

1

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	77.78	102.46
2	87.68	101.03
3	97.62	100.02
4	107.61	99.43
5	117.61	99.25
6	127.60	99.50
7	137.58	100.16
8	147.52	101.24
9	157.41	102.74
10	167.23	104.64
11	176.95	106.96
12	186.58	109.69
13	196.07	112.81
14	205.43	116.33
15	214.64	120.24
16	223.67	124.53
17	231.72	128.78

Circle Center At X = 116.8 ; Y = 337.9 and Radius, 238.7

*** 2.433 ***

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	66.67	102.11
2	76.52	100.37
3	86.43	99.09
4	96.40	98.26
5	106.39	97.88
6	116.39	97.96
7	126.38	98.50
8	136.33	99.48
9	146.22	100.92
10	156.04	102.81
11	165.77	105.14
12	175.38	107.92
13	184.85	111.13
14	194.16	114.76
15	203.30	118.82
16	212.25	123.28
17	220.98	128.15
18	221.39	128.41

Circle Center At X = 109.7 ; Y = 317.5 and Radius, 219.6

*** 2.471 ***

1

```
               Y          A     X     I     S           F     T

                .00    43.75    87.50   131.25   175.00   218.75

 X       .00 +---------+---------+--*------+---------+---------+
             -
             -
             -
             -
             -
       43.75 +
             -                       .
             -                      ..
             -                    ...6
             -                   ....0
```

Earle44

```
                     -              .....6
A        87.50 +             .......4
                     -              ......06*
                     -             .........41
                     -             .......04*
                     -            .........031
                     -            ..........96
X       131.25 +           ...........415
                     -           ...........71**
                     -           ...........94
                     -           ...........03**
                     -           ...........9315
                     -           ............712
I       175.00 +           ............946.
                     -           .............016.
                     -           .............7418
                     -            .............413.
                     -            ..............413
                     -            ..............9**
S       218.75 +             ..............21
                     -              .............92
                     -              ..............2
                     -               .............55
                     -                ..............
                     -                 .............
        262.50 +                  ...........
                     -                   ..........
                     -                     ........
                     -                      .......
                     -                        .....
                     -                           ..
F       306.25 +
                     -
                     -
                     -
                     -
                     -
T       350.00 +                     W*       *
```

CALCULATION WORKSHEET Order No. 19116 (01-91)

PAGE ______ OF ______

CLIENT NWS EARLE	JOB NUMBER 7602
SUBJECT SETTLEMENT ANALYSES SITE 4	
BASED ON	DRAWING NUMBER
BY T Allen / CHECKED BY [illegible] 8/28/97	APPROVED BY / DATE 8/25/97

SETTLEMENT ANALYSES

SITE 4

NWS EARLE

CALCULATION WORKSHEET Order No. 19116 (01-91)

CLIENT NWS	JOB NUMBER 7602
SUBJECT SETTLEMENT ANALYSES	
BASED ON	DRAWING NUMBER
BY T Allen / CHECKED BY MEA	APPROVED BY / DATE 8/25/97

PURPOSE: DETERMINE SETTLEMENT EFFECTS ON LANDFILL CAP

APPROACH: DETERMINE SETTLEMENT AT HIGH POINT OF FILL. ASSUMING NO SETTLEMENT AT EDGE, RECALCULATE SLOPE BASED ON FINAL ELEVATION

PROCEDURE: FROM PROFILE USED FOR STABILITY ANALYSES ADDITIONAL LOADING DUE TO FILL AND CAP PLACEMENT

MAXIMUM ADDITIONAL HEIGHT = 8'

8' x 110 pcf = 880 pcf

ASSIGN COMPRESSBILITY TO FILL AND NATURAL SOILS

FILL - ELASTIC (DURING CONSTRUCTION)

NATURAL SOILS - ELASTIC (DURING CONSTRUCTION)

RESULTS: NEGLIGIBLE LONG TERM SETTLEMENT THEREFORE NO DETRAMENTAL EFFECTS TO SLOPES

CALCULATION WORKSHEET Order No. 19116 (01-91)

PAGE ____ OF ____

CLIENT NWS EARLE		JOB NUMBER 7602	
SUBJECT STABILITY ANALYSES SITE 5			
BASED ON		DRAWING NUMBER	
BY T Allen	CHECKED BY MEA 8/28/97	APPROVED BY	DATE 8/25/97

STABILITY ANALYSES

SITE 5

NWS EARLE

CALCULATION WORKSHEET Order No. 19116 (01-91)

CLIENT NWS EARLE	JOB NUMBER 7602
SUBJECT STABILITY ANALYSES SITE 5	
BASED ON	DRAWING NUMBER

BY T Allen	CHECKED BY MA	APPROVED BY	DATE 8/25/97

PURPOSE ASSESS LONGTERM STABILITY OF FINAL LANDFILL CONFIGURATION

APPROACH USE COMPUTER MODEL PCSTABL5 TO EVALUATE CRITICAL FAILURE SURFACES

PROCEDURE 1) DEVELOP SECTION REPRESENTING WORST CASE CONDITIONS (SEE SHEET 2)

2) DEVELOP SOIL PARAMETERS BASED ON LABORATORY DATA, CLASSIFICATION, AND CORRELATIONS. (SEE SHEET 3)

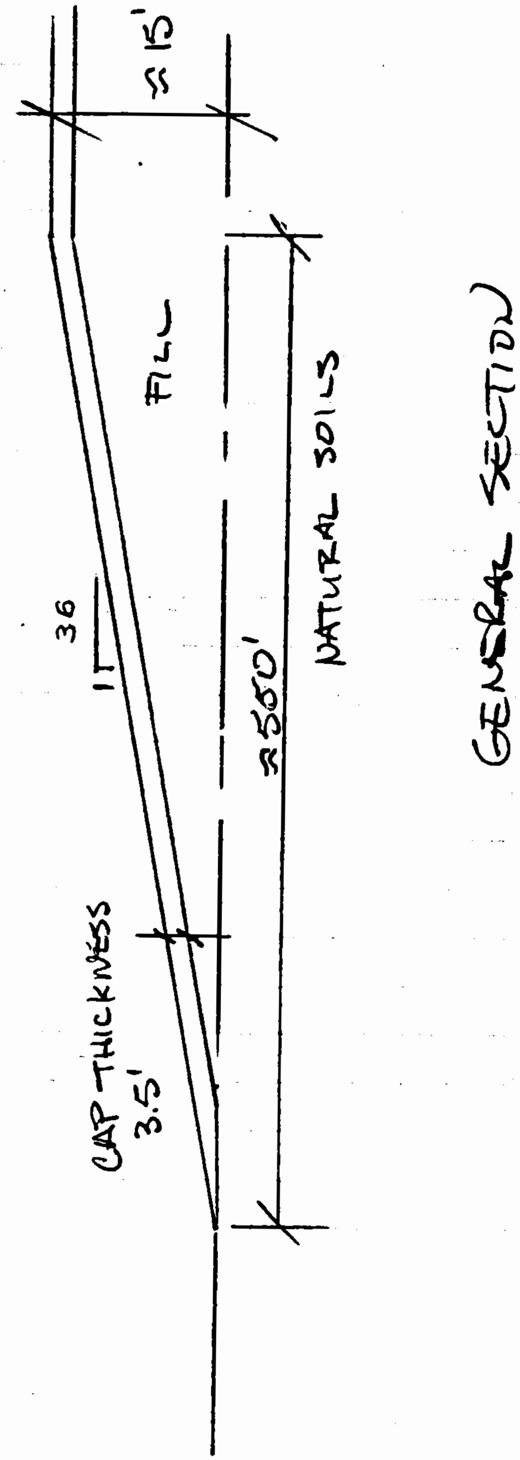
3) COMPUTE FACTOR OF SAFETY FOR WORST CASE (SEE ATTACHED PRINTOUT)

4) ACCEPT DESIGN IF FS ≈ 2 OR GREATER

RESULTS - OK.

CALCULATION WORKSHEET Order No. 19116 (01-91)

CLIENT NWS EARLE	JOB NUMBER 7602
SUBJECT STABILITY ANALYSES SITE 5	
BASED ON	DRAWING NUMBER
BY T Allen / CHECKED BY MEA	APPROVED BY / DATE 8/25/97



CALCULATION WORKSHEET Order No. 19116 (01-91)

CLIENT NWS EARLE	JOB NUMBER 7602
SUBJECT STABILITY ANALYSES SITE 5	
BASED ON	DRAWING NUMBER
BY T Allen / CHECKED BY MCA	APPROVED BY / DATE 8/25/97

SOIL PARAMETERS

CAP - CLAYS

$\gamma^T = 110$ pcf
$\gamma^S = 115$ pcf
$c = 0$
$\phi = 25°$

FILL HETROGENEOUS - PRIMARILY SANDY

$\gamma^T = 110$ pcf
$\gamma^S = 115$ pcf
$C = 0$
$\phi = 20°$

NATURAL SOILS - MEDIUM DENSE SANDS

$\gamma^T = 110$ psf
$\gamma^S = 115$ psf
$c = 0$
$\phi = 30°$

** PCSTABL5M **

by
Purdue University

1

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

√'d MEA
3/28/97

Run Date: 82297
Time of Run:
Run By: tja
Input Data Filename: earle5-1.in
Output Filename: earle5-1.out

PROBLEM DESCRIPTION general stability phi=20 waste, phi=25 c
ap, phi=30 base

BOUNDARY COORDINATES

3 Top Boundaries
7 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	100.00	100.00	100.00	3
2	100.00	100.00	650.00	115.00	1
3	650.00	115.00	700.00	115.00	1
4	100.00	100.00	112.00	100.00	3
5	112.00	100.00	650.00	111.50	2
6	650.00	111.50	700.00	111.50	2
7	112.00	100.00	700.00	100.00	3

1

ISOTROPIC SOIL PARAMETERS

3 Type(s) of Soil

Soil Total Saturated Cohesion Friction Pore Pressure Piez.

Type No.	Unit Wt. (pcf)	Unit Wt. (pcf)	Intercept (psf)	Angle (deg)	Pressure Param.	Constant (psf)	Surface No.
1	110.0	115.0	.0	25.0	.00	.0	1
2	110.0	115.0	.0	20.0	.00	.0	1
3	110.0	115.0	.0	30.0	.00	.0	1

1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 2 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	100.00
2	700.00	100.00

1

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.

300 Trial Surfaces Have Been Generated.

30 Surfaces Initiate From Each Of 10 Points Equally Spaced
Along The Ground Surface Between X = 50.00 ft.
and X = 100.00 ft.

Each Surface Terminates Between X = 300.00 ft.
and X = 700.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = 25.00 ft.

10.00 ft. Line Segments Define Each Trial Failure Surface.

1

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Failure Surface Specified By 47 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	72.22	100.00
2	81.53	96.35
3	90.91	92.87
4	100.35	89.57
5	109.84	86.43
6	119.39	83.46
7	128.99	80.67
8	138.64	78.05
9	148.34	75.61
10	158.08	73.34
11	167.86	71.25
12	177.67	69.33
13	187.52	67.60
14	197.40	66.04
15	207.30	64.66
16	217.23	63.46
17	227.18	62.44
18	237.14	61.59
19	247.12	60.93
20	257.11	60.45
21	267.11	60.15
22	277.11	60.03
23	287.11	60.09
24	297.10	60.34
25	307.09	60.76
26	317.08	61.36
27	327.05	62.15
28	337.00	63.11
29	346.93	64.25
30	356.85	65.57
31	366.73	67.08
32	376.59	68.76
33	386.42	70.61
34	396.21	72.65
35	405.96	74.86
36	415.67	77.25
37	425.34	79.81

38	434.95	82.54
39	444.52	85.45
40	454.03	88.54
41	463.49	91.79
42	472.89	95.21
43	482.22	98.81
44	491.48	102.57
45	500.68	106.50
46	509.80	110.59
47	511.13	111.21

Circle Center At X = 278.7 ; Y = 613.4 and Radius, 553.4

*** 12.802 ***

Individual data on the 50 slices

Slice No.	Width Ft(m)	Weight Lbs(kg)	Water Force Top Lbs(kg)	Water Force Bot Lbs(kg)	Tie Force Norm Lbs(kg)	Tie Force Tan Lbs(kg)	Earthquake Force Hor Lbs(kg)	Earthquake Force Ver Lbs(kg)	Surcharge Load Lbs(kg)
1	9.3	1952.8	.0	1138.0	.0	.0	.0	.0	
2	9.4	5807.8	.0	3361.3	.0	.0	.0	.0	
3	9.1	9115.8	.0	5241.5	.0	.0	.0	.0	.0
4	.3	413.1	.0	237.4	.0	.0	.0	.0	.0
5	9.5	13251.9	.0	7490.1	.0	.0	.0	.0	.0
6	2.2	3523.5	.0	1961.8	.0	.0	.0	.0	.0
7	7.4	13429.6	.0	7432.5	.0	.0	.0	.0	.0
8	9.6	20500.4	.0	11190.7	.0	.0	.0	.0	.0
9	9.7	23886.2	.0	12878.9	.0	.0	.0	.0	.0
10	9.7	27103.2	.0	14458.2	.0	.0	.0	.0	.0
11	9.7	30144.7	.0	15928.3	.0	.0	.0	.0	.0
12	9.8	33004.3	.0	17288.5	.0	.0	.0	.0	.0
13	9.8	35675.9	.0	18538.4	.0	.0	.0	.0	.0
14	9.8	38154.0	.0	19677.7	.0	.0	.0	.0	.0
15	9.9	40433.5	.0	20705.9	.0	.0	.0	.0	.0
16	9.9	42509.7	.0	21622.8	.0	.0	.0	.0	.0
17	9.9	44378.3	.0	22428.0	.0	.0	.0	.0	.0
18	9.9	46035.6	.0	23121.3	.0	.0	.0	.0	.0
19	10.0	47478.2	.0	23702.3	.0	.0	.0	.0	.0
20	10.0	48703.3	.0	24171.1	.0	.0	.0	.0	.0
21	10.0	49708.5	.0	24527.3	.0	.0	.0	.0	.0
22	10.0	50491.9	.0	24770.9	.0	.0	.0	.0	.0
23	10.0	51052.3	.0	24901.8	.0	.0	.0	.0	.0
24	10.0	51388.4	.0	24920.0	.0	.0	.0	.0	.0
25	10.0	51499.9	.0	24825.3	.0	.0	.0	.0	.0
26	10.0	51386.7	.0	24618.0	.0	.0	.0	.0	[illegible]

27	10.0	51049.6	.0	24298.1	.0	.0	.0	.0	.0
28	10.0	50489.1	.0	23865.5	.0	.0	.0	.0	.0
29	10.0	49707.0	.0	23320.6	.0	.0	.0	.0	.0
30	9.9	48705.1	.0	22663.4	.0	.0	.0	.0	.0
31	9.9	47486.0	.0	21894.3	.0	.0	.0	.0	.0
32	9.9	46052.3	.0	21013.3	.0	.0	.0	.0	.0
33	9.9	44407.3	.0	20020.9	.0	.0	.0	.0	.0
34	9.8	42555.1	.0	18917.3	.0	.0	.0	.0	.0
35	9.8	40499.6	.0	17702.9	.0	.0	.0	.0	.0
36	9.8	38245.8	.0	16378.2	.0	.0	.0	.0	.0
37	9.7	35798.8	.0	14943.5	.0	.0	.0	.0	.0
38	9.7	33163.9	.0	13399.2	.0	.0	.0	.0	.0
39	9.6	30347.3	.0	11746.0	.0	.0	.0	.0	.0
40	9.6	27355.6	.0	9984.4	.0	.0	.0	.0	.0
41	9.5	24195.3	.0	8114.8	.0	.0	.0	.0	.0
42	9.5	20873.9	.0	6138.1	.0	.0	.0	.0	.0
43	9.4	17398.8	.0	4054.6	.0	.0	.0	.0	.0
44	9.3	13778.2	.0	1865.3	.0	.0	.0	.0	.0
45	2.9	3583.4	.0	118.0	.0	.0	.0	.0	.0
46	6.3	6477.5	.0	.0	.0	.0	.0	.0	.0
47	9.2	6342.3	.0	.0	.0	.0	.0	.0	.0
48	4.2	1649.9	.0	.0	.0	.0	.0	.0	.0
49	4.9	867.8	.0	.0	.0	.0	.0	.0	.0
50	1.3	42.6	.0	.0	.0	.0	.0	.0	.0

Failure Surface Specified By 57 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	77.78	100.00
2	87.06	96.28
3	96.40	92.70
4	105.79	89.26
5	115.22	85.95
6	124.71	82.79
7	134.24	79.77
8	143.82	76.89
9	153.44	74.16
10	163.10	71.57
11	172.79	69.12
12	182.53	66.81
13	192.29	64.66
14	202.08	62.64
15	211.91	60.77
16	221.76	59.05
17	231.63	57.48
18	241.53	56.05
19	251.45	54.77
20	261.39	53.64
21	271.34	52.65

22	281.30	51.82
23	291.28	51.13
24	301.26	50.59
25	311.26	50.20
26	321.25	49.96
27	331.25	49.86
28	341.25	49.92
29	351.25	50.12
30	361.24	50.47
31	371.23	50.97
32	381.21	51.62
33	391.18	52.42
34	401.13	53.37
35	411.07	54.46
36	421.00	55.70
37	430.90	57.09
38	440.78	58.63
39	450.64	60.31
40	460.47	62.14
41	470.27	64.11
42	480.05	66.23
43	489.79	68.50
44	499.49	70.91
45	509.16	73.47
46	518.79	76.16
47	528.38	79.00
48	537.92	81.99
49	547.42	85.11
50	556.87	88.38
51	566.27	91.78
52	575.62	95.33
53	584.92	99.01
54	594.16	102.83
55	603.35	106.79
56	612.47	110.89
57	619.49	114.17

Circle Center At X = 332.6 ; Y = 722.3 and Radius, 672.4

*** 12.805 ***

1

Failure Surface Specified By 62 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)

1	61.11	100.00
2	70.37	96.21
3	79.67	92.55
4	89.03	89.03
5	98.44	85.63
6	107.89	82.36
7	117.38	79.22
8	126.92	76.22
9	136.50	73.35
10	146.12	70.61
11	155.77	68.01
12	165.46	65.54
13	175.19	63.20
14	184.94	61.00
15	194.73	58.94
16	204.54	57.01
17	214.38	55.22
18	224.24	53.57
19	234.12	52.05
20	244.03	50.67
21	253.95	49.43
22	263.89	48.32
23	273.84	47.36
24	283.81	46.53
25	293.78	45.84
26	303.77	45.29
27	313.76	44.88
28	323.76	44.61
29	333.76	44.47
30	343.76	44.48
31	353.75	44.62
32	363.75	44.90
33	373.74	45.32
34	383.73	45.88
35	393.70	46.58
36	403.67	47.42
37	413.62	48.39
38	423.56	49.51
39	433.48	50.76
40	443.38	52.15
41	453.26	53.67
42	463.12	55.34
43	472.96	57.14
44	482.77	59.07
45	492.56	61.14
46	502.31	63.35
47	512.03	65.70
48	521.72	68.17
49	531.37	70.79
50	540.99	73.53
51	550.56	76.41
52	560.10	79.43

53	569.59	82.57
54	579.04	85.85
55	588.44	89.25
56	597.79	92.79
57	607.10	96.46
58	616.35	100.25
59	625.55	104.18
60	634.69	108.23
61	643.78	112.40
62	649.17	114.98

Circle Center At X = 338.4 ; Y = 764.4 and Radius, 720.0

*** 12.807 ***

Failure Surface Specified By 29 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	88.89	100.00
2	98.26	96.50
3	107.72	93.27
4	117.28	90.33
5	126.92	87.66
6	136.63	85.28
7	146.41	83.19
8	156.24	81.38
9	166.13	79.86
10	176.05	78.63
11	186.01	77.70
12	195.99	77.06
13	205.98	76.71
14	215.98	76.65
15	225.98	76.89
16	235.96	77.42
17	245.93	78.24
18	255.87	79.35
19	265.77	80.76
20	275.62	82.46
21	285.42	84.44
22	295.16	86.71
23	304.83	89.27
24	314.42	92.10
25	323.92	95.22
26	333.33	98.62
27	342.63	102.29

28	351.82	106.23
29	353.28	106.91

Circle Center At X = 212.9 ; Y = 417.5 and Radius, 340.8

*** 12.808 ***

1

Failure Surface Specified By 53 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	77.78	100.00
2	87.00	96.12
3	96.28	92.40
4	105.62	88.83
5	115.02	85.42
6	124.47	82.16
7	133.98	79.06
8	143.54	76.13
9	153.15	73.35
10	162.80	70.74
11	172.49	68.28
12	182.23	65.99
13	192.00	63.86
14	201.80	61.90
15	211.64	60.10
16	221.51	58.46
17	231.40	56.99
18	241.31	55.69
19	251.25	54.55
20	261.20	53.57
21	271.17	52.77
22	281.15	52.13
23	291.13	51.65
24	301.13	51.35
25	311.13	51.21
26	321.13	51.24
27	331.13	51.43
28	341.12	51.80
29	351.11	52.33
30	361.08	53.02
31	371.04	53.89
32	380.99	54.92
33	390.92	56.11
34	400.83	57.47

35	410.71	59.00
36	420.56	60.69
37	430.39	62.55
38	440.18	64.57
39	449.94	66.76
40	459.66	69.10
41	469.34	71.61
42	478.98	74.28
43	488.57	77.11
44	498.11	80.10
45	507.60	83.25
46	517.04	86.56
47	526.42	90.03
48	535.74	93.65
49	545.00	97.43
50	554.20	101.36
51	563.32	105.45
52	572.38	109.68
53	579.33	113.07

Circle Center At X = 314.4 ; Y = 649.4 and Radius, 598.2

*** 12.809 ***

Failure Surface Specified By 53 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	83.33	100.00
2	92.62	96.28
3	101.96	92.72
4	111.36	89.30
5	120.81	86.04
6	130.32	82.94
7	139.87	79.98
8	149.47	77.19
9	159.12	74.55
10	168.81	72.07
11	178.53	69.74
12	188.29	67.58
13	198.09	65.57
14	207.92	63.72
15	217.78	62.04
16	227.66	60.51
17	237.57	59.15
18	247.49	57.94

19	257.44	56.90
20	267.40	56.02
21	277.37	55.30
22	287.36	54.74
23	297.35	54.35
24	307.35	54.12
25	317.35	54.05
26	327.35	54.14
27	337.34	54.40
28	347.33	54.82
29	357.32	55.40
30	367.29	56.14
31	377.25	57.05
32	387.19	58.12
33	397.12	59.35
34	407.02	60.74
35	416.90	62.29
36	426.75	64.00
37	436.57	65.87
38	446.36	67.90
39	456.12	70.09
40	465.84	72.44
41	475.52	74.95
42	485.16	77.61
43	494.76	80.43
44	504.30	83.40
45	513.80	86.54
46	523.25	89.82
47	532.64	93.26
48	541.97	96.85
49	551.24	100.59
50	560.46	104.48
51	569.60	108.52
52	578.68	112.71
53	579.45	113.08

Circle Center At X = 316.6 ; Y = 669.0 and Radius, 614.9

*** 12.814 ***

1

Failure Surface Specified By 37 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	83.33	100.00

2	92.75	96.63
3	102.23	93.46
4	111.79	90.50
5	121.40	87.75
6	131.07	85.20
7	140.79	82.86
8	150.56	80.73
9	160.38	78.81
10	170.23	77.10
11	180.12	75.61
12	190.03	74.33
13	199.98	73.26
14	209.94	72.41
15	219.92	71.77
16	229.91	71.35
17	239.91	71.14
18	249.91	71.15
19	259.91	71.37
20	269.90	71.81
21	279.88	72.46
22	289.84	73.33
23	299.78	74.41
24	309.70	75.71
25	319.58	77.22
26	329.43	78.94
27	339.24	80.88
28	349.01	83.02
29	358.73	85.37
30	368.39	87.94
31	378.00	90.71
32	387.55	93.68
33	397.03	96.87
34	406.44	100.25
35	415.77	103.84
36	425.03	107.63
37	428.07	108.95

Circle Center At X = 244.5 ; Y = 535.5 and Radius, 464.4

*** 12.814 ***

Failure Surface Specified By 32 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	77.78	100.00

2	87.16	96.53
3	96.62	93.31
4	106.17	90.33
5	115.79	87.60
6	125.48	85.12
7	135.23	82.90
8	145.03	80.93
9	154.88	79.21
10	164.78	77.76
11	174.70	76.55
12	184.66	75.61
13	194.64	74.93
14	204.63	74.51
15	214.63	74.34
16	224.63	74.44
17	234.62	74.79
18	244.60	75.41
19	254.56	76.28
20	264.50	77.42
21	274.40	78.81
22	284.26	80.45
23	294.08	82.36
24	303.85	84.51
25	313.55	86.93
26	323.19	89.59
27	332.76	92.50
28	342.24	95.66
29	351.65	99.06
30	360.96	102.71
31	370.17	106.60
32	371.97	107.42

Circle Center At X = 215.9 ; Y = 459.0 and Radius, 384.6

*** 12.818 ***

1

Failure Surface Specified By 62 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	66.67	100.00
2	76.08	96.61
3	85.53	93.35
4	95.02	90.20
5	104.55	87.16

6	114.11	84.25
7	123.72	81.46
8	133.35	78.78
9	143.02	76.23
10	152.72	73.80
11	162.45	71.49
12	172.21	69.30
13	181.99	67.23
14	191.80	65.28
15	201.63	63.46
16	211.49	61.76
17	221.36	60.18
18	231.25	58.73
19	241.16	57.39
20	251.09	56.19
21	261.03	55.10
22	270.99	54.14
23	280.95	53.30
24	290.93	52.59
25	300.91	52.01
26	310.90	51.54
27	320.89	51.20
28	330.89	50.99
29	340.89	50.90
30	350.89	50.93
31	360.89	51.09
32	370.88	51.38
33	380.88	51.79
34	390.86	52.32
35	400.84	52.98
36	410.81	53.76
37	420.77	54.67
38	430.72	55.70
39	440.65	56.85
40	450.57	58.13
41	460.47	59.53
42	470.35	61.05
43	480.21	62.70
44	490.06	64.47
45	499.88	66.36
46	509.67	68.38
47	519.44	70.52
48	529.18	72.77
49	538.89	75.15
50	548.58	77.65
51	558.23	80.28
52	567.84	83.02
53	577.43	85.88
54	586.97	88.86
55	596.48	91.96
56	605.95	95.17
57	615.38	98.51

58	624.76	101.96
59	634.10	105.53
60	643.40	109.21
61	652.65	113.01
62	657.32	115.00

Circle Center At X = 343.1 ; Y = 853.3 and Radius, 802.4

*** 12.819 ***

Failure Surface Specified By 57 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	72.22	100.00
2	81.67	96.72
3	91.16	93.57
4	100.69	90.54
5	110.26	87.64
6	119.87	84.86
7	129.51	82.21
8	139.18	79.69
9	148.89	77.29
10	158.63	75.02
11	168.40	72.88
12	178.20	70.87
13	188.02	68.98
14	197.86	67.23
15	207.73	65.61
16	217.62	64.11
17	227.52	62.75
18	237.45	61.51
19	247.39	60.41
20	257.34	59.43
21	267.30	58.59
22	277.28	57.88
23	287.26	57.30
24	297.25	56.85
25	307.25	56.53
26	317.24	56.34
27	327.24	56.29
28	337.24	56.37
29	347.24	56.57
30	357.24	56.91
31	367.22	57.38
32	377.21	57.98

33	387.18	58.71
34	397.14	59.58
35	407.09	60.57
36	417.03	61.70
37	426.95	62.95
38	436.85	64.34
39	446.74	65.85
40	456.60	67.50
41	466.44	69.27
42	476.26	71.17
43	486.05	73.21
44	495.82	75.37
45	505.55	77.65
46	515.25	80.07
47	524.93	82.61
48	534.56	85.28
49	544.16	88.08
50	553.73	91.00
51	563.25	94.05
52	572.73	97.23
53	582.17	100.52
54	591.57	103.94
55	600.92	107.49
56	610.23	111.15
57	617.45	114.11

Circle Center At X = 326.5 ; Y = 817.5 and Radius, 761.2

*** 12.827 ***

1

```
                Y            A     X     I     S           F     T

                 .00     87.50    175.00    262.50    350.00    437.50

X          .00 +----------+*--------+---------+---------+---------+
               -
               -
               -           .
               -          .3
               -         ..1
         87.50 +        ..31
               -       ..31*
               -      ...31*
               -     ...314.
               -    ....314.
               -    ...314..
```

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A     175.00 +   ...314..
             -  ....214..
             -  ....114..
             -  ...3174..
             -  ...3174..
             -  ...2174..
X     262.50 +  ...2174..
             -  ..32174...
             -  ..321784..
             -  ..321.74..
             -  ..321.784.
             -  ..321.7.44
I     350.00 +  ..321.7.84
             -  ..3201.7.8
             -  ..3261.7.8
             -  ..3251..7.
             -  ..325.1.7.
             -  ...25.1..7
S     437.50 +  ...32611...
             -   ..325.1...
             -   ..325.11..
             -   ...326.1..
             -    ..325..1.
             -    ...205..1
      525.00 +    ...325...
             -     ..3205..
             -     ...3265.
             -      ..32255
             -      ...32.5
             -       ...32.
F     612.50 +       ...3.2
             -        ...3.
             -         ..33
             -          ..*
             -           ..
             -           ..
T     700.00 +          * *
```

CALCULATION WORKSHEET Order No. 19116 (01-91)

PAGE ____ OF ____

CLIENT NWS EARLE		JOB NUMBER 7602	
SUBJECT SETTLEMENT ANALYSES			
BASED ON		DRAWING NUMBER	
BY T Allen	CHECKED BY MEA 8/27/97	APPROVED BY	DATE 8/25/97

SETTLEMENT ANALYSIS

SITE 5

NWS EARLE

CALCULATION WORKSHEET Order No. 19116 (01-91)

CLIENT NWS EARLE	JOB NUMBER 7602
SUBJECT SETTLEMENT ANALYSES	
BASED ON	DRAWING NUMBER

BY T Allen	CHECKED BY MEA	APPROVED BY	DATE 8/25/97

PURPOSE: DETERMINE SETTLEMENT EFFECTS ON LANDFILL

APPROACH DETERMINE SETTLEMENT AT HIGH POINT OF FILL. ASSUMING NO SETTLEMENT AT EDGE, RECALCULATE SLOPE BASED ON FINAL ELEVATION

PROCEDURE OBTAIN LOADING FROM REGRADED SLOPE MAXIMUM DIFFERENTIAL = EL 120 - EL 110 OR 10 FT.

$$10' \times 110 \text{ pcf} = 1100 \text{ psf}$$

ASSIGN COMPRESSIBILITY TO FILL AND NATURAL SOILS

FILL ELASTIC COMPLETE DURING PLACEMENT

NATURAL SOILS ELASTIC - COMPLETE DURING FILL PLACEMENT

RESULTS NEGLIGIBLE LONG TERM SETTLEMENT. THEREFOR NO DETRAMENTAL EFFECTS TO SLOPES.

APPENDIX K

PAVEMENT DESIGN

CLIENT NWS EARLE		JOB NUMBER 7602-0106	
SUBJECT Asphalt Design			
BASED ON NAVFAC DM-5.4		DRAWING NUMBER	
BY KMS	CHECKED BY DCW 8/20/97	APPROVED BY	DATE 8/18/97

OBJECTIVE: DETERMINE A SUITABLE ASPHALT DESIGN FOR A LANDFILL AREA BASED ON THE FOLLOWING CRITERIA:

- HAUL ROAD FOR LOADED PICKUP TRUCKS
- LANDFILL CAP LAYER FROST SUSCEPTIBILITY
- BITUMINOUS SECTION
- STATE OF NEW JERSEY SPECIFICATIONS
- END PRODUCT: OCCASIONAL PICKUP TRUCK USE

APPROACH: THE ASPHALT SECTION WILL BE DETERMINED USING THE METHODS DESCRIBED IN THE DESIGN MANUAL FOR PAVEMENTS BY THE DEPARTMENT OF THE NAVY NAVFAC DM 5.4 (OCTOBER 1979).

Relevant EQUATIONS:

$$c = a - p$$

where c is the zero frost penetration
a is the frost penetration depth
p is the thickness of the bituminous pavement

Source: AFM 88-7, June 1992.

ASSUMPTIONS:

- Subgrade CBR 18
- Subgrade compacted to ASTM 698 Standard Proctor
- Frost Susceptible Subgrade soil
- USE OF PASSENGER TRUCKS Predominant FOR OCCASIONAL SWEEPING OF SKEET RANGE

CALCULATION WORKSHEET Order No. 19116 (01-91)

CLIENT NWS EARLE	JOB NUMBER 7602-0106
SUBJECT Asphalt Design	
BASED ON NAVFAC DM-5.4	DRAWING NUMBER
BY KMS / CHECKED BY DCW 8/28/97	APPROVED BY / DATE 8/18/97

CALCULATIONS:

1. TO DETERMINE THE DESIGN INDEX (DI) TO ACCOUNT FOR EFFECTS OF TRAFFIC INTENSITY AND WEIGHT

VEHICLE GROUP - CHOOSE 1 (TABLE A SHEET 8)
PASSANGER CARS AND PANAL AND PICKUP TRUCKS

DESIGN INDEX (DI) CHOOSE #1 (TABLE 5 SHEET 8)
PASSANGER VEHICLES AND LIGHT TRUCKS, NO TRUCKS IN GROUPS 2 or 3.

2. TO DETERMINE SUBGRADE STRENGTH FOR A FLEXIBLE PAVEMENT

ASSUME SUBGRADE SOIL TYPE TO BE A SILTY SAND.

CHOOSE CBR OF 18 (TABLE B SHEET 9)

(THIS IS A CONSERVATIVE VALUE BASED UPON THE FILL MATERIAL AND COMPACTION EFFORT TO BE DETERMINED).

3 TO DETERMINE TOTAL REQUIRED STRUCTURAL THICKNESS

CBR = 18
DI = 1

FROM FIGURE 7 - TOTAL THICKNESS ABOVE SUBGRADE IS Approx 5"
(SHEET 10, DM 5.4)

CALCULATION WORKSHEET Order No. 19116 (01-91)

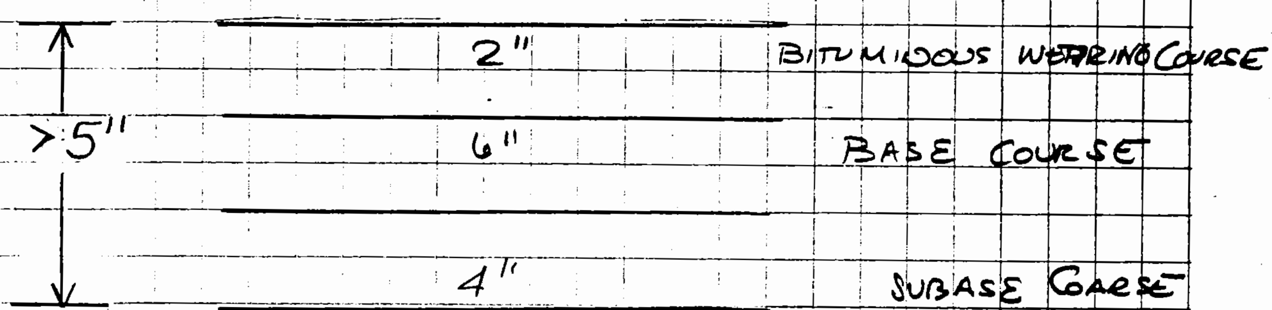
CLIENT NWS EARLE		JOB NUMBER 7602-0106	
SUBJECT Asphalt Design			
BASED ON NAVFAC DM-5.4		DRAWING NUMBER	
BY KMS	CHECKED BY DCW 8/28/97	APPROVED BY	DATE 8/18/97

4. TO DETERMINE THE STRUCTURAL THICKNESS OF EACH SECTION.

FROM PAGE 20 OF DM 5.4
MINIMUM SUBASE THICKNESS IS 4"
MINIMUM BASE THICKNESS IS 6" (PER ¶ f pg 20)

FROM TABLE C SHEET 9, MINIMUM THICKNESS OF SURFACE IS 2". (SECONDARY ROADS)

∴ PROPOSED SECTION (STRUCTURAL THICKNESS)



THE MINIMUM PAVEMENT THICKNESSES EXCEED THE STRUCTURAL REQUIREMENTS, USE MINIMUM PAVEMENT THICKNESSES.

CLIENT NWS EARLE	JOB NUMBER 7602-0106
SUBJECT Asphalt Design	
BASED ON NAVFAC DM-5.4	DRAWING NUMBER
BY KMS	CHECKED BY DCW 8/28/97	APPROVED BY	DATE 8/18/97

5. FROST DESIGN AFM 88-7 Chapter 1, Sub Chapt 18

DETERMINE DEPTH OF FROST PENETRATION TO PROTECT GEOMEMBRANE FROM FROST USING AVERAGE FROST PENETRATION

a. ASSUME THE GEOMEMBRANE OF THE CAP CONFIGURATION IS THE FROST SUSCEPTABLE SOIL. CONCERNED WITH KEEPING THE GEOMEMBRANE BELOW THE FROST LINE.

b. DESIGN AIR FREEZING INDEX:

FROM FIGURE 3-1 SHEET 11
FOR NEW JESEY : 0 (NORMAL YEAR)

c. COMPUTE DEPTH OF FROST PENETRATION

$c = a - p$

where a = frost penetration depth
p = thickness of bituminous pavement
c = depth of base and subbase material

FROM FIGURE 18-3 (SHEET 12, REFERENCE #2)

ASSUME SUBGRADE OF 7% MOISTURE
135 lb/ft^3

ENTER AIR FREEZING INDEX OF 0

FROST PENETRATION = 20

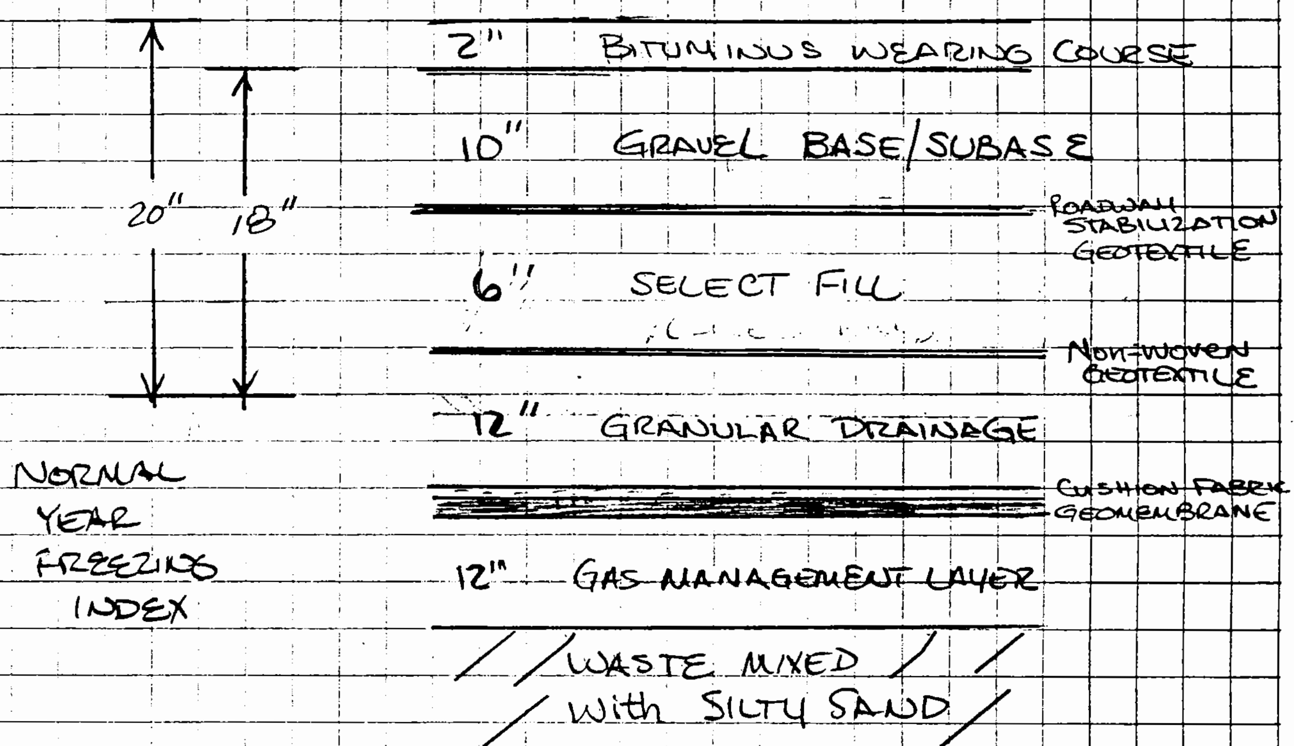
CALCULATION WORKSHEET Order No. 19116 (01-91)

CLIENT: NWS EARLE	JOB NUMBER: 7602-0106
SUBJECT: Asphalt Design	
BASED ON: NAVFAC DM-5.4	DRAWING NUMBER:
BY: KMS / CHECKED BY: DCW 8/28/97	APPROVED BY: / DATE: 8/18/97

$C = 20 - 2 = \underline{18}$

∴ 18" OF NON-FROST SUSCEPTIBLE MATERIAL IS REQUIRED BELOW THE WEARING COURSE.

PROPOSED SECTION



THEORETICALLY, THE GEOMEMBRANE IS NOT EFFECTED BY FROST SO THE EXTREME FROST PENETRATION EVENT WILL NOT BE USED TO DESIGN A PROPOSED SECTION.

THE THICKNESS USED FOR THE DRAINAGE LAYER AND SECTIONS OF THE COURSE MATERIALS WERE DETERMINED TO MAKE THE COVER SYSTEM COMPATABLE WITH THE FINAL COVERS OF THE GRAVEL ROADWAY AND VEGETATED AREAS.

CALCULATION WORKSHEET Order No. 19116 (01-91)

CLIENT NWS EARLE	JOB NUMBER 7602-0106
SUBJECT Asphalt Design	
BASED ON NAVFAC DM-5.4	DRAWING NUMBER

BY	CHECKED BY	APPROVED BY	DATE
KMS	DCW 8/20/97		8/18/97

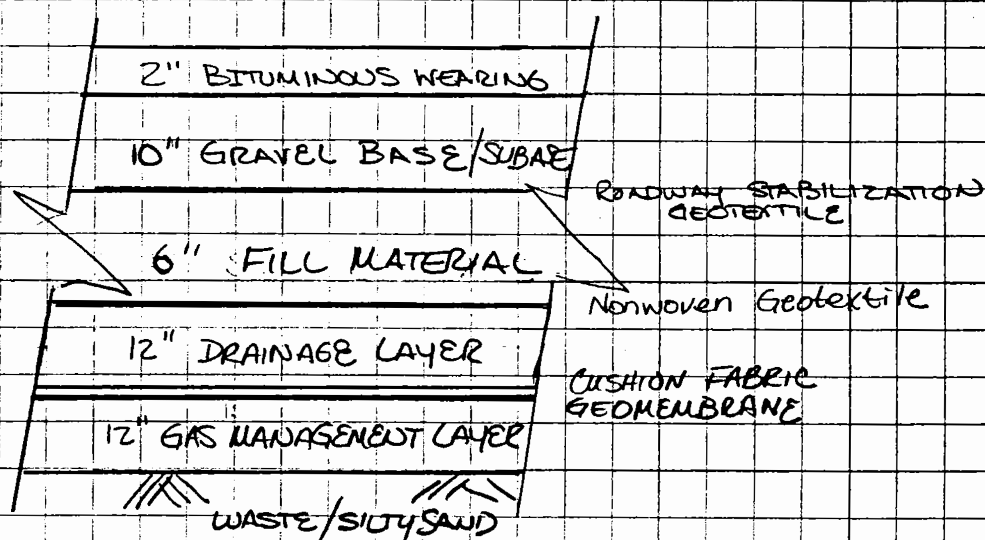
SUMMARY

WITH THE FOLLOWING CONDITIONS AND ASSUMPTIONS:

- SUBGRADE CBR 18
- SUBGRADE COMPACTED TO ASTM 698 Standard Proctor
- GCL OF CAP CONFIGURATION IS FROST SUSCEPTABLE.
- USE OF PASSANGER TRUCKS PREDOMINANT FOR OCCASIONAL SWEEPING OF SKEET RANGE
- GCL layer must be below frost Penetration of 20"
- MINIMUM THICKNESS OF SURFACE IS 2"
- MINIMUM THICKNESS OF SUBBASE IS 6"

THE RECOMMENDED PAVEMENT SECTION IS:

- CHOOSE DESIGN FOR NORMAL YEAR FREEZING INDEX.



LOCATED IN APPENDIX A ARE THE SPECIFICATIONS REQUIRED BY NEW JERSEY FOR THE WEARING COURSE, BASE COURSE, AND SUBASE COURSE OF THIS SECTION.

CLIENT NWS EARLE		JOB NUMBER 7602-0106	
SUBJECT Asphalt Design			
BASED ON NAVFAC DM-5.4		DRAWING NUMBER	
BY KMS	CHECKED BY DW 8/20/97	APPROVED BY	DATE 8/18/97

References

1. Department of the Navy, Naval Facilities Engineering Command, October 1979, Civil Engineering Pavements NAVFAC DM-5.4.

2. Department of the Army and Air Force, January 1995, PAVEMENT Design for Seasonal Frost Conditions, AFM-88-6.

3. Department of the ARMY and the Air Force June 1992, Pavement Design for Roads, Streets, WALKS, AND OPEN STORAGE, AFM 88-7.

4. NEW JERSEY DEPARTMENT OF TRANSPORTATION, STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION, 1996

CLIENT NWS EARLE	JOB NUMBER 7602-0106
SUBJECT Asphalt Design	
BASED ON NAVFAC DM-5.4	DRAWING NUMBER
BY KMJ / CHECKED BY DEW 8/26/97	APPROVED BY / DATE 8/18/97

TABLE A

a. Vehicle Groups. Where detailed traffic survey and axle load data are not available, spot counts or estimates can be made to ascertain the general characteristics and volume of traffic. As an aid to determining a DI, vehicles should be grouped according to the following categories:

(1) Group 1: Passenger cars and panel and pickup trucks.
(2) Group 2: Two-axle trucks.
(3) Group 3: Trucks having three or more axles.

TABLE 5
Vehicular Traffic Design Index

DI	Traffic Characteristics	Approx. Daily EAL
1	Passenger Vehicles and Light Trucks. No trucks in Groups 2 or 3.	1-5
2	Medium-Light Traffic, less than 1000 VPD. 10% in Group 2 and none in Group 3.	6-20
3	Medium traffic up to 3000 VPD. Up to 10% Group 2 plus Group 3. 1% Group 3 vehicles.	21-75
4	Medium-heavy traffic up to 6000 VPD. Up to 15% Group 2 plus Group 3. 10% Group 3 vehicles.	76-250
5	Heavy traffic to 6000 VPD. Maximum 25% Group 2 plus Group 3 and 15% Group 3.	251-900
6	Very heavy traffic exceeding 6000 VPD. Over 25% Group 2 or Group 3.	901-3000

TAKEN FROM REFERENCE #1

CLIENT NWS EARLE		JOB NUMBER 7602-0106	
SUBJECT ASPHALT DESIGN			
BASED ON NAVFAC DM-5.4		DRAWING NUMBER	
BY KMS	CHECKED BY DCW 8/26/97	APPROVED BY	DATE 8/18/97

TABLE B

Subgrade Soil Type	Approx. CBR
Well and poorly graded gravels, well graded sands	>18
Silty and clayey sands	12-18
Low plastic clays, inorganic silts, very fine sands	6-12
Highly plastic and organic clays, micaceous silts	1-6

TABLE C
MINIMUM THICKNESS OF SURFACE

Type of Surface	Minimum Thickness (inches)
Primary Road	3
Secondary and Tertiary Roads	2
Parking Area	2
Driveway	1.5
Sidewalk	1
Surfacing Used by Tracked Vehicles	4

TAKEN FROM REFERENCE #1

CALCULATION WORKSHEET Order No. 19116 (01-91)

CLIENT NWS EARLE	JOB NUMBER 7602-0106
SUBJECT ASPHALT DESIGN	
BASED ON NAVFAC DM-5.4	DRAWING NUMBER

BY KMS	CHECKED BY DCW 8/28/97	APPROVED BY	DATE 8/18/97

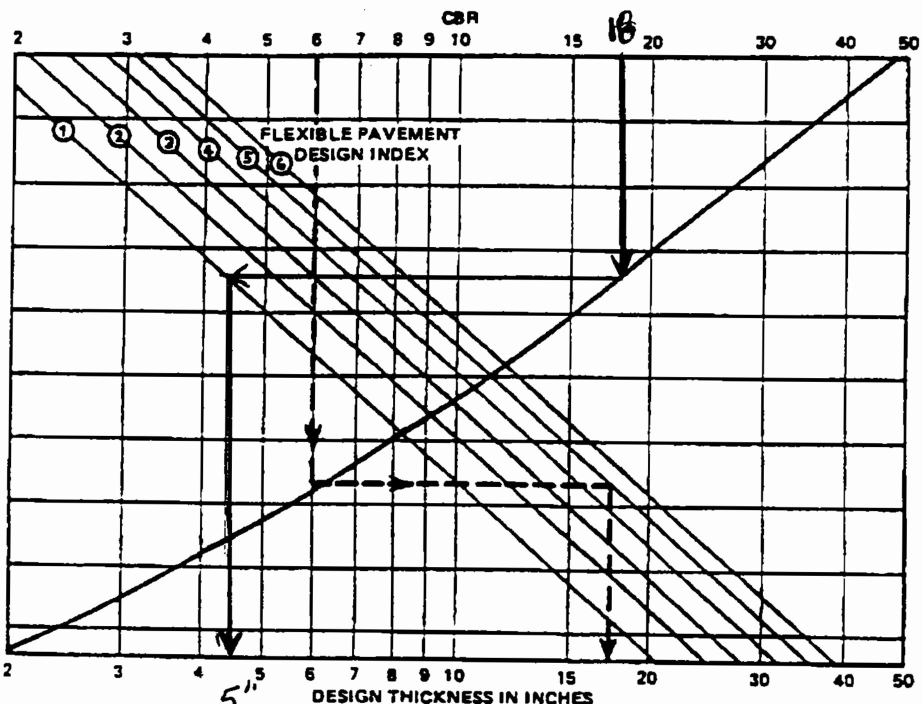
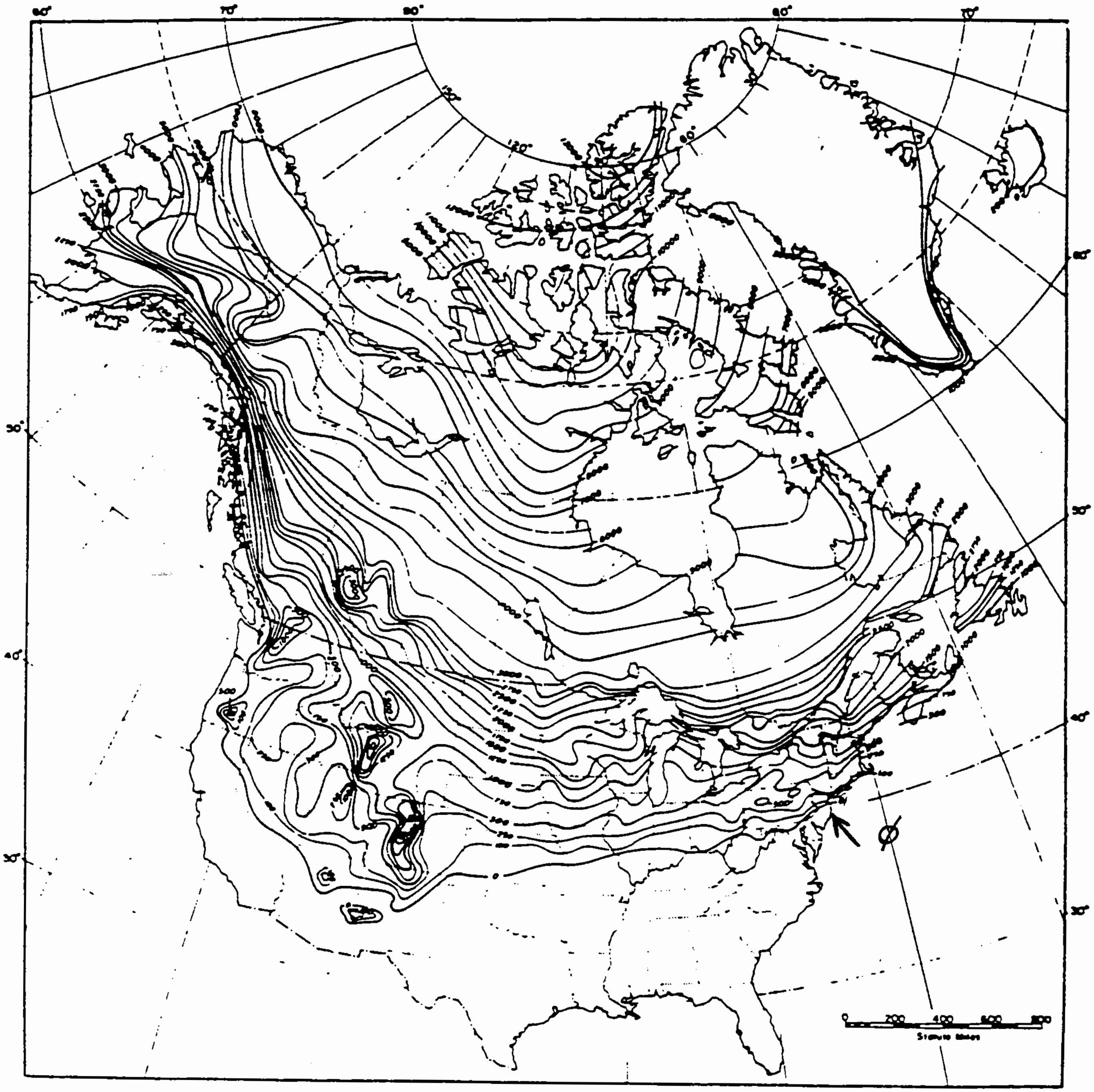


FIGURE 7
CBR Thickness Design Chart—Flexible Pavements

TAKEN FROM REFERENCE #1

CALCULATION WORKSHEET Order No. 19116 (01-91)

CLIENT NWS EARLE		JOB NUMBER 7602-0106	
SUBJECT Asphalt Design			
BASED ON NAVFAC DM-5.4		DRAWING NUMBER	
BY KMS	CHECKED BY DCW 8/20/97	APPROVED BY	DATE 8/18/97



U.S. Army Corps of Engineers

Figure 3-1. Distribution of mean air freezing indices in North America.

(NORMAL YEAR)

CALCULATION WORKSHEET Order No. 19116 (01-91)

CLIENT NWS EARLE		JOB NUMBER 7602-006	
SUBJECT Asphalt Design			
BASED ON NAVFAC DM-5.4		DRAWING NUMBER	
BY KMS	CHECKED BY DCW 8/28/97	APPROVED BY	DATE 8/18/97

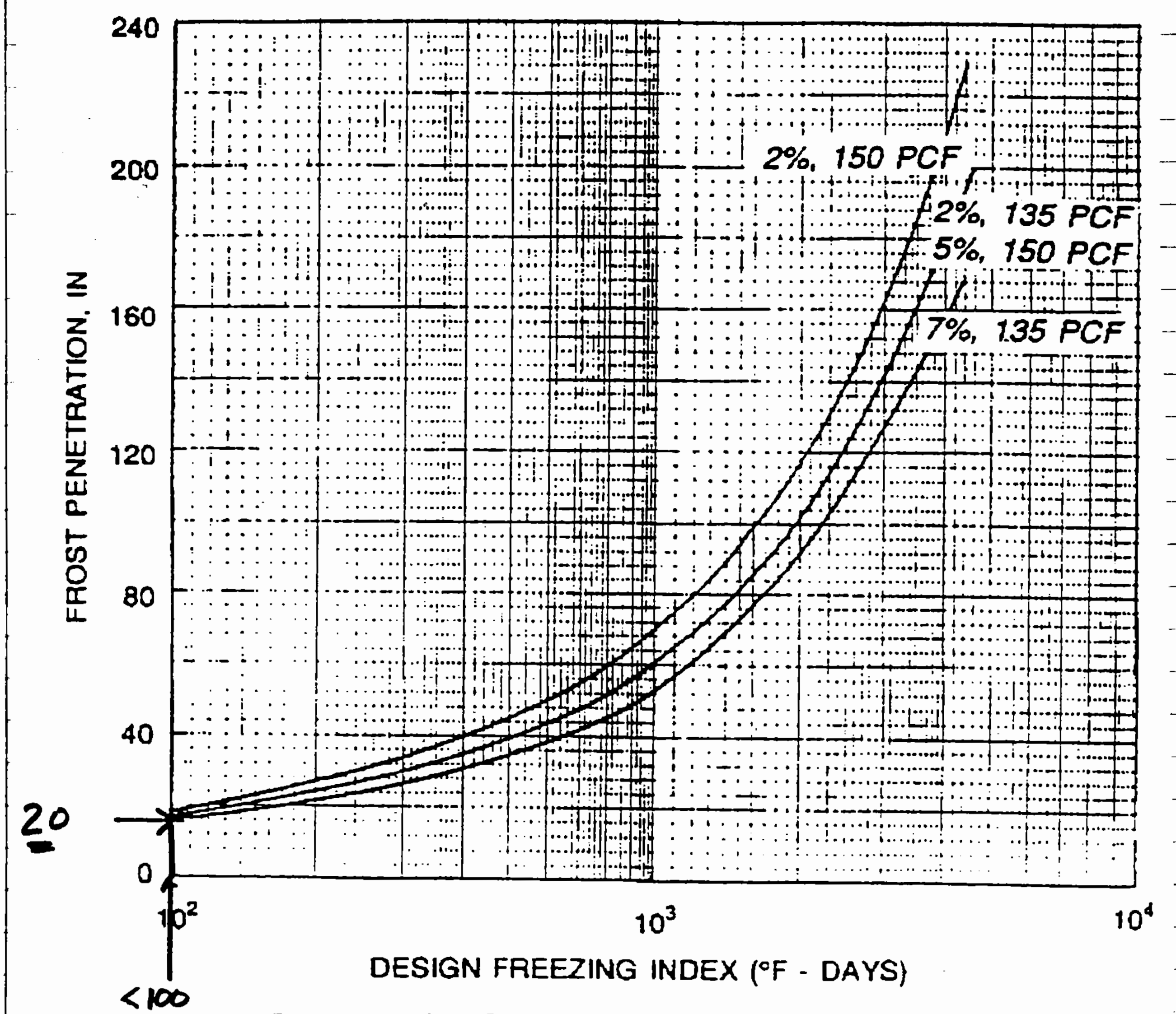


Figure 18-3. Frost Penetration Beneath Pavements. (Sheet 1 of 3)

TAKEN FROM REFERENCE # 2

CLIENT	JOB NUMBER		
SUBJECT			
BASED ON	DRAWING NUMBER		
BY	CHECKED BY DCW	APPROVED BY	DATE

Appendix A

FROM REFERENCE #4 SHEET 14, THE FOLLOWING SPECIFICATIONS ARE REQUIRED BY NEW JERSEY FOR THE 3 SECTIONS OF THE ASPHALT DESIGN:

WEARING COURSE (BITUMINUS):

USE I-5 MIX

BASE AND SUBASE COURSE

USE I-2 MIX

CLIENT NWS EARLE	JOB NUMBER 7602-0106	
SUBJECT ASPHALT DESIGN		
BASED ON NAVFAC DM-5.4	DRAWING NUMBER	
BY KMS	CHECKED BY DCW 8/20/97	APPROVED BY	DATE 8/18/97

DIVISION 900 - MATERIALS

Table 903-1 Bituminous Concrete Mixtures

New Jersey Interagency Engineering Committee
Standard Bituminous Concrete Mixture Design Table

Mix Designation and Nominal Maximum Size of Aggregate

	Base Course			Surface Course		
Mix	**I-1**	**I-2**	**I-4 HD**	**I-4**	**I-5**	**I-5 HD**
Size, mm	25.0	37.5	19.0	19.0	9.5	12.5

Sieve Size Grading of total aggregate (coarse plus fine, plus filler if required). Amounts finer than each laboratory sieve (square opening) weight percent.

Sieve Size	I-1	I-2	I-4 HD	I-4	I-5	I-5 HD
50 mm	--	100				
37.5 mm	100	90-100				
25.0 mm	90-100	80-100	100	100		
19.0 mm	60-80	65-95 (NA)	95-100	98-100		100
12.5 mm	--	50-85	75-95	88-98	100	72-98
9.5 mm	15-40	40-75 (NA)	65-85 (N/A)	65-88	80-100	60-82
4.75 mm	0-10	25-60	35-65	35-65	55-75	40-56
2.36 mm	--	20-45	25-36	25-46	30-56	28-37
1.18 mm	--	--	15-35	18-40	20-45	19-27
600 µm	--	--	10-30	12-30	15-35	13-19
300 µm	--	8-30	8-25	10-25	10-30	8-16
150 µm	--	--	--	--	--	5-10
75 µm	--	4-7.5	4-7.5	4-7.5	4-8	3-6
Asphalt Cement, Percent by Weight of Total Mixture	2.5-3.1	4-6	4.8-7	5-7	5-7	5-6

Note 1: Material passing the 75-micrometer sieve may consist of fine particles of the aggregate mineral filler, or both. Material passing the 425-micrometer sieve shall be nonplastic when test in accordance with AASHTO T 90.

Note 2: Maximum aggregate size requirements - the maximum size of coarse aggregate for any given n on a project shall be no more than one-half of the proposed lift thickness on the Project. (I example: If the proposed lift thickness for an I-2 mix is 50 millimeters, the mix used must 100 percent passing the 25.0-millimeter sieve even though the overall specification allows 100 percent passing the 25.0-millimeter sieve.)

Note 3: Mix I-1 is not subject to the design requirements specified elsewhere.

Note 4: (NA) Denotes not applicable for NJDOT Mix.

Note 5: Mix Descriptions:

1. I-1 is a permeable base course which should be used in a minimum lift of 75 millimete
2. I-2 is a dense-graded base course which may be used in full depth construction or as bottom course in an overlay.
3. I-4 HD (heavy duty) is a 19.0-millimeter nominal maximum size surface course intended to be used on heavy traffic roadways.
4. I-4 is a 19.0-millimeter nominal maximum size surface course mix for medium to he traffic roadways.
5. I-5 is a 9.5-millimeter nominal maximum size surface course mix for low to medium tr roadways.
6. I-5 HD (heavy duty) is a 12.5-millimeter nominal maximum size surface course intended to be used for thin lifts (less than 37.5 millimeters) on heavy traffic roadway

TAKEN FROM REFERENCE #4

CALCULATION WORKSHEET Order No. 19116 (01-91)

CLIENT NWS EARLE	JOB NUMBER 7602 - 0106
SUBJECT AGGREGATE ROAD DESIGN	
BASED ON	DRAWING NUMBER

BY	CHECKED BY	APPROVED BY	DATE
CSF	DCW		8/22/97

OBJECTIVE: Determine the aggregate thickness to be used for the unpaved utility roads at NWS EARLE

BASIS OF DESIGN: Aggregate thickness will be determined using the AGGREGATE - SURFACED ROAD DESIGN CATALOG presented in Ref #1

ASSUMPTIONS: Assumptions used to determine the aggregate thickness for the utility roads using the aggregate - surfaced road design catalog include the following:

a) The allowable range of relative traffic for aggregate - surfaced roads design is between 10,000 and 100,000 18-kip equivalent single axle load (ESAL) applications.

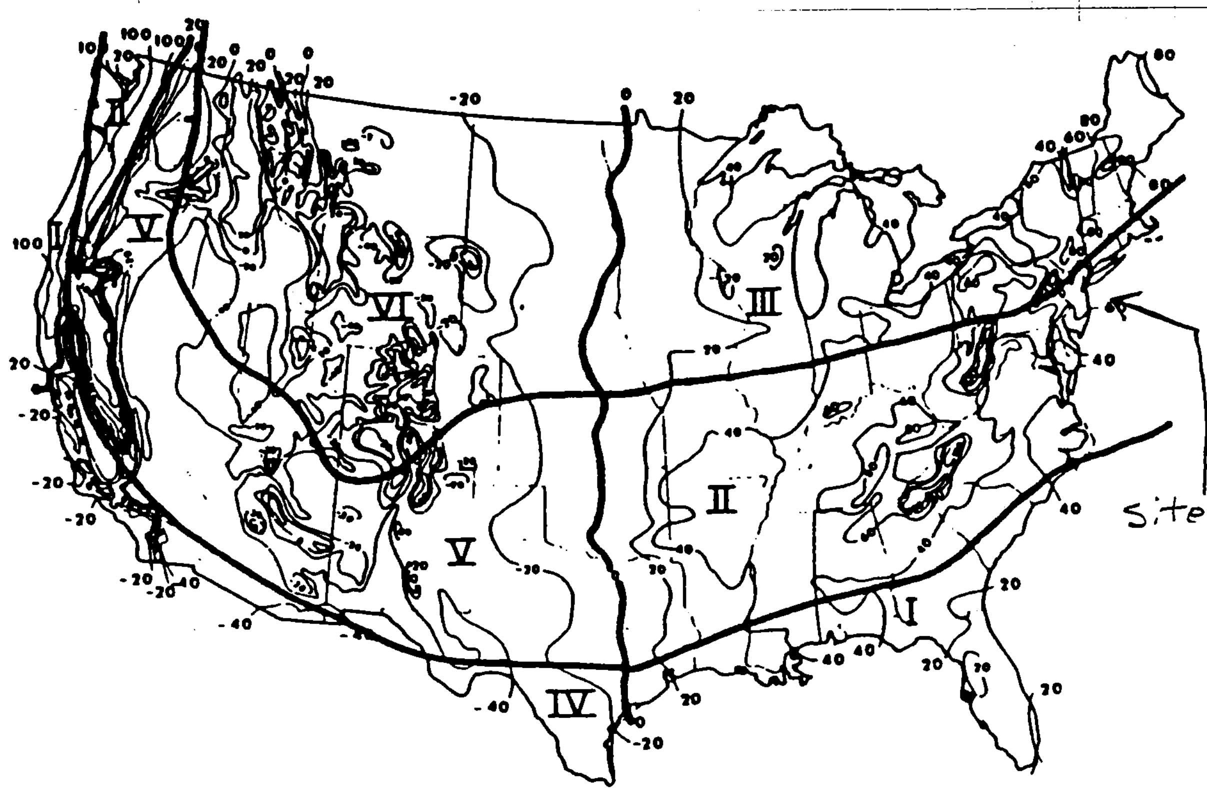
b) The presented design is based on a 50 - 75 percent level of reliability.

c) The effective resilient modulus of the aggregate base material is 30,000 psi regardless of the quality of the roadbed soil.

CALCULATION WORKSHEET Order No. 19116 (01-91)

CLIENT NWS EARLE	JOB NUMBER 7602 - 0106
SUBJECT AGGREGATE ROAD DESIGN	
BASED ON	DRAWING NUMBER
BY CSF / CHECKED BY DCW	APPROVED BY / DATE 8/22/97

Select the appropriate climatic region for the site location:



REGION	CHARACTERISTICS
I	Wet, no freeze
II	Wet, freeze - thaw cycling
III	Wet, hard-freeze, spring thaw
IV	Dry, no freeze
V	Dry, freeze - thaw cycling
VI	Dry, hard freeze, spring thaw

* CLIMATIC REGION *

II

Figure 4.1. The Six Climatic Regions in the United States (*12*)

Reference: Ref (1) pp II-20.

CALUCLATION WORKSHEET Order No. 19116 (01-91)

CLIENT	JOB NUMBER
NWS EARLE	7602- 0106
SUBJECT	
AGGREGATE ROAD DESIGN	
BASED ON	DRAWING NUMBER

BY	CHECKED BY	APPROVED BY	DATE
CSF	DCW		8/22/97

Traffic volume will be infrequent on the utility road. Select a low volume traffic pattern with a corresponding 18-kip ESAL range of 10,000 - 30,000

Traffic volume	18-kip ESAL range
High	60,000 to 100,000
Medium	30,000 to 60,000
Low	10,000 to 30,000

Source: Ref(1) pp II - 81

Table 4.10. Aggregate Surfaced Road Design Catalog: Recommended Aggregate Base Thickness (in Inches) for the Six U.S. Climatic Regions, Five Relative Qualities of Roadbed Soil and Three Levels of Traffic

Relative Quality of Roadbed Soil	Traffic Level	U.S. Climatic Region I	II	III	IV	V	VI
Very good	High	8*	10	15	7	9	15
	Medium	6	8	11	5	7	11
	Low	4	4	6	4	4	6
Good	High	11	12	17	10	11	17
	Medium	8	9	12	7	9	12
	Low	4	5	7	4	5	7
Fair	High	13	14	17	12	13	17
	Medium	11	11	12	10	10	12
	Low	6	6	7	5	5	7
Poor	High	**	**	**	**	**	**
	Medium	**	**	**	15	15	**
	Low	9	10	9	8	8	9
Very poor	High	**	**	**	**	**	**
	Medium	**	**	**	**	**	**
	Low	11	11	10	8	8	9

*Thickness of aggregate base required (in inches).

**Higher type pavement design recommended.

Source: Ref (1) pp II - 86.

CALUCLATION WORKSHEET Order No. 19116 (01-91)

CLIENT	JOB NUMBER
NWS EARLE	7602-0106

SUBJECT: AGGREGATE ROAD DESIGN

BASED ON	DRAWING NUMBER		
BY	CHECKED BY	APPROVED BY	DATE
CSF	DCW		8/22/97

Given that the utility road is to be constructed on top of the graded and compacted landfill cap, select a GOOD relative quality for the roadbed soil.

⇒ From TABLE 4.10:

1. Good Roadbed Quality
2. Low Traffic Level
3. U.S. Climatic Region II

REQUIRED AGGREGATE THICKNESS FOR THE UTILITY ROAD:

5 INCHES MIN

⇒ USE 6 INCHES to conform with proposed surface layer thickness on the caps

Reference

1. AASHTO Guide for Design of Pavement Structures, American Association of State Highway and Transportation Officials, Washington, D.C. 1993.

APPENDIX L

CONCRETE SLAB CALCULATIONS

CALCULATION WORKSHEET Order No. 19116 (01-91)

PAGE 1 OF 5

CLIENT: NAVY (EARLE)		JOB NUMBER: 7602	
SUBJECT: SLAB CALCULATIONS – POTABLE WATER TANK SLAB AND SPORTING CLAY BUILDING SLABS			
BASED ON		DRAWING NUMBER	
BY: S. RUFFING	CHECKED BY: L Shipley 1/14/97	APPROVED BY	DATE

PROBLEM:

DESIGN SLAB TO SUPPORT SPORTING CLAY BUILDINGS (TYP FOR 4) AND A POTABLE WATER TANK. DETERMINE SLAB THICKNESS AND REINFORCING.

KNOWN:

- SLABS ARE ON GRADE W/ DRAINAGE LAYER CONSISTING OF GRANULAR MATERIAL UNDERNEATH.
- SPORTING CLAY SLABS ARE 10'X10'
- LOADING IS MINIMAL - ONLY BUILDING AND SKEET THROWING EQUIPMENT.
- POTABLE WATER TANK SLAB WILL BE 9'X15'
-

ASSUME:

- USE 3000 psi CONCRETE @ 150 pcf
- COEFFICIENT OF FRICTION BETWEEN SLAB AND SUBASE IS 1.5
- ALLOWABLE TENSILE STRENGTH OF CONCRETE IS 0.07 X 3000 = 210 psi ⇒ USE 200 psi
- MAXIMUM LOAD IS 2000 lb APPLIED OVER 4" DIAMETER
- POISSON'S RATIO (ν) FOR CONCRETE = 0.15
- STANDARD MODULUS OF SOIL REACTION (K) = 500 pci FOR SUBASE CLASSIFIED AS GW.
- LOADING FOR POTABLE WATER TANK SLAB AND SPORTING SLABS IS THE SAME.

∴ SPORTING CLAY SLAB LOAD = $2000/(2^2\pi) = 160$ psi

POTABLE WATER TANK LOAD = 750 gal × 8.3 lb/gal = 6225 lb

6225 lb/2 = 3110 lb/WHEEL APPLIED OVER ~6" DIA AREA

$3110/(3^2\pi) = 110$ psi

∴ DESIGN FOR SPORTING CLAY LOADS FOR ALL SLABS.

USE:

- WESTERGAARD ANALYSIS
- ACI 318-89

CALCULATION WORKSHEET Order No. 19116 (01-91)

CLIENT NAVY (EARLE)	JOB NUMBER 7602
SUBJECT SLAB CALCULATIONS - POTABLE WATER TANK SLAB AND SPORTING CLAY BUILDING SLABS	
BASED ON	DRAWING NUMBER
BY S. RUFFING / CHECKED BY LS 11/4/97	APPROVED BY / DATE

USING ACI 318-89, TABLE 9.5(a)
MINIMUM SLAB THICKNESS WITH BOTH ENDS CONTINUOUSLY SUPPORTED IS L/28 WHERE L IS THE LENGTH OF SLAB BETWEEN JOINTS IN INCHES.

$L = 10' \times 12 \text{ in/ft} = 120$ INCHES

$h = \frac{120}{28} = 4.3'' \Rightarrow \underline{\text{USE } 5''}$ ✓

VERIFY SLAB THICKNESS USING WESTERGAARD ANALYSIS
CASE 1 - CRITICAL LOAD @ SLAB CORNER

E_c = MODULUS OF ELASTICITY FOR CONCRETE
$= 57000\sqrt{f_c} = 57000\sqrt{3000} = 3{,}122{,}019$ psi ✓

DETERMINE RADIUS OF RELATIVE STIFFNESS (ℓ)

$$\ell = \sqrt[4]{\frac{E_c h^3}{12(1-\nu^2)k}}$$

$$= \sqrt[4]{\frac{3{,}122{,}019\,(5)^3}{12(1-0.15^2)500}} = \sqrt[4]{66539} = 16.06 \text{ in}$$ ✓

DETERMINE MINIMUM THICKNESS

$$h^2 = \frac{3P}{f_t}\left[1-\left(\frac{a\sqrt{2}}{\ell}\right)^{0.6}\right]$$ WHERE a = RADIUS OF LOAD CONTACT AREA

$a = 2''$

$f_t = 200$ psi (ALLOWABLE TENSILE STRESS)

$$h^2 = \frac{3(2000)}{200}\left[1-\left(\frac{2\sqrt{2}}{16.06}\right)^{0.6}\right]$$

$h^2 = 19.4 \text{ in}^2 \Rightarrow h = 4.4 \text{ in}$ ✓

$\therefore$ 5 INCH SLAB OK

CLIENT NAVY (EARLE)
JOB NUMBER 7602
SUBJECT SLAB CALCULATIONS - ~~SPORTING CLAY BUILDING~~ POTABLE WATER TANK SLAB SLABS
BASED ON
DRAWING NUMBER
BY S. RUFFING
CHECKED BY LS 11/4/97
APPROVED BY
DATE

CASE 2

VERIFY STRESS IN SLAB IS ACCEPTABLE IF LOAD APPLIED IN CENTER OF SLAB

$$f_b = 0.316\frac{P}{h^2}\left[\log h^3 - 4\log\left(\sqrt{1.6a^2+h^2} - 0.675h\right) - \log k + 6.48\right]$$

$$f_b = 0.316\frac{(2000)}{5^2}\left[\log 5^3 - 4\log\left(\sqrt{1.6(2)^2+5^2} - 0.675(5)\right) - \log 500 + 6.48\right]$$

$$f_b = 25.28\left[2.1 - 1.4 - 2.7 + 6.48\right] = 113.3 \text{ psi}$$

$$f_b = 113.3 \text{ psi} < 200 \text{ psi} \therefore \text{OK}$$ ✓

CASE 3

VERIFY STRESS IN SLAB IF LOAD IS APPLIED ALONG EDGE

$$f_b = 0.572\frac{P}{h^2}\left[\log h^3 - 4\log\left(\sqrt{1.6a^2+h^2} - 0.675h\right) - \log k + 5.77\right]$$

$$f_b = 0.572\frac{(2000)}{5^2}\left[\log 5^3 - 4\log\left(\sqrt{1.6(2)^2+5^2} - 0.675(5)\right) - \log 500 + 5.77\right]$$

$$f_b = 45.76\left[2.1 - 1.4 - 2.7 + 5.77\right]$$

$$f_b = 172.5 \text{ psi}$$

$$172.5 \text{ psi} < 200 \text{ psi} \therefore \text{OK}$$ ✓

CLIENT Navy (Earle)	JOB NUMBER 7602
SUBJECT Slab Calculations - Sporting Clay Building Slabs / Potable Water Tank Slab	
BASED ON	DRAWING NUMBER
BY S. Ruffing	CHECKED BY LS 11/4/97
APPROVED BY	DATE

REINFORCING STEEL REQ'D:
ONLY NEED STEEL TO CONTROL TEMPERATURE / SHRINKAGE CRACKING.

TENSION DUE TO CONTRACTION $(T) = \frac{W_0 \mu l}{2}$

W_0 = WEIGHT OF SLAB psf = 62.5 psf ✓
μ = COEFFICIENT OF FRICTION = 1.5
l = LENGTH BETWEEN CONTRACTION JOINTS = 10'
T = TENSILE FORCE, lb/FT WIDTH OF SLAB

$T = \frac{62.5 \times 1.5 \times 10}{2} = 468.8$ lb/FT OF WIDTH ✓

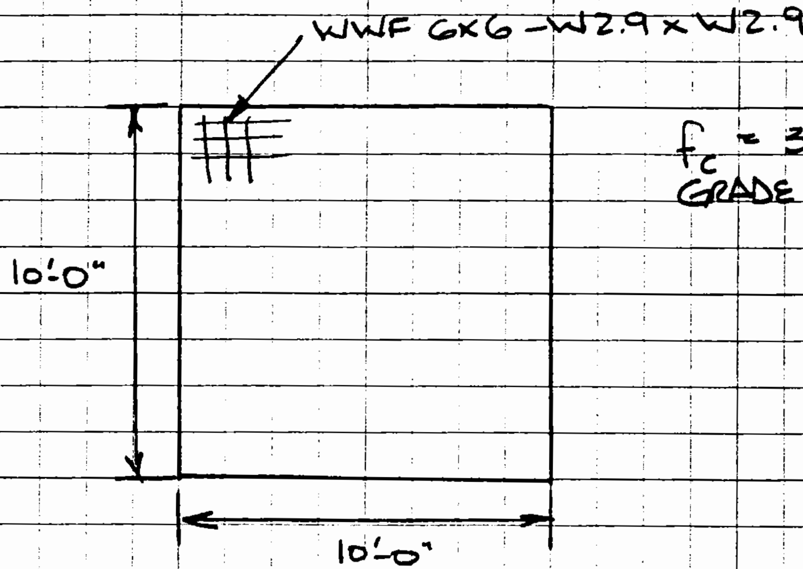
AREA OF STEEL $(A_s) = \frac{T}{f_s}$ WHERE f_s = ALLOWABLE STRESS IN STEEL ~ 1/2 YIELD STRESS = 30,000 psi FOR GRADE 60

$A_s = \frac{468.8}{30,000} = 0.016$ in²/FT ✓

∴ USE WWF 6X6 − W2.9 x W2.9 WITH A_s = 0.06 in²/FT

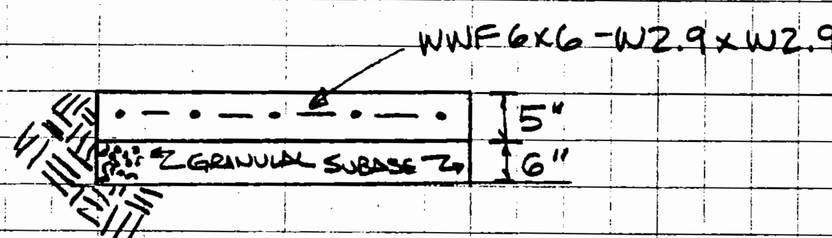
CALCULATION WORKSHEET Order No. 19116 (01-91)

CLIENT NAVY (EARLE)	JOB NUMBER 7602
SUBJECT SLAB CALCULATIONS - ~~SPORTING CLAY BUILDING SLABS~~ POTABLE WATER TANK SLAB	
BASED ON	DRAWING NUMBER
BY S. RUFFING	CHECKED BY LS 11/4/97
APPROVED BY	DATE



$f'_c = 3000$ psi
GRADE 60 STEEL

PLAN



X-SECTION

NOTE: FOR POTABLE WATER TANK SLAB ADD CONTRACTION JOINT AT MIDPOINT ALONG 15' DIMENSION. NOTCH CONCRETE TO A DEPTH OF 1/4 OF THE SLAB THICKNESS.

CLIENT NAVY (EARLE)	JOB NUMBER 7602
SUBJECT SLAB CALCULATIONS – HIGH AND LOW HOUSE BUILDING SLAB	
BASED ON	DRAWING NUMBER

BY S. RUFFING	CHECKED BY L. Shipley 11/4/97	APPROVED BY	DATE

PROBLEM:

DESIGN SLABS ON GRADE TO SUPPORT HIGH AND LOW HOUSE BUILDING AND THROWING EQUIPMENT. DETERMINE SLAB THICKNESS AND REINFORCING FOR EACH.

KNOWN:

- SLABS ARE ON GRADE W/ GRANULAR DRAINAGE LAYER UNDERNEATH.
- SLABS WILL BE 12'x22' (HIGH HOUSE) AND 12'x12' (LOW HOUSE)
- LOADING IS MINIMAL – ONLY BUILDING AND THROWING EQUIPMENT

ASSUME:

- USE 3000 psi CONCRETE @ 150 pcf
- COEFFICIENT OF FRICTION BETWEEN SLAB AND SUBASE IS 1.5
- ALLOWABLE TENSILE STRENGTH OF CONCRETE IS 0.07 x 3000 = 210 psi ⇒ USE 200 psi
- MAXIMUM LOAD IS 2000 lb APPLIED OVER 4" DIAMETER SURFACE
- POISSON'S RATIO (ν) FOR CONCRETE IS = 0.15
- STANDARD MODULUS OF SOIL REACTION (k) = 500 pci FOR SUBASE CLASSIFIED AS GW.

USE:

- ACI 318-89
- WESTERGAARD ANALYSIS

CALCULATION WORKSHEET Order No. 19116 (01-91)

CLIENT: NAVY (EARLE)
JOB NUMBER: 7602
SUBJECT: SLAB CALCS - HIGH AND LOW HOUSE
BASED ON:
DRAWING NUMBER:
BY: S. RUFFING
CHECKED BY: LS 11/4/97
APPROVED BY:
DATE:

USING ACI 318-89, TABLE 9.5(a)
THE MINIMUM SLAB THICKNESS WITH BOTH ENDS CONTINUOUSLY SUPPORTED IS L/28, WHERE L IS THE LENGTH OF SLAB BETWEEN JOINTS.

HIGH HOUSE $L = 12 \times 22 = 264$ IN ✓
LOW HOUSE $L = 12 \times 12 = 144$ IN ✓

HIGH HOUSE $h = 264/28 = 9.4$ in USE <u>10 in</u> ✓

LOW HOUSE $h = 144/28 = 5.1$ IN USE <u>6 in</u> ✓

HIGH HOUSE:

VERIFY SLAB THICKNESS USING WESTERGAARD ANALYSIS
CASE 1 - CRITICAL LOAD @ SLAB CORNER

E_c = MOD. OF ELASTICITY FOR CONCRETE $= 57000\sqrt{f'_c}$

$E_c = 57000\sqrt{3000} = 3{,}122{,}019$ psi ✓

RADIUS OF RELATIVE STIFFNESS $(\ell) = \sqrt[4]{\dfrac{E_c h^3}{12(1-\nu^2)k}}$

$$\ell = \sqrt[4]{\frac{3{,}122{,}019\,(10)^3}{12(1-0.15^2)500}} = 27 \text{ in} ✓$$

MINIMUM THICKNESS $(h) \Rightarrow h^2 = \dfrac{3P}{f_t}\left[1-\left(\dfrac{a\sqrt{2}}{\ell}\right)^{0.6}\right]$

WHERE $a = 2"$, $f_t = 200$ psi

$$h^2 = \frac{3(2000)}{200}\left[1-\left(\frac{2\sqrt{2}}{27}\right)^{0.6}\right] = 22.3 \text{ in}^2 ✓$$

$h = 4.7$ in ✓

∴ REDUCE SLAB TO 6 in THICKNESS WITH CONTRACTION JOINT @ MIDPOIN

CLIENT NAVY (EARLE)	JOB NUMBER 7602		
SUBJECT SLAB CALCS – HIGH AND LOW HOUSE			
BASED ON	DRAWING NUMBER		
BY S. RUFFING	CHECKED BY LS 11/4/97	APPROVED BY	DATE

CASE 2

VERIFY STRESS IN SLAB IF LOAD APPLIED AT CENTER OF SLAB

$$f_b = 0.316 \frac{P}{h^2}\left[\log h^3 - 4\log\left(\sqrt{1.6a^2+h^2} - 0.675h\right) - \log K + 6.48\right]$$

$$= 0.316 \frac{(2000)}{6^2}\left[\log 6^3 - 4\log\left(\sqrt{1.6(2)^2+6^2} - 0.675(6)\right) - \log 500 + 6.48\right]$$

$$= 17.6\left[2.3 - 1.6 - 2.7 + 6.48\right] = 78.8 \text{ psi} \checkmark$$

$$f_b = 78.8 \text{ psi} < 200 \text{ psi} \therefore \underline{OK} \checkmark$$

CASE 3

VERIFY STRESS IN SLAB IF LOAD APPLIED AT EDGE

$$f_b = 0.572 \frac{P}{h^2}\left[\log h^3 - 4\log\left(\sqrt{1.6a^2+h^2} - 0.675h\right) - \log K + 5.77\right]$$

$$= 0.572 \frac{(2000)}{6^2}\left[\log 6^3 - 4\log\left(\sqrt{1.6(2)^2+6^2} - 0.675(6)\right) - \log 500 + 5.77\right]$$

$$= 31.8\left[2.3 - 1.6 - 2.7 + 5.77\right] = 119.9 \text{ psi} \checkmark$$

$$f_b = 119.9 \text{ psi} < 200 \text{ psi} \therefore \underline{OK} \checkmark$$

CLIENT NAVY (EARLE)		JOB NUMBER 7602	
SUBJECT SLAB CALCS - HIGH AND LOW HOUSE			
BASED ON		DRAWING NUMBER	
BY S. RUFFING	CHECKED BY LS 11/4/97	APPROVED BY	DATE

REINFORCING STEEL REQUIRED: (HIGH HOUSE)
ONLY NEED STEEL TO CONTROL CRACKING

TENSION DUE TO CONTRACTION $(T) = \dfrac{W_o \mu l}{2}$

W_o = WEIGHT OF SLAB psf = 75.0 psf ✓
μ = COEFFICIENT OF FRICTION = 1.5 ✓
l = LENGTH OF SLAB BETWEEN CONTRACTION JOINTS
T = TENSILE FORCE, lb/FT WIDTH OF SLAB

USE $l = 11'$ (22' SLAB W/ CONTRACTION JOINT AT MIDPOINT)

$$T = \frac{75 \times 1.5 \times 11}{2} = 618.75 \text{ lb/FT OF WIDTH}$$ ✓

AREA OF STEEL $(A_s) = \dfrac{T}{f_s}$ WHERE f_s = ALLOWABLE STRESS IN STEEL ~ ½ YIELD STRESS = 30,000 psi FOR GRADE 60

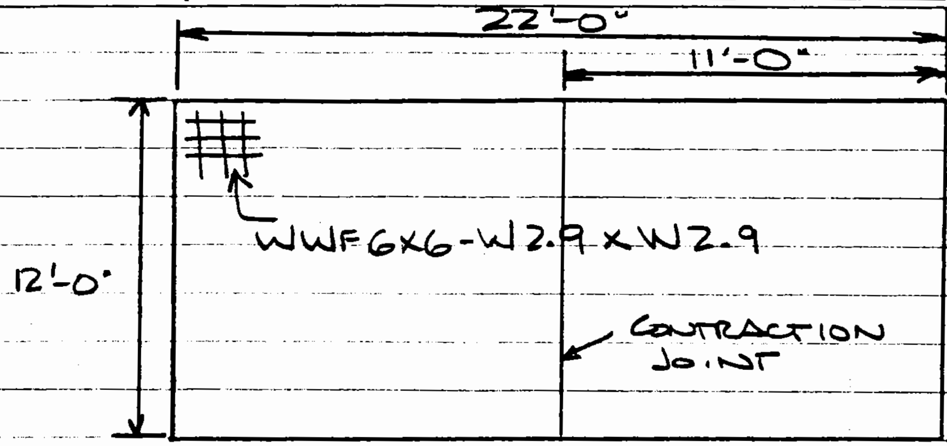
$$A_s = \frac{618.75}{30{,}000} = 0.02 \text{ in}^2/\text{FT}$$ ✓

∴ USE WWF 6x6 - W2.9 x W2.9 w/ A_s = 0.06 in²/FT

CALCULATION WORKSHEET Order No. 19116 (01-91)

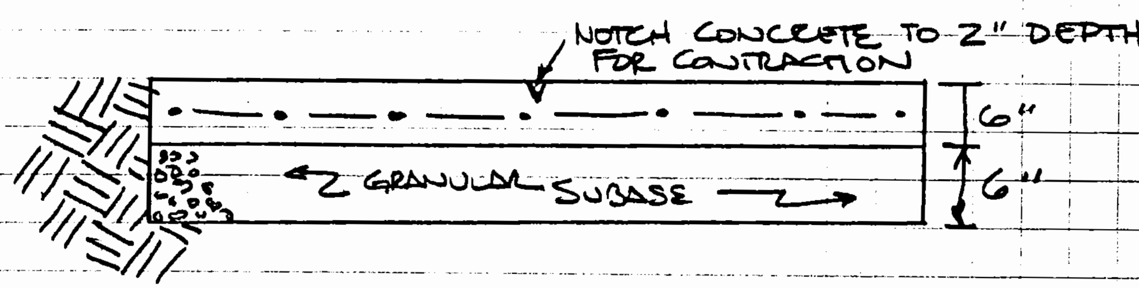
CLIENT NAVY (EARLE)	JOB NUMBER 7602
SUBJECT SLAB CALCS - HIGH AND LOW HOUSE	
BASED ON	DRAWING NUMBER

BY	CHECKED BY	APPROVED BY	DATE
S. RUFFING	LS 11/4/97		



$f'_c = 3000$ psi
GRADE 60 STEEL

HIGH HOUSE PLAN



X-SECTION

CALCULATION WORKSHEET Order No. 19116 (01-91)

CLIENT NAVY (EARLE)	JOB NUMBER 7602
SUBJECT SLAB CALCS - HIGH AND LOW HOUSE	
BASED ON	DRAWING NUMBER
BY S. RUFFING / CHECKED BY LS 11/4/97	APPROVED BY / DATE

LOW HOUSE:

VERIFY SLAB THICKNESS USING WESTERGAARD ANALYSIS
CASE 1 CRITICAL LOAD @ SLAB CORNER
$E_c = 3{,}122{,}019$ psi (SEE PAGE 2) ✓

RADIUS OF RELATIVE STIFFNESS (ℓ) - SEE PAGE 2

$$\ell = \sqrt[4]{\frac{3122019\,(6)^3}{12(1-0.15^2)500}} = 18.4 \text{ in}$$ ✓

MIN. THICKNESS (h)

$$h^2 = \frac{3(2000)}{200}\left[1-\left(\frac{2\sqrt{2}}{18.4}\right)^{0.6}\right] = 20.2$$ ✓

$$h = 4.5 \text{ in}$$ ✓

∴ REDUCE SLAB TO 5 INCH THICKNESS ✓

CASE 2
VERIFY STRESS IN SLAB IF LOAD APPLIED AT CENTER
(SEE PAGE 3)

$$f_b = 0.316\frac{(2000)}{5^2}\left[\log 5^3 - 4\log\left(\sqrt{1.6(2)^2+5^2}-0.675(5)\right)-\log 500+6.48\right]$$

$$= 25.28\left[2.1-1.4-2.7+6.48\right]$$

$$f_b = 113.3 \text{ psi} < 200 \text{ psi} \therefore \text{OK}$$ ✓

CLIENT NAVY (EARLE)	JOB NUMBER 7602
SUBJECT SLAB CALCULATIONS - HIGH AND LOW HOUSE	
BASED ON	DRAWING NUMBER
BY S. RUFFING	CHECKED BY LS 11/4/97
APPROVED BY	DATE

CASE 3

VERIFY STRESS IN SLAB IF LOAD APPLIED AT EDGE
(SEE PAGE 3)

$$f_b = 0.572\frac{(2000)}{5^2}\left[\log 5^3 - 4\log\left(\sqrt{1.6(2)^2+5^2} - 0.675(5)\right) - \log 500 + 5.77\right]$$

$$= 45.76\left[2.1 - 1.4 - 2.7 + 5.77\right]$$

$$f_b = 172.5\ psi < 200\ psi \therefore OK$$ ✓

REINFORCING STEEL REQ'D: (LOW HOUSE)
SEE PAGE 4

$$T = \frac{W_o \mu l}{2} \qquad W_o = 62.5\ psf\ (\text{FOR } 5''\ \text{SLABS})$$ ✓

$$T = \frac{62.5(1.5)12}{2} = 562.5\ lb/\text{FT OF WIDTH}$$ ✓

$$A_s = \frac{562.5}{30{,}000} = 0.019\ in^2/FT$$

$\therefore$ USE WWF 6×6 − W2.9×W2.9 w/ $A_s = 0.06\ in^2/FT$

CLIENT: NAVY (EARLE)

JOB NUMBER: 7602

SUBJECT: SLAB CALCULATIONS - HIGH AND LOW HOUSE

BASED ON:

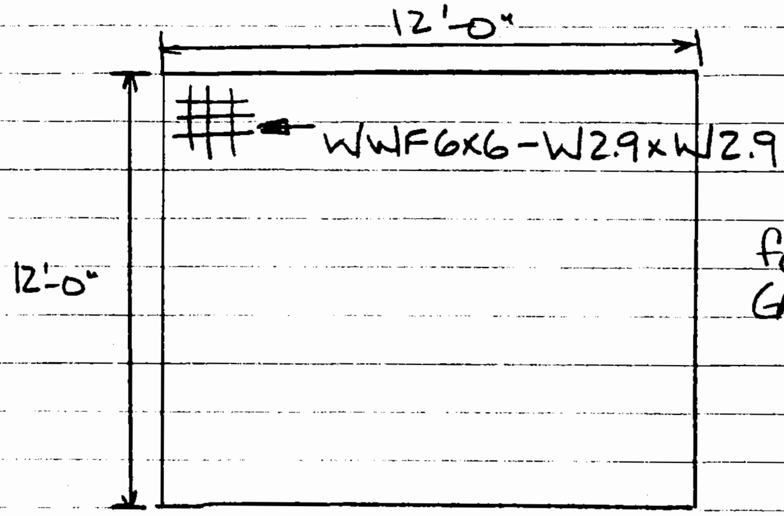
DRAWING NUMBER:

BY: S. RUFFING

CHECKED BY: LS 4/4/97

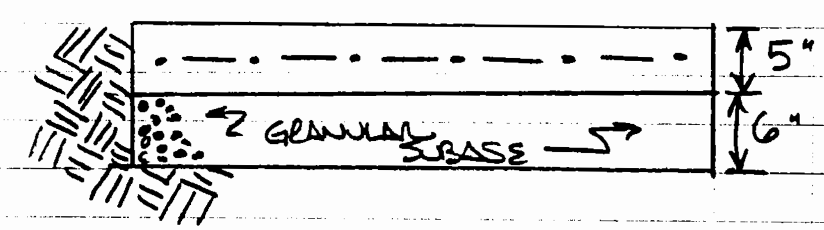
APPROVED BY:

DATE:



$f_c = 3000$ psi
GRADE 60 STEEL

LOW HOUSE PLAN



X-SECTION

CALCULATION WORKSHEET
Order No. 19116 (01-91)

CLIENT NAVY (EARLE)		JOB NUMBER 7602	
SUBJECT SLAB CALCULATIONS - FUTURE CLUBHOUSE			
BASED ON		DRAWING NUMBER	
BY S. RUFFING	CHECKED BY L. Shipley 11/4/97	APPROVED BY	DATE

PROBLEM:
DESIGN SLAB TO SUPPORT CLUBHOUSE TRAILER.
DETERMINE SLAB THICKNESS AND REINFORCING.

KNOWN:
- SLAB IS ON GRADE W/ DRAINAGE LAYER CONSISTING OF GRANULAR MATERIAL UNDERNEATH.
- SLAB WILL BE 15' x 70'
- LOADING WILL BE BASED ON ATTACHMENT 1 (DEAD LOAD) + 100 PSF (LIVE LOAD)

ASSUME:
- USE 3000 psi CONCRETE @ 150 pcf
- USE COEFFICIENT OF FRICTION BETWEEN SLAB AND SUBASE = 1.5.
- ALLOWABLE TENSILE STRENGTH OF CONCRETE IS 0.07 x 3000 = 210 psi ⇒ USE 200 psi
- POISSON'S RATIO (ν) FOR CONCRETE = 0.15
- STANDARD MODULUS OF SOIL REACTION ('k') = 500 pci FOR SUBASE MATERIAL CLASSIFIED AS GW.
- $E_c = 57000\sqrt{3000} = 3{,}122{,}019$ psi

USE:
WESTERGAARD ANALYSIS

CALCULATION WORKSHEET Order No. 19116 (01-91)

CLIENT NAVY (EARLE)	JOB NUMBER 7602
SUBJECT SLAB CALCS. - FUTURE CLUBHOUSE	
BASED ON	DRAWING NUMBER
BY S. RUFFING / CHECKED BY LS 11/4/97	APPROVED BY / DATE

LOADING

AS PER ATTACHMENT 1 DEAD LOAD(DL) = 10 TONS
ASSUME LIVE LOAD = 100 psf
AREA OF TRAILER = 55' x 11'-9" = 646.25 SF ✓
⇒ LIVE LOAD (LL) = 64625 ✓

TOTAL LOAD = LL + DL = 84625 lb ✓

AS SHOWN IN ATTACHMENT 1 THE TRAILER WILL BE SUPPORTED BY BLOCKING AT 12 LOCATIONS

∴ LOAD / LOCATION = 84625 / 12 = 7052 lb/LOCATION ✓
USE 7100 lb

USING WESTERGAARD ANALYSIS ASSUME THE LOAD AT EACH LOCATION IS APPLIED OVER AN AREA OF 16" x 16" = 256 in² OR AN EQUIVALENT RADIUS OF

$$\pi r^2 = 256\,in^2$$
$$r = 9\,in \checkmark$$

DETERMINE MINIMUM SLAB THICKNESS:

CASE 1: CRITICAL LOAD @ SLAB CORNER

$E_c = 3{,}122{,}019$ psi
ASSUME $h = 8$ in
DETERMINE RADIUS OF RELATIVE STIFFNESS (ℓ)

$$\ell = \sqrt[4]{\frac{E_c h^3}{12(1-\nu^2)k}} = \sqrt[4]{\frac{3122019\,(8)^3}{12\,(1-0.15^2)\,500}}$$

$$\ell = 22.85\,in \checkmark$$

CALCULATION WORKSHEET Order No. 19116 (01-91)

CLIENT: NAVY (EARLE)	JOB NUMBER: 7602
SUBJECT: SLAB CALCS. – FUTURE CLUBHOUSE	
BASED ON	DRAWING NUMBER
BY: S. RUFFING / CHECKED BY: LS 11/4/97	APPROVED BY / DATE

MINIMUM THICKNESS:

$$h^2 = \frac{3P}{f_t}\left[1-\left(\frac{a\sqrt{2}}{\ell}\right)^{0.6}\right]$$

WHERE a = RADIUS OF LOAD CONTACT AREA = 9 in

$f_t = 200$ psi

$$h^2 = \frac{3(7100)}{200}\left[1-\left(\frac{9\sqrt{2}}{22.85}\right)^{0.6}\right]$$

$h^2 = 31.5 \text{ in}^2$ ✓

$h = 5.6 \text{ in}$ ✓

∴ USE 8" THICK SLAB TO ALLOW FOR TRAILER SETUP AND BLOCKING

CASE 2

VERIFY STRESS IN SLAB FOR LOAD APPLIED IN CENTER OF SLAB

$$f_b = 0.316\frac{P}{h^2}\left[\log h^3 - 4\log\left(\sqrt{1.6a^2+h^2}-0.675h\right) - \log k + 6.48\right]$$

$$= 0.316\frac{(7100)}{8^2}\left[\log 8^3 - 4\log\left(\sqrt{1.6(9^2)+8^2}-0.675(8)\right) - \log 500 + 6.48\right]$$

$$= 35\left[2.7 - 3.72 - 2.7 + 6.48\right]$$

$= 96.6$ psi < 200 psi ∴ OK ✓

CALCULATION WORKSHEET Order No. 19116 (01-91)

CLIENT NAVY (EARLE)	JOB NUMBER 7602
SUBJECT SLAB CALCS - FUTURE CLUBHOUSE	
BASED ON	DRAWING NUMBER
BY S. RUFFING · CHECKED BY LS 11/4/97	APPROVED BY · DATE

CASE 3

VERIFY STRESS IN SLAB IF LOAD APPLIED ALONG EDGE

$$f_b = 0.572\frac{P}{h^2}\left[\log h^3 - 4\log\left(\sqrt{1.6(a^2)+h^2} - 0.675(h)\right) - \log k + 5.77\right]$$

$$= 0.572\frac{(700)}{8^2}\left[\log 8^3 - 4\log\left(\sqrt{1.6(9^2)+8^2} - 0.675(8)\right) - \log 500 + 5.77\right]$$

$$= 63.5\left[2.7 - 3.7 - 2.7 + 5.77\right]$$

f_b = 131.4 psi < 200 psi ∴ OK ✓

REINFORCING STEEL REQ'D:

ONLY NEED STEEL FOR TEMP/SHRINK CONTROL

TENSION DUE TO CONTRACTION (T) = $\frac{W_o \mu l}{2}$

W_o = WT OF SLAB (PSF)
μ = COEFF. OF FRICTION
l = LENGTH BTWN CONTRACTION JOINTS
T = TENSILE FORCE

W_o = 150 pcf × (.67 × 1 × 1) = 100.5 lb/sf ✓
μ = 1.5
l = 12' MAX

$$T = \frac{100.5(1.5)(12)}{2} = 904.5 \text{ lb/FT OF WIDTH}$$ ✓

AREA OF STEEL (A_s) = $\frac{T}{f_s}$ WHERE f_s = 30,000 psi (ALLOWABLE STRESS ≅ 1/2 YIELD STRESS)

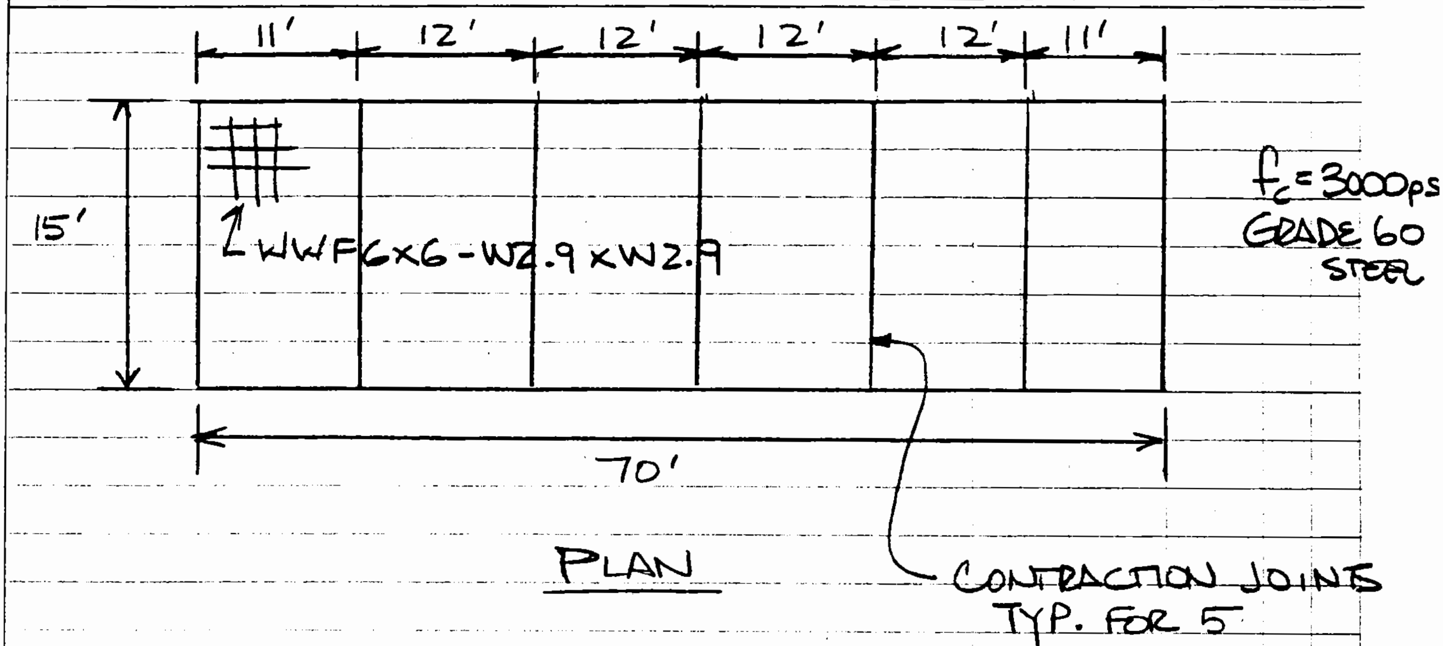
$A_s = \frac{904.5}{30000}$ = 0.03 in²/FT OF WIDTH ✓

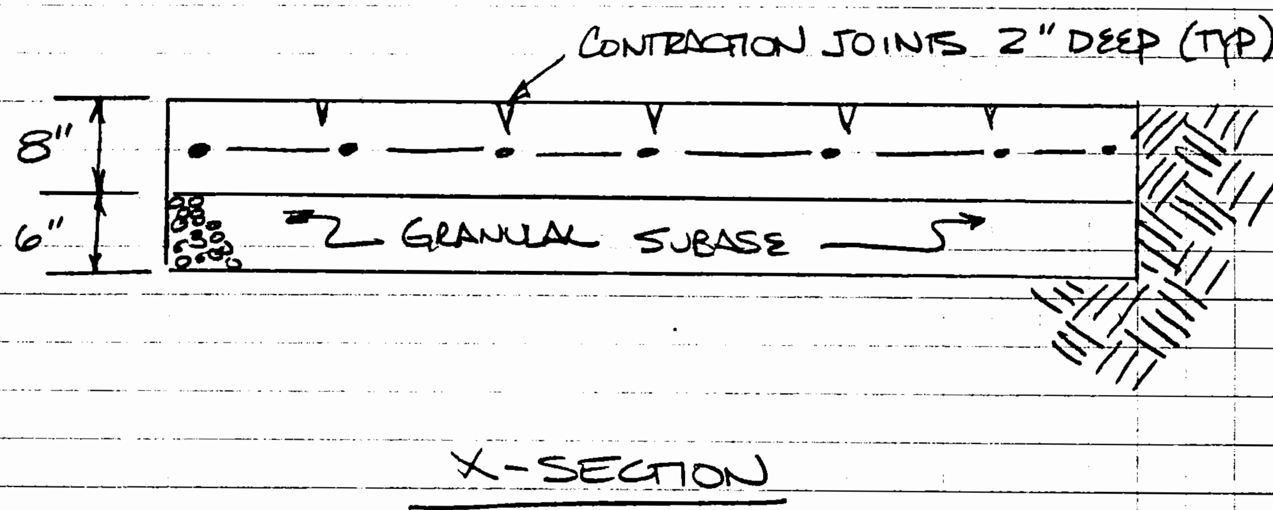
∴ USE WWF 6×6 - W2.9×W2.9 w/ A_s = 0.06 in²/FT

CALCULATION WORKSHEET Order No. 19116 (01-91)

CLIENT NAVY (EARLE)	JOB NUMBER 7602
SUBJECT SLAB CALCS - FUTURE CLUBHOUSE	
BASED ON	DRAWING NUMBER

BY	CHECKED BY	APPROVED BY	DATE
S. RUFFING	LS 11/4/97		





1900 Old Cuthbert Road
Cherry Hill, NJ 08034

Phone: (215) 923-5250
Fax: (609) 429-7478

Williams Scotsman, Inc.

ATTACHMENT 1

Fax

To:	Mike Wierman	From:	Michael O'Connell
Fax:	610-491-9645	Date:	10/28/97
Phone:		Pages:	
Re:		CC:	

• Urgent • For Review • Please Comment • Please Reply • Please Recycle

•Comments:

Mike

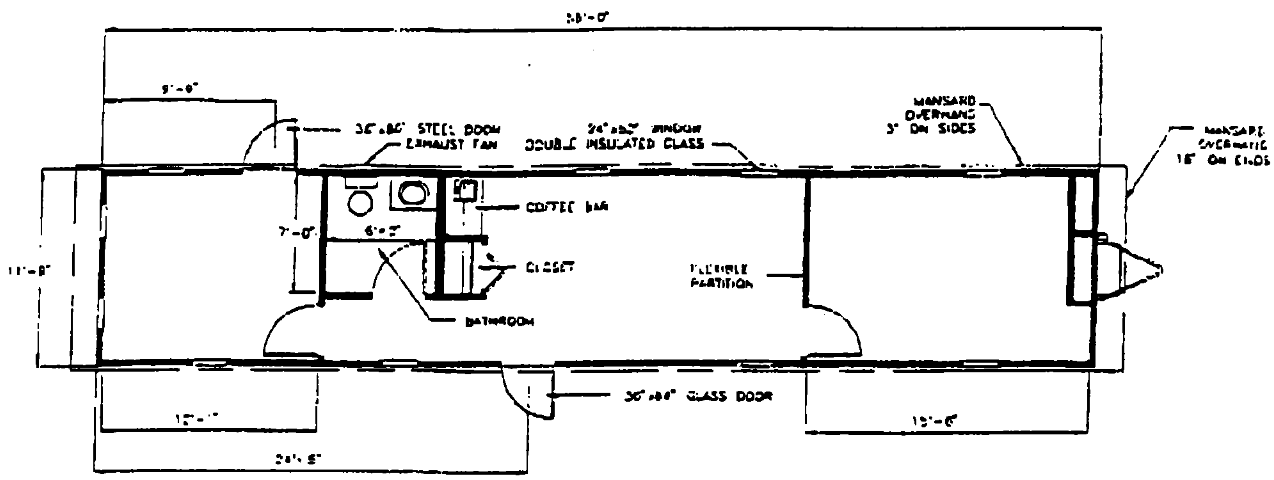
Call me if you have additional questions

Thank you

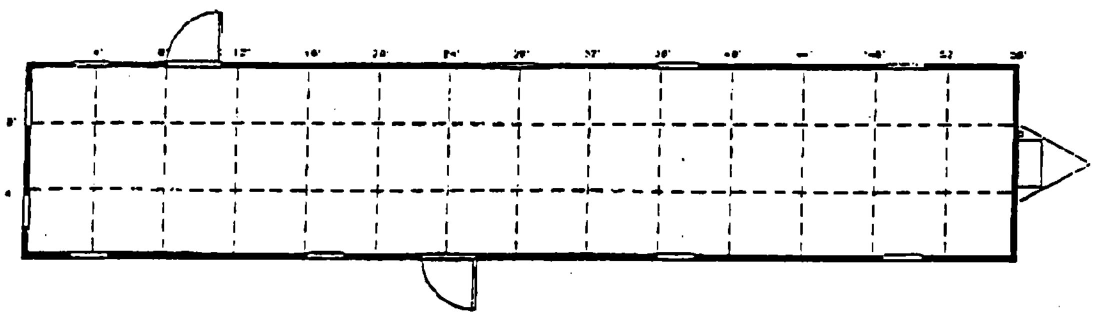
Michael O'Connell

Executive Line

EL6012



FLOOR PLAN



WORKING FLOOR PLAN

STANDARD FEATURES

3 Ton Central HVAC
1" Mini-blinds
Upgraded Insulation
Plywood Sub-floors
Simpson Board Siding
Flexible Front Partition

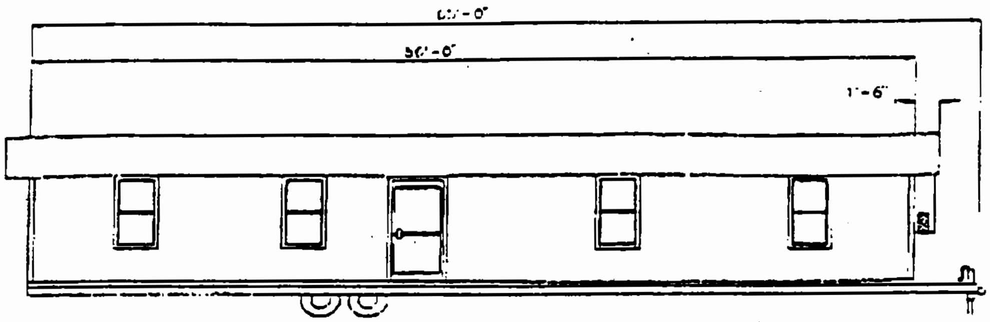
FRAME
12" I-Beam
Triple Axles
Electric Brakes
Asphalt Base Finish

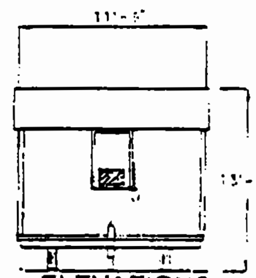
WALLS
5/8" Simpson Board Siding
2x4 Ext. Wall Framing
1/2" Vinyl Covered Sheetrock
3 1/2" R-11 Insulation
Flexible Front Partition

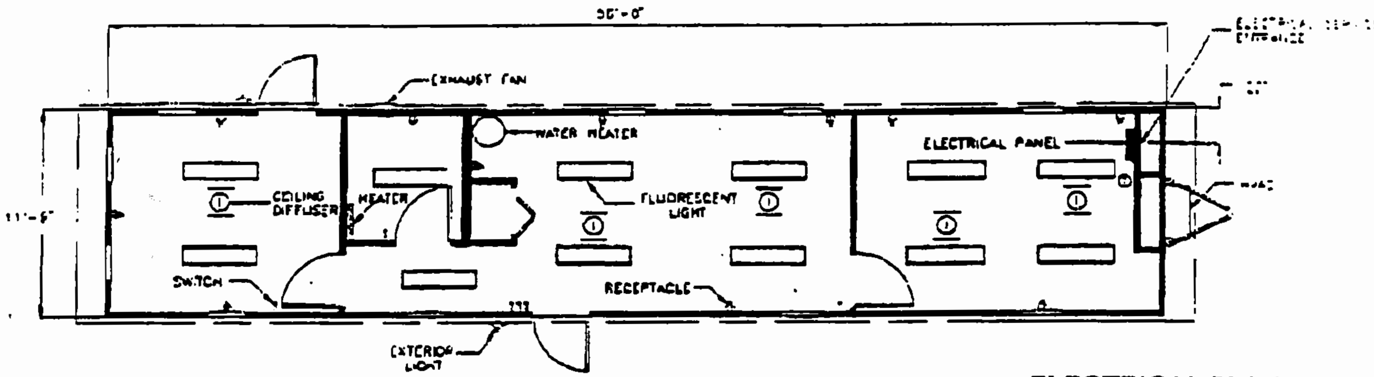
FLOOR
2x6 Joist
6" R-19 Insulation
5/8" Fir Plywood Decking (5 Ply)
Carpet Finish /Tile in
Bath & Entryway

ROOF
Galv. Steel Roofing
3/8" CD Plywood Sheathing
Wood Truss Rafters
6" R-19 Insulation
3/8" Gypsum Ceiling Finish
Mansard Roof Line w/Vent Soffit

EL6012







ELECTRICAL PLAN

PLUMBING
Type L Copper Supply Lines
DWV Lines To Meet
Code Requirements
6 Gallon Electric Water Heater

ELECTRICAL/HVAC
100 Amp 120/240V 1 Phase Service
48" 2-Tube Diffused Fluorescent Lights
3 Ton A/C w/ 10 KW Heat

ENGINEERING DATA
Unit Weight - 10 Tons
Floor to Ceiling Height - 8'-0"
Square Footage- 672
Nominal

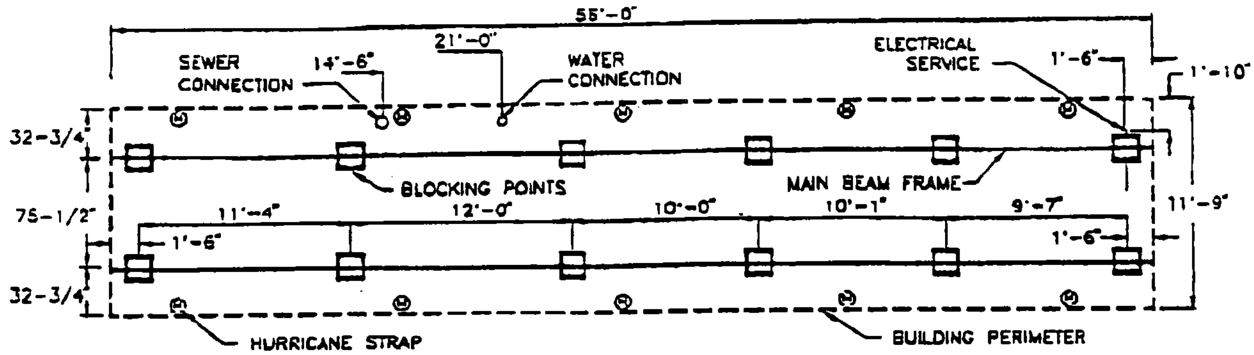
CODES

ANSI .... ☐ UBC .... ☐
BOCA .... ☐ SBC .... ☐
OTHER ....

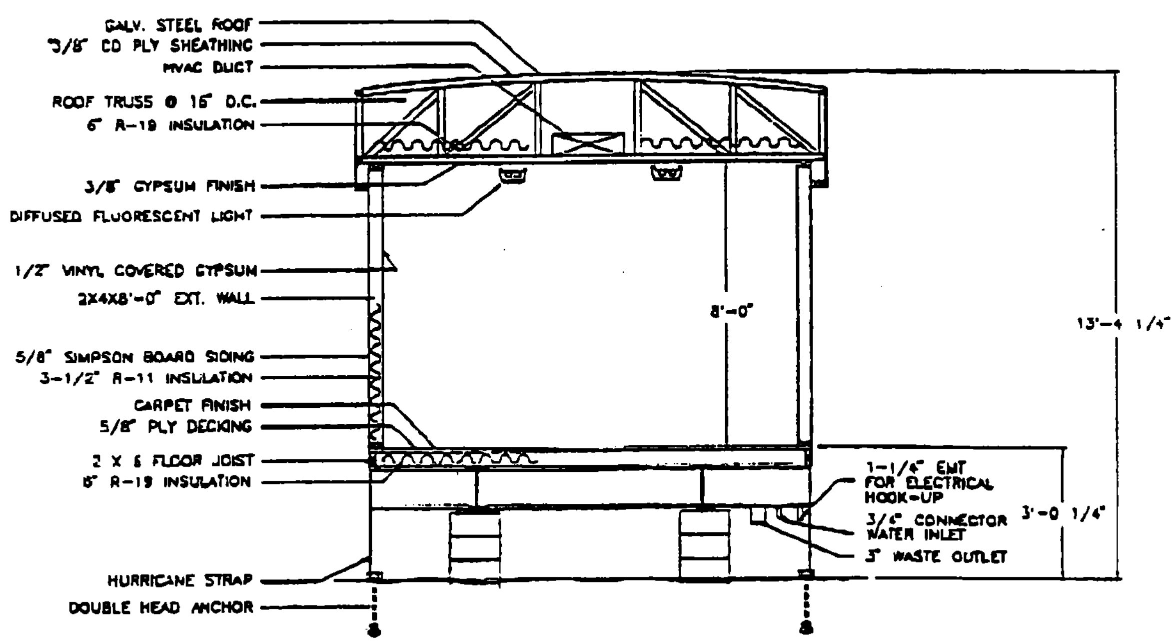
320S 0587- 8

Specifications subject to change without notice.

EL6012



BLOCKING DIAGRAM PLAN

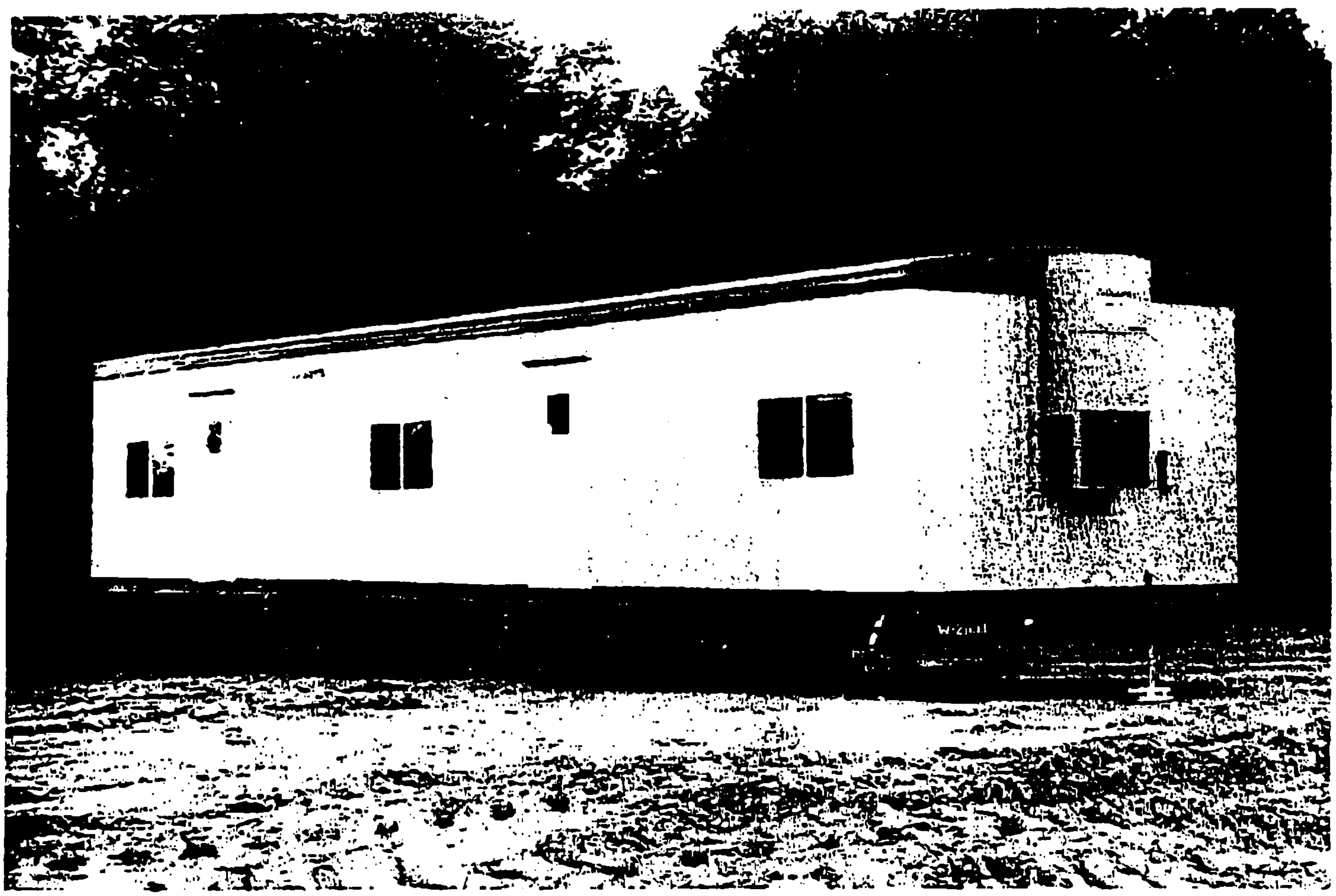


TYPICAL CROSS SECTION

Williams
MOBILE OFFICES / MODULAR STRUCTURES

MOBILE OFFICE 60 - 12

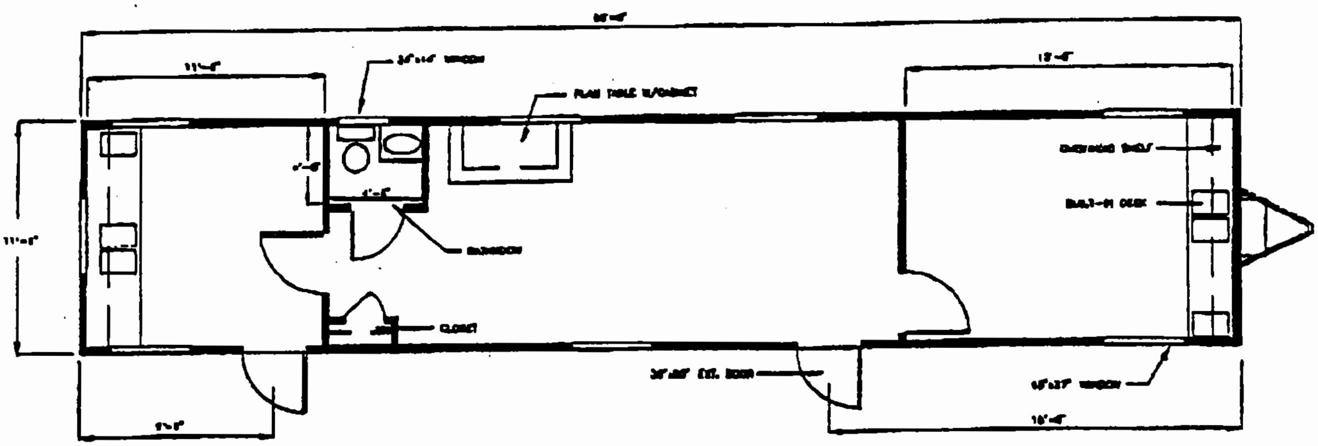
MO6012



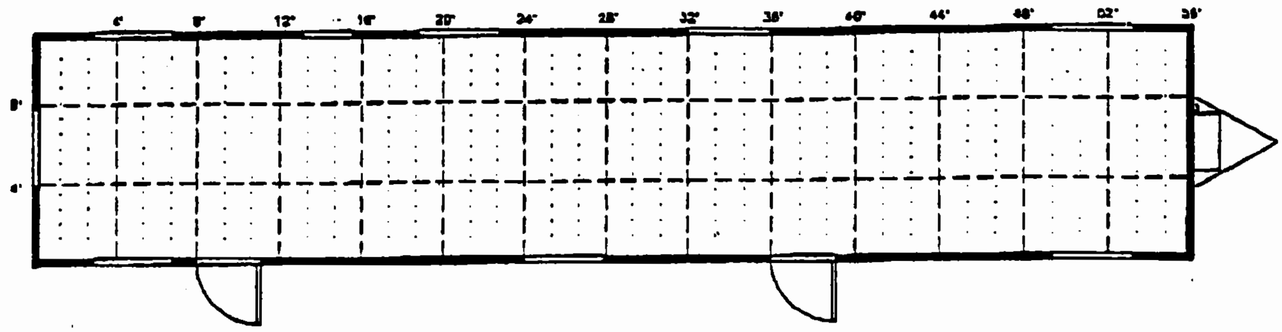
Offices For Business And Industry

Mobile Office

MO6012



FLOOR PLAN



WORKING FLOOR PLAN

STANDARD FEATURES

3 Ton Central HVAC
1" Mini-blinds
Upgraded Insulation
Plywood Sub-floors
Maintenance Free Aluminum Siding
Flexible Partitions

FRAME
12" I-Beam
Double Axles
Electric Brakes
Asphalt Base Finish

FLOOR
2x6 Joist
3 1/2" R-11 Insulation
5/8" Fir Plywood Decking (5 Ply)
3/32" Vinyl Composition Tile Finish

WALLS
Aluminum Siding
*1/8" Thermo-Bar Sheathing
2x4 Ext. Wall Framing
1/4" Paneling
3 1/2" R-11 Insulation

ROOF
Galv. Steel Roofing
*3/8" CD Plywood Sheathing
Bow Truss Rafters
6" R-19 Insulation
3/8" Gypsum Ceiling Finish

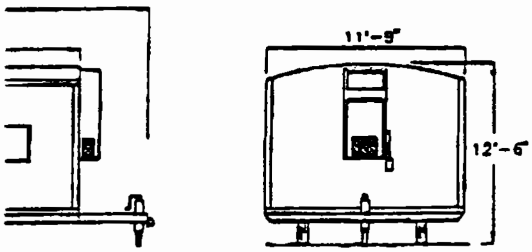
PLUMBING
Type L Copper Supply Lines
DWV Lines To Meet
Code Requirements
6 Gallon Electric Water Heater

ELECTRICAL/HVAC
100 Amp 120/240V 1 Phase Service
48" 2-Tube Fluorescent Lights
3 Ton A/C w/ 10 KW Heat

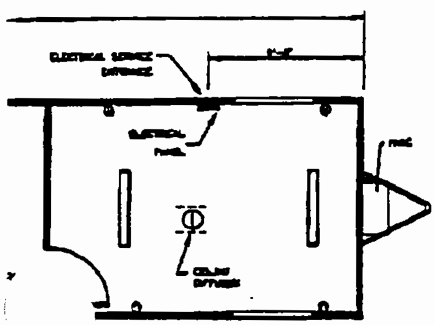
ENGINEERING DATA
Unit Weight - 7 Tons
Floor to Ceiling Height - 8'-0"
Square Footage - 672
Nominal

*Feature standard on BOCA, UBC, & SBC units only.

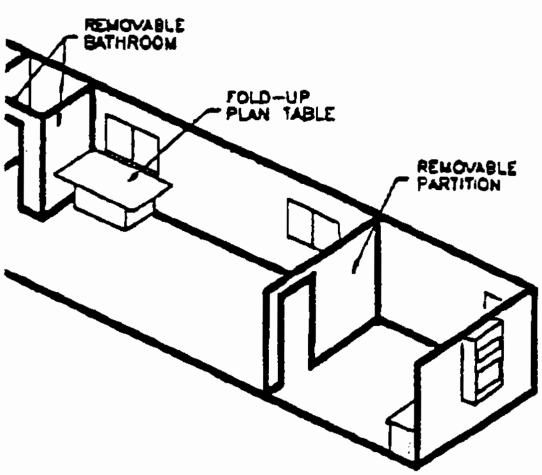
MO6012



ELEVATIONS

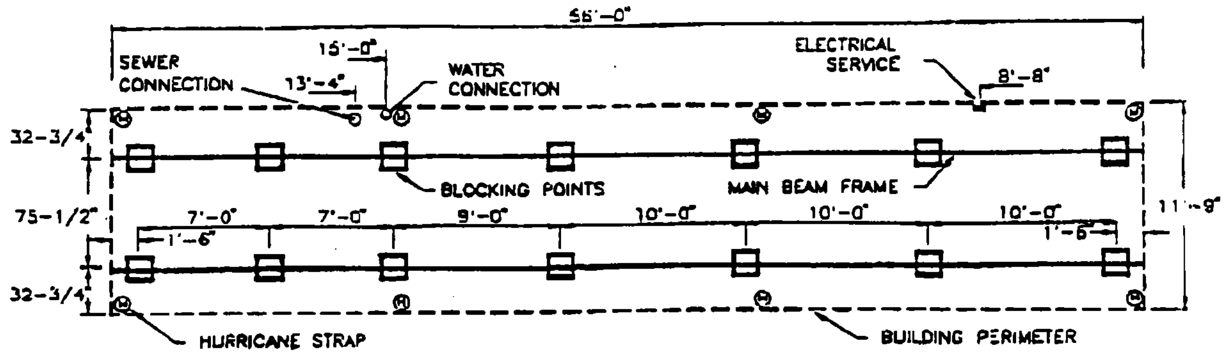


ELECTRICAL PLAN

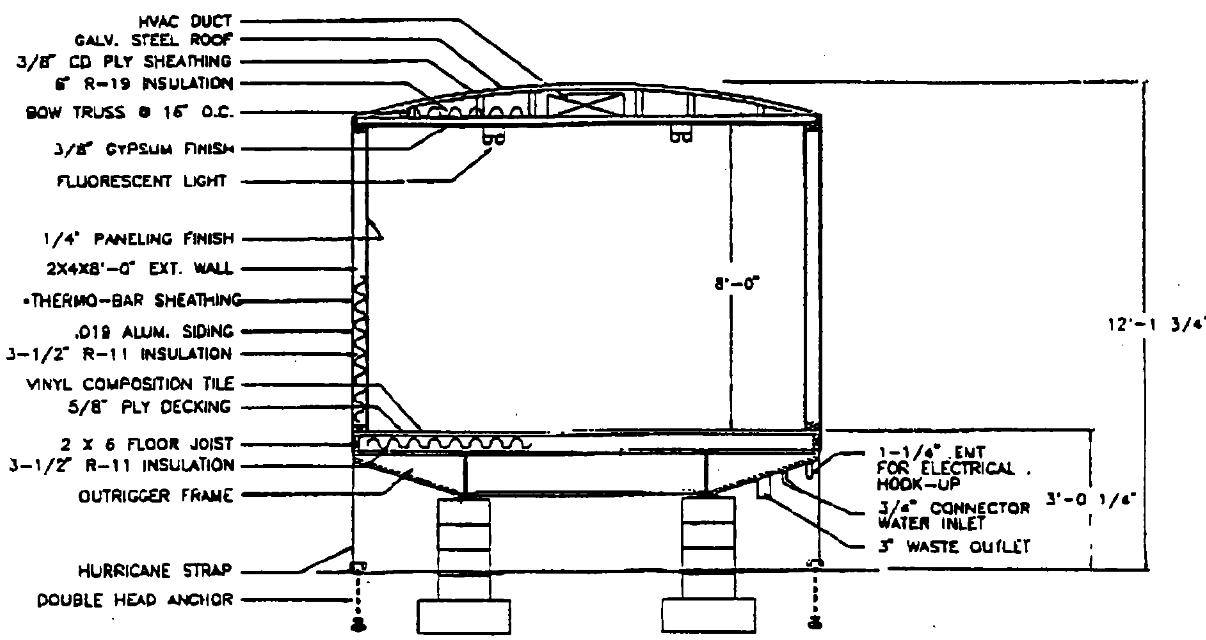


ubject to change without notice.

MO6012



BLOCKING DIAGRAM PLAN



TYPICAL CROSS SECTION

Environmental Permits Report and Consolidated Compliance Assessment Report

for

Final Design Submission Remedial Action at Operable Unit 1 (Sites 4 and 5)

Naval Weapons Station Earle

Colts Neck, New Jersey

Northern Division

Naval Facilities Engineering Command

Contract Number N62472-90-D-1298

Contract Task Order 0289

November 1997

079716/P

ENVIRONMENTAL PERMITS REPORT AND CONSOLIDATED COMPLIANCE ASSESSMENT REPORT FOR REMEDIAL ACTION AT OPERABLE UNIT 1 (SITES 4 AND 5)

NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

Submitted to:
Northern Division
Environmental Branch Code 18
Naval Facilities Engineering Command
10 Industrial Highway, Mail Stop #82
Lester, Pennsylvania 19113-2090

Submitted by:
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600 Clark Avenue, Suite 3
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CONTRACT NUMBER N62472-90-D-1298
CONTRACT TASK ORDER 0289

November 1997

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1.0 INTRODUCTION

This Environmental Permits Report/Consolidated Compliance Assessment Report was prepared under the Comprehensive Long-Term Environmental Action Navy (CLEAN) Contract No. N62472-90-D-1298, Contract Task Order (CTO) No. 289. Under CTO No. 289, Brown & Root (B&R) Environmental is performing engineering, design, and post-construction award services for remedial action at Operable Unit 1 (OU-1) at Naval Weapons Station (NWS) Earle in Colts Neck, New Jersey.

OU-1 includes Site 4 (the Landfill West of "D" Group) and Site 5 (the Landfill West of Army Barricades). The OU-1 sites were grouped together based on similarities of waste volumes, types of contaminants, and the potential for contaminants to migrate to human and/or environmental receptors. Figure 1-1 provides the location of Sites 4 and 5 at NSW Earle.

1.1 BACKGROUND INFORMATION

Sites 4 and 5 (OU-1) are Navy Installation Restoration Program (IRP) sites at NWS Earle. B&R Environmental recently performed environmental investigative work at Sites 4 and 5 under CTO No. 231.

1.1.1 Site 4 - Landfill West of "D" Group

Site 4 is a 5-acre landfill that received approximately 10,200 tons of mostly domestic wastes, with some industrial wastes, from 1943 until 1960. Industrial wastes included metal scrap, construction debris, pesticide and herbicide containers, paint residues, and rinsewaters. It has been reported that containers of paint, paint thinner, varnish, shellac, acid, alcohol, caustic, and asbestos may have been disposed of at Site 4. A site layout map is provided in Figure 1-2.

The landfill is covered primarily with sandy soil and vegetated primarily with white pine and grasses. Exposed debris is present on the eastern side of the landfill. The fill is approximately 25 feet high on the southeastern part of the site, but tapers to the original ground surface near the western and northern limits of the landfill.

A broad, low-lying wetland extends from the eastern portion of Site 4. A portion of this wetland exists immediately to the southeast of the landfill. Surface water and groundwater flow is to the east and east-southeast toward these wetlands.

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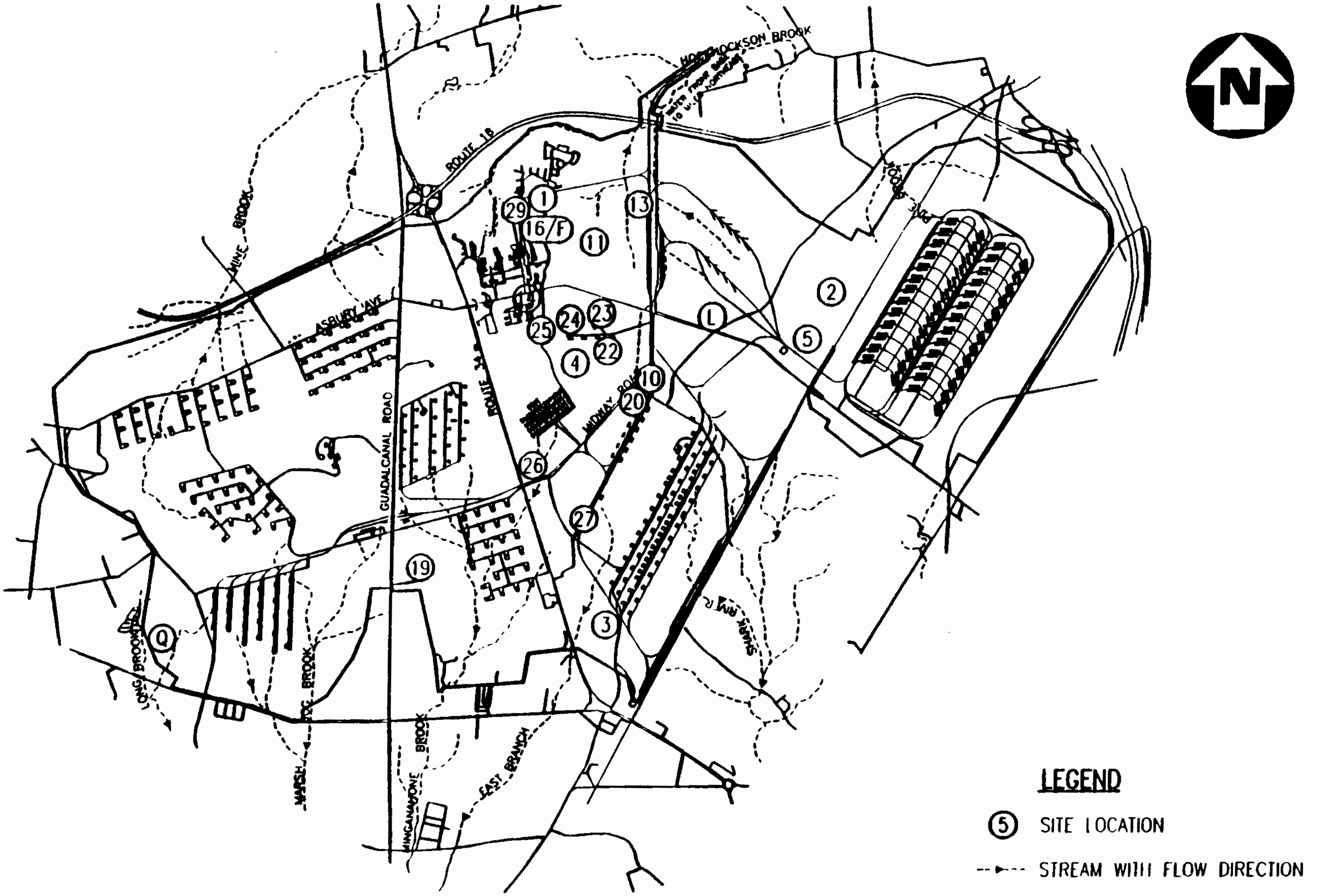

DRAWN BY MRM	DATE 1/7/97	Brown & Root Environmental	CONTRACT NO.	OWNER NO.
CHECKED BY RET	DATE 1/7/97	MAINSIDE SITE LOCATIONS	APPROVED BY	DATE
COST/SCHED.-AREA		NAVAL WEAPONS STATION EARLE	APPROVED BY	DATE
SCALE 1"=5000'		COLTS NECK, NEW JERSEY	DRAWING NO. FIGURE 1-1	REV

CTO 0289

Rev. 1
November 1997

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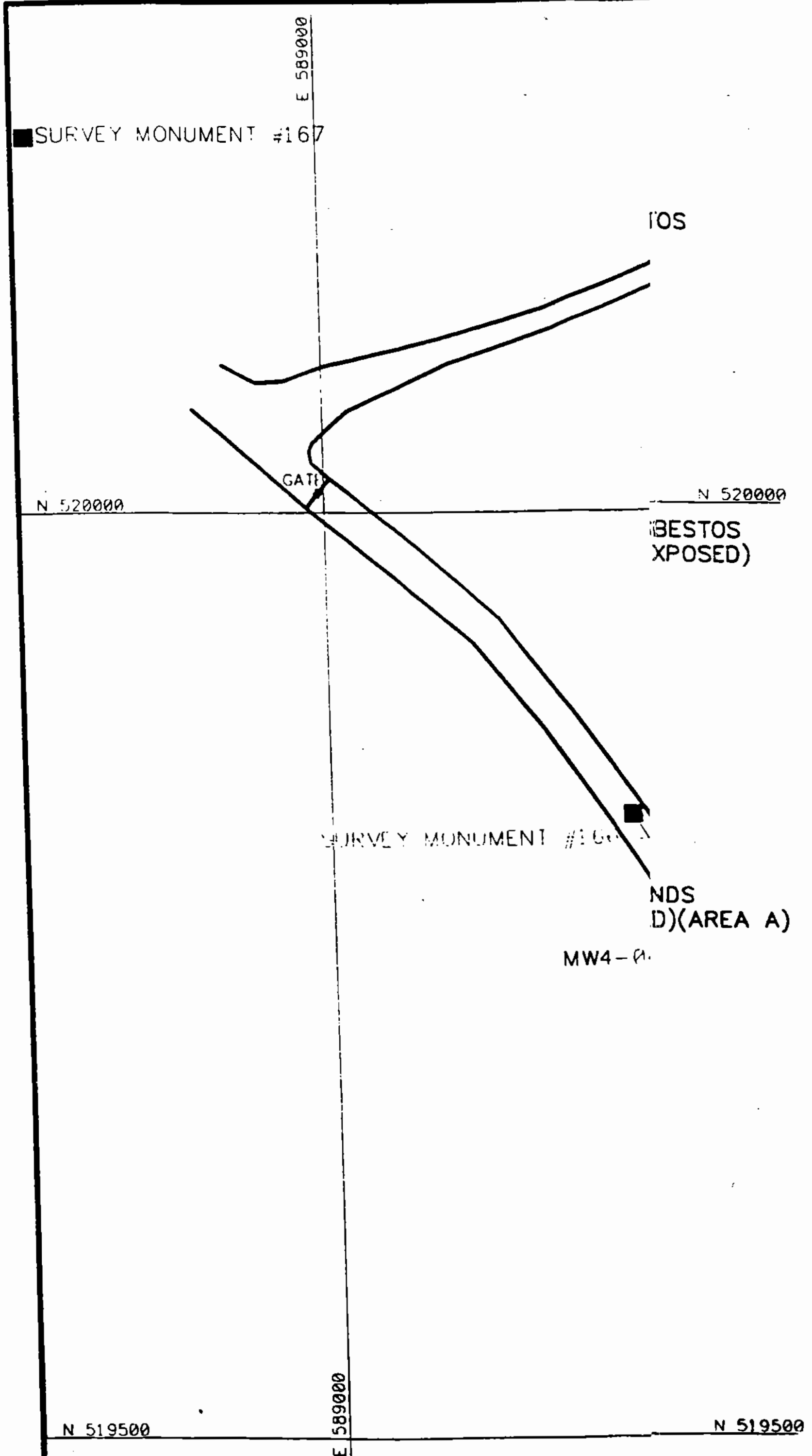

LEGEND:

- TEST PIT
- GEOTECHNICAL BORING
- MONITORING WELL

NOTES:

1) SURVEY MONUMENT 166 IS A RAILROAD SPIKE IN BITUMINOUS ROAD.
2) SURVEY MONUMENT 167 IS IRON PIN IN IN A BITUMINOUS/SAND ROAD.
3) EXACT HORIZONTAL LOCATION AND VERTICAL ELEVATION OF WATERLINE ARE UNKNOWN. ILLUSTRATED LOCATION IS APPROXIMATE BASED ON HISTORICAL INFORMATION.

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SCALE IN FEET

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CONTRACT NO. 7602	OWNER NO.
APPROVED BY	DATE
APPROVED BY	DATE
DRAWING NO. FIGURE 1-2	REV. 0

FORM CADD NO. SOUTH_BH.DGN - REV 0 - 02/11/97

The results of remedial investigations at Site 4 identified metals in groundwater at levels above regulatory guidelines, including aluminum, iron, and manganese. Organic compounds found in groundwater at concentrations above regulatory guidelines include 1,2-dichloroethene and trichloroethene. The remedial investigations concluded that there has been no migration of volatile organics to deeper aquifer levels. Samples of surface water and sediment contain a variety of compounds at concentrations below human health risk levels.

The human health risk assessment concluded that non-cancer risks were above guideline limits only for ingestion of groundwater. The ecological risk assessment concluded that contaminants do not appear to be significantly migrating to surface water or sediment in the wetlands at a level of ecological concern.

1.1.2 Site 5 - Landfill West of Army Barricades

Site 5 is a 4-acre landfill that received approximately 6,600 tons of mostly domestic wastes, with some industrial wastes, from 1968 until 1978. The majority of the waste was domestic waste, consisting of paper, glass, and plastics. Industrial waste included construction debris, small amounts of asbestos, pesticide and herbicide containers, pesticide rinsewaters, and discarded containers of paint, paint thinner, solvents, varnish, shellac, acid, alcohol, and caustic. A site layout map is provided in Figure 1-3.

The site is characterized by a mix of open areas moderately vegetated with grasses and wooded areas vegetated with white pines. The landfilled materials are currently covered by a sand and vegetated soil layer ranging in depth from 1 to 3 feet. Railroad tracks run along the southwestern boundary, and a wetland is located to the west. The topography slopes slightly to the southwest. Groundwater flow is generally to the northeast. Approximately 1 acre of the site is currently used as a skeet shooting range. Wastewater from the club house at the skeet range flows to an on-lot septic system.

The results of remedial investigations at Site 5 identified metals in groundwater at levels above regulatory guidelines, including aluminum, cadmium, iron, manganese, nickel, and thallium. Organic compounds found in groundwater at concentrations above regulatory guidelines include 1,2-dichloroethane, benzene, chloroform, and trichloroethene.

The human health risk assessment concluded that non-cancer risks were above guideline limits only for ingestion of groundwater. The ecological risk assessment concluded that contaminants do not appear to be significantly migrating to surface water or sediment in the wetlands.

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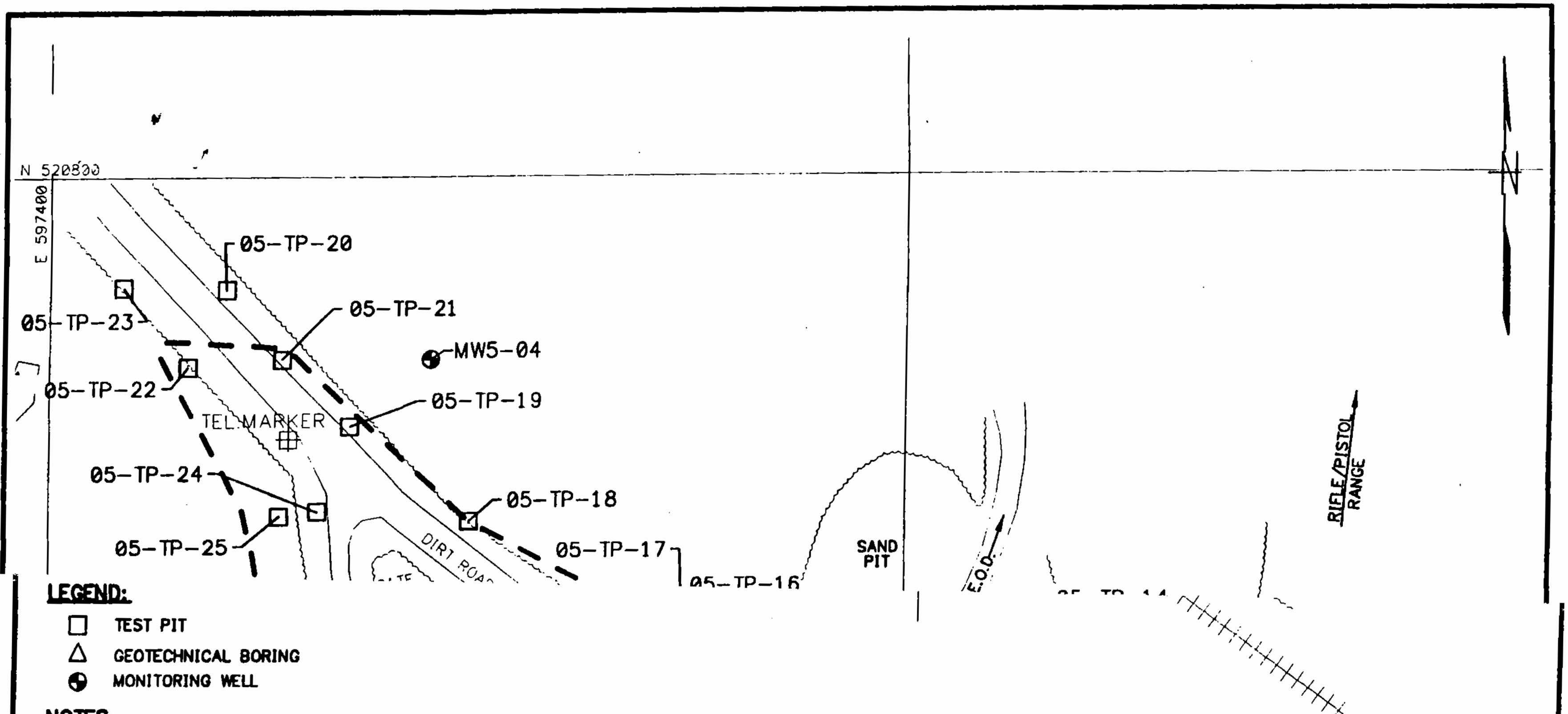

LEGEND:

- TEST PIT
- GEOTECHNICAL BORING
- MONITORING WELL

NOTES:

1) SITE 5 SURVEY MONUMENTS ARE LOCATED OUTSIDE THE BOUNDARIES PRESENTED ON THIS FIGURE.

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SCALE IN FEET

CHECK GRAPHIC SCALE BEFORE USING

DRAWN BY TAD DATE 8/28/97	Brown & Root Environmental	CONTRACT NO. 7602	OWNER NO. 0289
CHECKED BY DATE	SITE 5 PRE-DESIGN EXISTING CONDITIONS PLAN NAVAL WEAPONS STATION EARLE COLTS NECK, NEW JERSEY	APPROVED BY	DATE
COST/SCHED-AREA		APPROVED BY	DATE
SCALE AS NOTED		DRAWING NO. FIGURE 1-3	REV. 0

FORM CADD NO. SOUTH_BV.DWG - REV 0 - 04/16/97

1.2 PURPOSE

This report identifies applicable permits, filing procedures, and filing costs required to complete the remedial actions outlined in Section 2.0. The Comprehensive Environmental Response Compensation and Liability Act (CERCLA) Section 121(e) exempts any response action conducted entirely on site from having to obtain a federal, state, or local permit. Onsite actions need comply only with the substantive aspects of environmental regulations, not with the corresponding administrative requirements, such as permits, reporting, and recordkeeping. For onsite actions, the substantive aspects of permits regulations are also identified. According to 40 CFR 300.400(e), the term "onsite" means the areal extent of contamination and all suitable areas in very close proximity to the contamination necessary for implementation of the response action. Permits, if required, shall be obtained for all response activities conducted offsite.

2.0 PROPOSED REMEDIAL ACTION

2.1 REMEDIAL ACTION OBJECTIVE

Analytical results for groundwater samples collected during the remedial investigations at Sites 4 and 5 indicated that there were contaminant concentrations that exceeded the established Preliminary Remediation Goals (PRGs). The remedial investigations also concluded that buried wastes in the landfill at each site represent future risks to human and ecological receptors. No impacts to surface water or sediment were identified as a result of waste disposal at each site. The scope of this report is limited to landfilled wastes and groundwater at the site that have been affected by hazardous chemical constituents.

The objective of the proposed remedial action for OU-1 is to contain buried waste beneath low-permeability caps. Potential exposure to groundwater will be mitigated through institutional controls.

2.2 REMEDIAL ACTION DESCRIPTION

The remedial action for OU-1 will consist of general site preparation work, capping the landfills, and restoration of the sites. Institutional controls will be imposed, and the sites will be monitored.

General Site Preparation: The areas in which construction activities will be performed will be cleared and grubbed. In addition, appropriate erosion and sediment control measures will be implemented. Because of the existing topography and drainage patterns at Site 4, a sedimentation basin will need to be constructed near the adjacent wetlands. The site surfaces will be graded to construct a suitable base for the cover systems and allow for proper drainage after the caps have been installed. The skeet shooting range at Site 5 will be removed, and the existing on-lot septic system will be abandoned. The skeet shooting range will be rebuilt once the site is capped, and a wastewater holding tank will be installed to replace the existing on-lot septic system.

Cap Landfills: A low-permeability cap, designed in accordance with New Jersey closure requirements for sanitary landfills, will be installed over the landfills at each site. The purpose of capping is to prevent potential human and animal contact with contaminants in the landfill materials, limit contaminant leaching to groundwater, and minimize contaminant migration via surface runoff and erosion. Some waste may be consolidated at each site or between sites to facilitate cap construction. Portions of the skeet shooting range (concrete rubble and other non-degradable waste) will be disposed of under the cap.

During cap installation at Site 5, existing wells within the work area will be affected. Several wells within the cap boundaries will need to be modified from "stick ups" to "flush mount." One monitoring well (MW5-04) will need to be abandoned to allow installation of a sedimentation basin.

Institutional Controls: Institutional controls will consist of maintaining records of the contamination at Sites 4 and 5 in the NWS Earle Master Plan and Navy real estate records, limiting future uses of the sites that may result in disturbance of the soil cover or direct contact with contaminated media, and prohibiting use of untreated contaminated groundwater. Long-term periodic monitoring of groundwater, surface water, and wetland sediment will be conducted to assess the migration of contaminants and to determine the need for future actions. Because site groundwater does not meet New Jersey groundwater quality standards, a classification exception area (CEA) will be established to provide notice that the constituent standards will not be met for a specified duration and to ensure that use of groundwater in the affected areas is suspended until standards are achieved.

Offsite Disposal: Portions of the skeet shooting range at Site 5 will be removed and transported offsite to a nonhazardous waste landfill.

3.0 REQUIRED PERMITS

Table 3-1 presents a project permit checklist to assess what (if any) permits may be required for specific projects to assure regulatory compliance. This table lists the type of permit, license, or certification that may be required by government agencies for specific types of projects. Based on a review of the permit checklist in Table 3-1, transporters of solid waste to an offsite landfill must have an approved registration statement. No other permits are required by government agencies for remedial actions at OU-1, since onsite remedial actions at CERCLA sites are exempt from obtaining permits or compliance with administrative requirements of federal, state, or local environmental laws and regulations. However, onsite remedial actions must comply with the substantive requirements. The substantive requirements are summarized below and described in Section 4.0.

3.1 FEDERAL PERMITS AND REQUIREMENTS

No U.S. Environmental Protection Agency (EPA) requirements apply to this project.

No Army Corps of Engineers (COE) permits or requirements apply to this project. Army COE regulations relating to construction activities that affect wetlands and open waters have been assumed by the State of New Jersey.

3.2 STATE PERMITS AND REQUIREMENTS

A limited amount of solid waste from the skeet shooting range (demolition debris) at Site 5 will be transported offsite. The transporter must have an approved registration statement from the New Jersey Department of Environmental Protection (NJDEP). There are no other NJDEP permits required for this project. Onsite remedial actions at CERCLA sites are exempt from permits and other administrative requirements; however, substantive requirements must be met. Requirements for stormwater discharges associated with construction activities, construction of a sedimentation basin near wetlands adjacent to Site 4, closure of the solid waste landfills, abandonment of the Site 5 on-lot septic system, modification or abandonment of existing monitoring wells, and construction of the wastewater holding tank to replace the on-lot septic system at Site 5 must be met. In addition, classification exemption areas must be established where groundwater contaminant concentrations exceed state standards. Requirements for earth moving operations (i.e., erosion and sediment control) have been delegated to the Freehold Soil Conservation District.

TABLE 3-1

PROJECT PERMIT CHECKLIST
OPERABLE UNIT 1 (SITES 4 AND 5), NWS EARLE
COLTS NECK, NEW JERSEY
PAGE 1 OF 3

Type of Project	Type of Permit, License, Certification	Issuing Agency	Applicability	Reason
Stationary Air Emission Source	Permit-to-Construct/Modify Source Permit-to-Operate	State	Not Applicable	Discharge of air emissions will not occur.
Construction in Floodplain, Waterway, or Wetlands	Dredge/Fill Permit Freshwater Wetland Permit Stream Encroachment Permit	COE State State	Applicable	Sedimentation basin at Site 4 will be constructed near adjacent wetlands. Permit not required; substantive requirements discussed in Section 4.1.
Wastewater Discharge to "Waters of the U.S."	Permit-to-Discharge (NJPDES)	State	Not Applicable	No discharge of wastewater will occur.
Wastewater Discharge to Sewer	Sewer-Use-Permit (if to municipal POTW)	State or Local	Not Applicable	No discharge of wastewater will occur.
Wastewater Facility	Treatment Works Approval	State	Applicable	Wastewater holding tank will be installed at Site 5. Permit not required; substantive requirements discussed in Section 4.2.
Septic Tank System	Permit to Construct/Alter/ Repair	State and Local	Applicable	On-lot septic system at Site 5 will be abandoned. Permit not required; substantive requirements discussed in Section 4.2.
Potable Water Treatment	Permit-to-Operate	State	Not Applicable	Water is not being treated for potable use.
Underground Injection for Waste Disposal	Discharge to Groundwater	State	Not Applicable	Underground injection will not be performed.
Ocean Dumping	Permit-to-Dump	EPA	Not Applicable	Ocean dumping will not be performed.
Dredging	Dredge/Fill Permit Ocean Disposal Permit State Water Quality Cert.	COE COE State	Not Applicable	Dredging will not be performed.

PROJECT PERMIT CHECKLIST
OPERABLE UNIT 1 (SITES 4 AND 5), NWS EARLE
COLTS NECK, NEW JERSEY

Type of Project	Type of Permit, License, Certification	Issuing Agency	Applicability	Reason
Structure in Navigable Water	Section 10 Permit	COE	Not Applicable	Structures will not be built in navigable water.
Stormwater Discharge to "Waters of the U.S."	Permit-to-Construct/Modify Source Permit-to-Discharge	State	Applicable	Stormwater runoff during construction activities will be controlled and discharged. Permit not required; substantive requirements discussed in Section 4.3.
Earth Moving Operations	Permit-to-Construct Erosion and Sediment Control Plan	State or Local	Applicable	Earth moving will occur during cap construction. Permit or Erosion and Sediment Control Plan not required; substantive requirements discussed in Section 4.4.
Fill Wetlands	Dredge/Fill Permit Freshwater Wetlands Permit	COE State	Applicable	Sedimentation basin at Site 4 will be constructed near adjacent wetlands. Permit not required; substantive requirements discussed in Section 4.1.
Solid Waste Landfills/Dumps	Permit-to-Operate	State	Applicable	Solid waste landfills will be closed. No permit required; closure requirements discussed in Section 4.5.
Solid Waste Transporting	Approved Registration Statement	State	Applicable	Offsite shipment of solid waste will occur (see Section 4.6).

TABLE 3-1

PROJECT PERMIT CHECKLIST
OPERABLE UNIT 1 (SITES 4 AND 5), NWS EARLE
COLTS NECK, NEW JERSEY
PAGE 3 OF 3

Type of Project	Type of Permit, License, Certification	Issuing Agency	Applicability	Reason
Hazardous Waste Generation	EPA Identification Number	State	Not Applicable	Hazardous wastes will not be generated.
Hazardous Waste Transporting	State Waste Hauler License/Permit	State	Not Applicable	Hazardous waste will not be hauled off site.
Hazardous Waste Treatment, Storage, Disposal	Permit-to-Construct Permit-to-Operate (Part B Permit)	State	Not Applicable	Hazardous waste will not be treated, stored, or disposed.
Underground Storage Tanks	Permit-to-Construct Permit-to-Operate Registration	State or EPA	Not Applicable	No underground storage tanks exist within this project.
Pesticide Application	Applicator Certification	DOD	Not Applicable	Pesticides will not be used.
Groundwater Remediation (Active or Passive)	Classification Exception Area	State	Applicable	Groundwater contaminant concentrations exceed state standards (see Section 4.7).
Modification at Monitoring Wells	New Jersey Well Drilling Certification	State	Applicable	All modifications to an existing well must be performed by a New Jersey Certified well driller.
Abandonment of Monitoring Wells	Well Abandonment Form Completed by a New Jersey Certified Driller	State	Applicable	One well will be abandoned.

3.3 LOCAL PERMITS AND REQUIREMENTS

The Freehold Soil Conservation District is responsible for the implementation of New Jersey erosion and sedimentation control requirements. An Erosion and Sedimentation Plan will not be required because onsite remedial actions at CERCLA sites are exempt from permits and other administrative requirements. However, the substantive aspects of these requirements must be met. Because preparation of an Erosion and Sediment Control Plan is included in the Scope of Work for this CTO, the plan will be prepared according to the Standards for Soil Erosion and Sediment Control in New Jersey.

Although not shown on Table 3-1, NWS Earle has construction contractor requirements that must be followed. Many of these requirements are contained in an information package supplied by NWS Earle (see Section 4.8).

4.0 PERMIT APPLICATIONS AND COMPLIANCE

No permits are required for OU-1 remedial activities. Onsite remedial actions at CERCLA sites are exempt from obtaining permits and other administrative requirements. However, compliance with substantive requirements is needed. An Erosion and Sedimentation Control Plan is part of the scope of work for this project. Compliance with substantive requirements and certification of the Erosion and Sedimentation Control Plan as well as other aspects of the proposed remedial activities are discussed in the following sections.

4.1 CONSTRUCTION IN FLOODPLAIN, WATERWAY, OR WETLAND; FILL WETLANDS

4.1.1 Freshwater Wetlands

A storm water retention basin of approximately 0.4 acres is proposed to be constructed adjacent to the freshwater wetland area south of Site 4. The installed landfill cap is likely to encroach on these wetlands. Waste materials in one area adjacent to these wetlands will be excavated and removed, providing additional area for wetlands restoration. In addition, stormwater may be discharged to wetlands from both sites. Under Section 404 of the Clean Water Act, EPA and the Army Corps of Engineers have authority to control the discharge of fill into lakes, ponds, rivers, and streams and their associated wetlands. The EPA has formally turned administration of the federal wetlands program over to the NJDEP.

NJDEP Freshwater Wetlands Regulations (NJAC 7:7A) are applicable to the "dumping, discharging, or filling with any materials" in a freshwater wetland. The wetlands adjacent to Sites 4 and 5 meet the classification of a freshwater wetland of intermediate resource value. NJDEP has a general permit program (NJAC 7:7A-9) that authorizes activities on a statewide basis. The following Statewide General Permits and related substantive requirements are relevant to this project.

Statewide General Permit 4 authorizes regulated activities, including work, discharges, and the construction or placement of structures, which are undertaken, authorized, or otherwise expressly approved in writing by NJDEP for the investigation, cleanup, or removal of hazardous substances. Mitigation shall be performed according to the procedures for mitigation at NJAC 7:7A-14 for all disturbance or destruction of freshwater wetlands caused by cleanup. Mitigation must be performed prior to or concurrently with activities that will permanently disturb wetlands and immediately after activities that will temporarily disturb wetlands. Mitigation may include restoration, creation, enhancement, or donation of money and/or land to the Mitigation Bank, or to other public or private non-profit conservation organizations. These mitigation measures are described below:

- Restoration refers to actions performed in the site of a regulated activity, within six months of the regulated activity, in order to reverse or remedy the effects of the activity on the wetland and to restore the site to pre-activity condition. Restoration is required at a ratio of one acre restored to one acre lost, modified, or disturbed. If more than six months has elapsed, creation will be required.

- Creation refers to actions performed to establish freshwater wetland characteristics, habitat, and functions on upland areas. Creation is required at a ratio of two acres created to one acre lost or disturbed.

- Enhancement refers to actions performed to improve the characteristics, habitat, and functions of an existing, degraded wetland such that the enhanced wetland will have resource values and functions similar to an undisturbed wetland.

- Contribution refers to the donation of money or land to the Mitigation Bank or to other public or private non-profit conservation organizations as approved by the Mitigation Council and the NJDEP in consultation with USEPA. Donations shall only be considered if other forms of mitigation are not feasible on site or off site in the same watershed.

Statewide General Permit 6 covers regulated activities (work, discharges, construction or placement of structures, placement of fill) in freshwater wetlands, provided the activity would not result in the loss or substantial modification of more than one acre of wetland.

Statewide General Permit 11 covers construction of stormwater outfall structures and associated stormwater conveyance structures such as pipes, headwalls, rip-rap, and other energy dissipation structures. The following conditions must be met:

- The structures must be designed to minimize the area of freshwater wetlands disturbed. The limit of disturbance or modification cannot exceed 20 feet in width.

- The total area of freshwater wetlands disturbed or modified cannot exceed 0.25 acre.

- The facility must be designed in accordance with the Standards for Soil Erosion and Sediment Control in New Jersey.

- All stormwater that is discharged into a freshwater wetland from an outfall constructed under this general permit must first be filtered or otherwise treated outside of the wetland to minimize sediment, pollutants, and any other detrimental effects. Detention basins, contour terraces, and grasses swales are examples of pre-discharge treatment techniques. This Statewide General Permit does not authorize placement of detention facilities in freshwater wetlands.

- The total amount of rip-rap or other material used for energy dissipation at the end of a headwall placed in the wetland cannot exceed 10 cubic yards.

- Excavated areas for the placement of conveyance pipes shall be returned to the pre-existing elevation using the original topsoil to backfill from a depth of 18 inches to the original grade and revegetated with indigenous wetland species.

- Pipes used for stormwater conveyance through the wetlands shall be properly sealed with anti-seep collars at a spacing sufficient to prevent drainage of the surrounding wetlands and designed not to exceed the pre-existing elevation.

- If a detention basin is proposed as the method of pretreatment of water quality, routing calculations shall show that the basin has been designed for the one-year storm event according to the Stormwater Management Regulations (NJAC 7:8).

- If a swale is proposed to convey stormwater through the wetlands, profiles from the outlet to the receiving water body, cross sections, and design support information shall show that the proposed swale will not result in drainage of wetlands. Swales can only be used if onsite conditions prohibit the construction of a buried pipe to convey stormwater to the outfall.

Standards and Conditions for all Statewide General Permit Authorizations (NJAC 7:7A-9.3) list other substantive requirements. The following requirements would apply to this project:

- Any discharge of dredged or fill material shall consist of suitable materials free from toxic pollutants (Section 307 of the Clean Water Act) in toxic amounts.

- Any structure or fill shall be maintained as specified in the construction plans.

- During construction activities, all excavation must be monitored to check for the presence of acid-producing deposits pursuant to NJAC 7:13-5.10 of the New Jersey Flood Hazard Area Control Rules.

If any such deposits are encountered, the mitigation and disposal standards described in NJAC 7:13-5.10 must be implemented.

- Best management practices shall be followed whenever applicable.

The activity shall not result in any direct or indirect adverse impacts to Swamp Pink (Helonias bullata) or its documented habitat, as contained in NJAC 7:7A-9.5(a)(2)(iii). The municipality of Colts Neck Township in Monmouth County has a documented record of Helonias bullata.

4.1.2 Transition Areas

There are also requirements for transition areas (NJAC 7:7A-6 and 7:7-A7), which are defined as an ecological transition zone from uplands to freshwater wetlands. The standard width of a transition area adjacent to a freshwater wetland area of intermediate resource value is 50 feet. The following activities are prohibited in transition areas:

- Removal, excavation, or disturbance of the soil.
- Dumping or filling or any material.
- Erection of structures.
- Placement of pavements.
- Destruction of plant life that would alter the existing pattern of vegetation.

The following activities may be conducted (i.e., are not prohibited) in transition areas, provided that the activities are performed in a manner that minimizes adverse effects to the transition area and adjacent freshwater wetlands:

- Normal property maintenance.

- Minor and temporary disturbance of the transition area resulting from, and necessary for, normal construction activities on land adjacent to the transition area.

- The erection of temporary structures (i.e., sheds or fences which do not have a foundation, or other structures that remain in the transition area for less than six months) covering a combined total of 150 square feet of less.

Authorization of activities under a Statewide General Permit, individual freshwater wetland permit, or mitigation plan automatically include a transition area waiver. The transition area waiver will allow encroachment only in that portion of the transition area bordering on that portion of the wetland in which the authorized activity is to take place. Any additional prohibited activities in the transition area not directly required for the authorized activity would require a separate waiver.

4.2 WASTEWATER FACILITIES; SEPTIC TANK SYSTEMS

During this project, the existing on-lot septic system at Site 5 will be replaced with a wastewater holding tank. Technical requirements for wastewater collection, conveyance, treatment, and discharge of wastewater are contained in the NJPDES regulations. These regulations contain the substantive requirements for wastewater facilities, including holding tanks and sewers (NJAC 7:14A-23). Requirements for septic tank systems are contained in the state standards for individual subsurface sewage disposal systems (NJAC 7:9A).

The following requirements apply to permanent holding tanks (NJAC 7:14A-23.5):

- A high water alarm is required to alert the responsible person that the tank has reached 75 percent of its capacity and to allow sufficient time to take appropriate measures to prevent overflows.

- The tank must have provisions for aeration at a rate of 2 cfm per 1,000 gallons to prevent septic conditions and solids settling.

- Measures shall be taken to protect the tank from vandalism and to safeguard public health and safety.

- Tanks shall be sized to provide a minimum of two days storage.

The following requirements apply to gravity sewers (NJAC 7:14A-23.6):

- Gravity sewers shall be designed to carry at least twice the estimated average projected flow when flowing half full.

- The minimum diameter for sewer extensions is 8 inches; however, smaller diameter sewers can be used for laterals. Sewer lines that are larger than necessary only for the purpose of achieving minimum slope requirements are not permitted. Minimum slope requirements are specified in NJAC 7:14A-23.6. Slopes producing a velocity of greater than 10 feet per second are not recommended.

- Sewer lines shall be constructed at least 3 feet below grade, as measured from the top of the pipe.

- Sewers containing sanitary flow shall be separated from water mains by a distance of at least 10 feet horizontally. If this is not possible, the pipes shall be installed in separate trenches with the sewer at least 18 inches below the bottom of the water main.

- The maximum infiltration/exfiltration rate shall not exceed 100 gallons per inch diameter per mile per day.

The following are the requirements for abandonment of a septic tank system (NJAC 7:9A-12.8):

- When it is necessary to abandon a system for any reason other than connection to a sanitary sewer line, all wastes must be removed and the septic tank must be removed or filled completely with gravel, stones, or soil.

- When components or residuals are removed from the ground, they shall be properly managed in accordance with state solid waste regulations (NJAC 7:26).

4.3 STORMWATER DISCHARGE TO "WATERS OF THE U.S."

Many stormwater discharges are covered by New Jersey Pollutant Discharge Elimination System (NJPDES) discharge to surface water (DSW) general permit regulations. Regulations applicable to this project include NJAC 7:14-3.9 (General permits) and the requirements contained in statewide general permit NJ0088323, which are contained in the NJPDES regulations (NJAC 7:14).

General Permit NJ0088323 applies to stormwater discharges from construction activities, including clearing, grading, and excavation activities, that disturb 5 or more acres. There are no specific effluent limitations or monitoring requirements; however, no discharges of hazardous substances, as defined in NJAC 7.1E-1.7, are permitted. Land disturbances shall be executed only in accordance with requirements for soil erosion and sediment control.

Stormwater discharge permits would not be required after completion of the construction provided that the landfills are closed in accordance with sanitary landfill regulations (see Section 4.5).

4.4 EARTH MOVING OPERATIONS

Although onsite actions would be exempt from permit and other administrative requirements, the scope of work for this project includes preparation of a Soil Erosion and Sediment Control Plan. Substantive requirements are contained in Standards for Soil Erosion and Sediment Control in New Jersey and include vegetative standards and structural standards. The purpose of these standards is to help those responsible for construction to control soil movement.

Vegetative standards are available for temporary and permanent soil stabilization, topsoil, maintaining vegetation, selection of vegetation, and tree protection.

Structural standards are available for grading, diversion, grassed waterways, sedimentation basins, slope protection structures, channel stabilization, detention basins, subsurface drainage, traffic control, dust control, lined waterways, riprap, sediment barriers, conduit outlet protection, stabilized construction entrances, storm sewer inlet protection, and grade stabilization structures.

Appendices contained in the standards include guidance, specifications, and examples.

4.5 SANITARY LANDFILL CLOSURE REQUIREMENTS

The landfills at Sites 4 and 5 were used for disposal of domestic waste, small amounts of industrial waste, construction debris, and demolition debris. Sanitary landfill engineering design standards and construction requirements (NJAC 7:26-2A.7) are in the New Jersey solid waste regulations. These regulations contain substantive requirements for surface drainage systems and final cover systems.

Surface drainage systems act to hydraulically isolate the landfill from surface water drainage in a controlled manner. The surface drainage system shall be designed and constructed to protect the sanitary landfill from run-on and control run-off, from, at a minimum, the peak discharge of a 24-hour, 25-year storm. Run-on/run-off structures shall be designed utilizing the U.S. Department of Agriculture, Soil Conservation Service, methods and in accordance with the Standards for Soil Erosion and Sedimentation Control (NJAC 2:90).

The final cover system shall be designed and constructed in accordance with the following:

- The permeability of the final cover shall be less than or equal to that of natural subsoils present or 1E-5 cm/sec, whichever is less. The depth of the final cover shall be a minimum of 18 inches with a minimum 6-inch erosion layer.

- The minimum thickness for a clay cap shall be 12 inches. The minimum thickness for a geomembrane cap shall be 30 mils (60 mils for HDPE).

- Geomembranes used as a cap shall be designed and constructed to withstand the calculated tensile forces acting on the geosynthetic materials. The design shall consider the maximum friction angle of the geomembrane with regard to any interface and shall ensure that the overall slope stability and erosion control of the final cover system are maintained.

- The geomembrane shall be protected from below and above by a minimum thickness of six inches of bedding and cover that is no coarser that a poorly graded sand (SP) and that is free of rocks, fractured stones, debris, cobbles, and solid waste. An equivalent geotextile may be utilized.

- The impermeable cap shall be located wholly below the average depth of frost penetration in the area. The average frost depth at the Earle facility is approximately 15 inches.

A drainage layer shall be designed and constructed according to the following:

- The material used in the drainage layer shall be an open graded material of clean aggregate. The material shall be in accordance with the following criteria of the cumulative grain-size distribution curves:

  $D_{85} > 4D_{15}$ and $D_2 > 0.1$ inch.

- The drainage layer shall be designed and constructed so that the discharge flows freely in the lateral direction to minimize the hydrostatic head on the cap, flows through the drainage layer, and provides a path for infiltrated liquids to exit the capping system.

- The drainage layer shall have a thickness and hydraulic conductivity capable of transmitting the estimated percolation, based on modeling of the system. The latest version of the HELP model shall be used to facilitate rapid estimations of surface run-off, subsurface drainage, and leachate generation quantities.

- When located above a clay cap, the drainage shall be a minimum of six inches thick. When located above a geomembrane cap, the drainage layer shall be a minimum of 12 inches thick.

- Drainage pipes and/or geonets, where necessary to control the hydrostatic head on the cap, should be located within the drainage layers. The drainage pipe should be installed at a distance sufficient to ensure that the hydrostatic head on the cap does not exceed the thickness of the drainage layer during a 25-year, 24-hour storm. A coarse gravel envelope, within a geotextile fabric, shall be installed around the drainage pipe to minimize the movement of soil particles in the drainage pipe.

- A soil filter or geotextile should be designed and constructed above the open aggregate in order to minimize the intrusion of fines into the drainage layer.

The vegetative layer shall be designed and constructed in accordance with the following:

- The vegetative layer shall be thick enough to contain the effective root depth or irrigation depth for the type of vegetation planted.

- Fertilizer, mulch, and seeding applications shall be performed in accordance with Standards for Soil Erosion and Sedimentation Control for permanent vegetative cover for soil stabilization.

- The minimum thickness of uncompacted topsoil in the upper layer of the vegetative layer shall be five inches. The topsoil shall meet the Topsoil Standard specified in Section 909.10 of the New Jersey Department of Transportation Standard Specifications for Road and Bridge Construction.

- The application of sludge or of Sludge Derived Product (SDP) to the final grades of the vegetative layer shall be performed in accordance with NJAC 7:14A.

The grades of the final slope shall be constructed in accordance with the following:

- The top slope final grades, after allowing for settlement and subsidence, shall be, at a minimum, three percent.

- The side slopes of the final grades shall be no steeper than three horizontal to one vertical (3:1)

A gas venting layer shall be designed and constructed in accordance with the following:

- The gas venting layer shall be located directly below the impermeable barrier.

- Passive gas venting systems may be designed and constructed initially as a preventive measure against sanitary landfill gas migration. Situations where gas migration is detected in amounts greater that 25 percent of the lower explosive limit of combustible landfill gas at the perimeter of the sanitary landfill property shall trigger the construction of an induced draft or active venting system.

In addition to the cover system standards listed above, the sanitary landfill regulations also contain requirements for design testing of materials and quality control testing.

4.6 SOLID WASTE TRANSPORT REQUIREMENTS

During this project, some components of the skeet shooting range at Site 5 will be removed and disposed of off site as a nonhazardous waste. Transportation requirements are contained in the New Jersey solid waste management regulations (NJAC 7:26-3). No person shall engage in the transportation of solid wastes without first obtaining an approved registration statement from NJDEP. Although NWS Earle will not transport the waste, it should insure that the waste transporter(s) meet all applicable requirements.

4.7 REQUIREMENTS FOR CLASSIFICATION EXCEPTION AREAS

Chemical concentrations in groundwater at Sites 4 and 5 exceed state groundwater quality standards. Whenever NJDEP approves a groundwater pollution remedy at a contaminated site under an applicable regulatory program (e.g., CERCLA), a CEA must be established if groundwater standards are not or will not be met during implementation of an approved remedy (active or passive). Requirements for a CEA are contained in the state regulations for groundwater quality (NJAC 7:9-6.6). Formal designation of the CEA is pursuant to the authority of an appropriate oversight document. Although the NJDEP Case Manager, with assistance from support staff, upon request by the lead program, will formally designate an area of non-compliance as a CEA, the information needed to develop the CEA should be provided by the responsible party.

A CEA consists of the following:

- Written and mapped description of the area in which constituent standards are not or will not be met. This includes the latitude and longitude of the affected property. Roads, streams, natural and manmade borders, and the plume extent should be shown on a USGS 7.5 minute quadrangle map.

- Identification of the contaminants for which the CEA has been established. The CEA only applies to contaminants that exceed groundwater standards and the formations (or aquifers) in which they are exceeded.

- Estimate of the longevity of the CEA. CEAs are related to the estimated time for completion of a remediation. If natural attenuation is proposed, the responsible party must provide an estimate of the time to achieve the groundwater standards. CEAs will remain in effect for the projected term of the cleanup.

- Additional information such as present and projected future property and surrounding land use and the presence or absence of receptors.

NJDEP is obligated to restrict or require the restriction of potable groundwater uses within any CEA when there is or will be an exceedance of Primary Drinking Water Standards (NJAC 7:10). When contaminant levels exceed MCLs and the designated aquifer classification includes potable use, NJDEP will identify the CEA as a Well Restriction Area (WRA). The WRA functions as the institutional control by which potable use restriction can be effected.

The state Remedial Lead will provide internal NJDEP notification of CEA designations. NJDEP requires the person responsible for conducting the remediation to notify the external agencies and affected parties of these designations. The degree of public notice required will depend upon current and projected groundwater use in a given area.

4.8 WELL INSTALLATION/MODIFICATION/ABANDONMENT

Several existing monitoring wells, which are located within the boundaries of the landfill cap at Site 5, will need to be modified. Existing monitoring wells located within the cap will be changed from the existing "stickup" configuration to a "flush mount" configuration. The length of the outer and inner casings will need changed to conform to the new grade elevations. Existing monitoring well MW5-04, located outside the cap boundary, will need to be abandoned to allow for installation of a sedimentation pond.

The State of New Jersey requires that installation, modification, and abandonment of monitoring wells be performed by a New Jersey licensed well driller. If a well is to be abandoned, a well abandonment form must be filed with the State of New Jersey.

4.9 NWS EARLE CONSTRUCTION CONTRACTOR REQUIREMENTS

NWS Earle has a information package containing multiple handouts obtained through the Officer in Charge, NAVFAC Contracts. The handouts cover the following topics:

- Agenda for Preconstruction Conference
- Security Department Agenda
- Contractor Passes and Vehicle Passes
- Fire Prevention Regulations and Safety Requirements for Contractors
- Sample Accident Prevention Plan Format
- Hard Hat and Protective Clothing Policy
- Clothing Requirements
- Contractor Weekly Safety Meeting Form
- Schedule of Prices Form
- Contractor Drawing and Information Submittal Form
- After Hours Request Form
- Statement of Acknowledgment Form
- Statement of Compliance Form
- Contractor Quality Control Requirements
- Quality Control Report Form
- Contractor Invoice Form with Certification
- Contractor Performance Statement Form
- Contractor Release Forms
- Equal Opportunity and Notice to All Employees Posters

5.0 COMPLIANCE SUMMARY

5.1 CONSTRUCTION IN FLOODPLAIN, WATERWAY, OR WETLAND; FILL WETLANDS

Any wetland areas that are disturbed by the remedial actions at Sites 4 and 5 will be mitigated by restoration and/or creation in accordance with the substantive requirements of Statewide General Permit 4 for freshwater wetlands. Stormwater outfall structures and associated stormwater conveyance structures that may disturb wetlands have been designed in accordance with the substantive requirements of Statewide General Permit 11. The design also complies with Standards and Conditions for all General Permit Authorizations (NJAC 7:7A-9.3).

5.2 WASTEWATER FACILITIES; SEPTIC TANK SYSTEMS

The gravity sewer system and holding tank that will replace the existing on-lot septic system at Site 5 have been designed in accordance with the requirements for gravity sewers (NJAC 7:14A-23.6) and permanent holding tanks (NJAC 7:14A-23.5), respectively. The existing on-lot septic system will be abandoned in accordance with the requirements of NJAC 7:9A-12.8).

5.3 STORMWATER DISCHARGES TO "WATERS OF THE U.S."

Stormwater discharges from the construction activities at Sites 4 and 5 will be in compliance with NJPDES General Permit NJ0088323. Land disturbance will be conducted in accordance with the requirements for soil erosion and sediment control, as required by this general permit (see Section 5.4).

5.4 EARTH MOVING OPERATIONS

Earth moving operations at Sites 4 and 5 will be conducted in accordance with a Soil Erosion and Sediment Control Plan. The design of the erosion and sediment control structures and vegetation requirements is in accordance with Standards for Soil Erosion and Sediment Control in New Jersey.

5.5 SANITARY LANDFILL CLOSURE REQUIREMENTS

The cap systems for the landfills at Sites 4 and 5 have been designed in accordance with sanitary landfill engineering design standards and construction requirements (NJAC 7:26-2A.7). This includes standards and requirements for surface drainage systems, final cover systems, drainage layers, vegetation layers, slopes of final grades, and gas venting layers.

5.6 SOLID WASTE TRANSPORT REQUIREMENTS

Solid waste transport requirements are not specifically addressed in the Remedial Design. However, the subcontractor that transports solid waste from Site 5 to the offsite landfill will be required to comply with New Jersey solid waste transportation requirements (NJAC 7:26-3), including registration requirements. This will be specified in subcontractor procurement documents.

5.7 REQUIREMENTS FOR CLASSIFICATION EXCEPTION AREAS

Requirements for classification exception areas (CEAs) are not specifically addressed in the Remedial Design. However, the following information needed to develop CEAs at Sites 4 and 5 will be supplied to NJDEP: written and mapped description of areas, contaminants of concern, estimate of time to achieve groundwater standards, and present and projected future property and land use.

5.8 REQUIREMENTS FOR WELL INSTALLATION /MODIFICATION/ABANDONMENT

Modification and abandonment of existing monitoring wells will be performed by a New Jersey licensed well driller. A well abandonment form will be filed with the State of New Jersey after monitoring well MW5-04 is abandoned.

5.8 NWS EARLE CONSTRUCTION CONTRACTOR REQUIREMENTS

Specific requirements for construction contractors are not addressed in the Remedial Design. However, remedial action subcontractors must comply with all NWS Earle requirements for construction contractors. This will be specified in subcontractor procurement documents.