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NWS EARLE
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Project Number 7695

October 13, 2000

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Naval Facilities Engineering Command
10 Industrial Highway Mail Stop No. 82
Lester, Pennsylvania 19113-2090

Reference: Contract No. N62472-90-D-1298 (CLEAN)
Contract Task Order (CTO) No. 300

Subject: Submission of Feasibility Study for OU-6 (Final)
NWS Earle - Colts Neck, New Jersey

Dear Mr. Kolicius:

Tetra Tech NUS, Incorporated (TtNUS) is pleased to provide ten copies of the subject document. Three copies have been sent to Jessica Mollin at EPA, Region II, three copies have been sent to Bob Marcolina at NJDEP, two copies have been sent to Greg Goepfert at NWS Earle, and two copies are enclosed for your use.

Thank you for this opportunity to submit the documents. Do not hesitate to contact me if you have any questions or require revisions.

Sincerely

Russ

Russ E. Turner
Project Manager

RET/ejc

c: Greg Goepfert (NWS Earle)
Jessica Mollin (EPA, Region II)
Bob Marcolina (NJDEP)
John Trepanowski (TtNUS)
Garth Glenn (TtNUS)
File

FEASIBILITY STUDY
for
SITES 3 AND 10 (OU-6)

NAVAL WEAPONS STATION EARLE
Colts Neck, New Jersey

Northern Division
Naval Facilities Engineering Command

Contract No. N62472-90-D-1298
Contract Task Order 300

SEPTEMBER 2000

TETRA TECH NUS, INC.

R-51-11-7-10

FEASIBILITY STUDY
for
SITES 3 AND 10 (OU-6)

NAVAL WEAPONS STATION EARLE
Colts Neck, New Jersey

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

Submitted to:
Northern Division
Environmental Branch, Code 14
Naval Facilities Engineering Command
10 Industrial Highway, Mall Stop #82
Lester, Pennsylvania 19113-2090

Prepared and Submitted by:
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September 2000

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EXECUTIVE SUMMARY

Under the Department of Defense's Installation Restoration Program, the Navy, in agreement with the United States Environmental Protection Agency (EPA) and in consultation with the state of New Jersey Department of Environmental Protection (NJDEP), is in the process of completing the remedial investigation and feasibility study (RI/FS) of 27 former known or suspected waste disposal sites at Naval Weapons Station Earle (NWS Earle), which is located in Colts Neck, New Jersey. The RI for the 27 NWS Earle Sites was completed in July 1996. Additional remedial investigation was performed on seven of the sites to fill data gaps, and these results were presented in the RI Addendum Report, dated February 1997.

This report presents the feasibility study (FS) performed for Sites 3 (Landfill Southwest of "F" Group) and 10 (Scrap Metal Landfill), collectively designated as Operable Unit 6 (OU-6). The FS considered a range of remedial alternatives that address potential risks to human health and the environment posed by site-related contaminants identified previously under the RI. This report addresses the remedial alternatives developed for Sites 3 and 10.

The remedial options developed in this document will be used by the Navy to select a preferred remedy for Sites 3 and 10. A Proposed Plan will then be prepared to present the preferred remedy for public comment. After the public comment period has concluded, all questions and concerns from the public will be addressed in a Responsiveness Summary, and the selected remedy will be documented in a Record of Decision.

NWS Earle Site Summary

NWS Earle is located in Monmouth County, New Jersey, approximately 47 miles southeast of New York City. This facility was commissioned in 1943 with the primary responsibility of supplying ammunition to the Naval fleet. This station consists of an inland 10,248-acre Main Base and a 706-acre Waterfront Area connected by a right-of-way controlled by the Navy. NWS Earle was included on the National Priorities List (NPL) in October 1990.

Site 3 - Landfill Southwest of "F" Group

The landfill southwest of "F" group (Site 3) is a 5-acre site that was used from 1960 to 1968 for the disposal of domestic and industrial wastes (Figure 1-2). Industrial wastes disposed at Site 3 consist of paints and paint thinners, solvents, varnishes, shellac, acids, alcohol's, caustics, pesticide containers and rinse water, wood, and small amounts of asbestos. Records indicate that the industrial wastes comprise only a small portion of the approximately 4,800 tons of wastes.

Site 10 - Scrap Metal Landfill

The scrap metal landfill (Site 10) is a 2-acre site that was used from 1953 to 1965 for the disposal of demilitarized munitions and spent munitions cases (Figure 1-3). An estimated 65,000 cubic yards, which includes cover material, were disposed at the site. The disposed material consisted primarily of aluminum and steel containers. Spent grit and paint chips from the ammunition re-work operations were also buried. Since site closure, the cover material has eroded and 40-mm shell cases have been uncovered.

Regulatory History

An Initial Assessment Study conducted in 1982 identified 29 waste disposal areas at NWS Earle and led to the further investigation of 11 of those sites. Following the listing of NWS Earle on the NPL in 1990, site investigations were initiated at 16 sites. Two of the remaining sites were not included in these investigations because they were permitted to operate under the Resource Conservation and Recovery Act. In 1992, EPA requested that Preliminary Assessments be performed on 17 of the sites. To date, the following investigations have been completed and are documented:

- Installation Restoration Program (IRP) Phase II Confirmation Study (September 1986)
- Phase II Site Inspection Study (December 1993)
- IRP RI/FS for 11 sites (September 1993)
- IRP RI for 27 sites (July 1996)
- IRP RI Addendum for 7 sites (February 1997)

Summary of Site Risks

The results of the RIs were evaluated using EPA guidance and directives to gauge potential impacts from Sites 3 and 10 conditions on human health and the environment. The exact procedures used for the estimation of human health risk assessment and ecological risk screening are presented in the RI report (July 1996) and RI Addendum report (January 1998).

The results of the Site 3 baseline human health risk assessment concluded that reasonable maximum exposure (RME) cancer risks estimated for future residents consuming and exposed to groundwater from beneath the site were at the upper end of the target maximum acceptable risk range. The estimated human health risk for the future industrial (groundwater) exposure scenario was also at the upper end of the target maximum acceptable risk range. Arsenic (via ingestion and dermal contact with groundwater) was the principal compound of concern in Site 3 groundwater that contributed to the estimated cancer

risks in these exposure scenarios. Noncancer risks estimated for the future residential exposure scenarios exceeded 1.0, the cutoff value below which adverse noncarcinogenic effects are not expected to occur. Arsenic was the principal compound of concern in Site 3 groundwater that contributed to the estimated Hazard Index greater than the EPA guideline for this exposure scenario. Arsenic concentrations in groundwater drive the majority of the excess estimated human health risk (above the EPA guideline acceptable range). Considering site-specific uncertainties regarding the actual concentrations of metals in groundwater samples, the arsenic concentration used for the calculation of the estimated risk and, therefore, the result risk estimation should be considered conservative and overestimated.

The results of the Site 10 baseline human health risk assessment concluded that RME cancer risks estimated for future residents consuming and exposed to groundwater from beneath the site were at the upper end of the target maximum acceptable risk range. The estimated human health risk for the future industrial (groundwater) exposure scenario was in the mid-range of the target maximum acceptable risk range. Arsenic (via ingestion and dermal contact with groundwater) was the principal compound of concern in Site 10 groundwater that contributed to the estimated cancer risks in these exposure scenarios. Noncancer risks estimated for the future residential exposure and future industrial scenarios were below the EPA maximum guideline values, below which adverse noncarcinogenic effects are not expected to occur.

Lead concentrations encountered at Sites 3 and 10 during the RIs were below the EPA guideline concentrations and would not be expected to be associated with increased blood levels based on the results of the Integrated Exposure Uptake Biokinetic (IEUBK) Lead Model (v. 0.99).

Objective of the FS

The overall objective of this FS is to develop and evaluate remedial alternatives that address contamination at Sites 3 and 10. The general FS process is described below:

- Develop remedial action objectives (RAOs) that incorporate clean-up goals protective of human health and the environment. The RAOs specify the contaminants, media of interest, exposure pathways, and preliminary remediation goals. The preliminary remediation goals (numeric criteria) are developed based on chemical-specific applicable or relevant and appropriate requirements (ARARs), when available, and site-specific risk-related factors.

- Develop general response actions to address each medium of interest. Each response action may be implemented singly or in combination with other actions to satisfy the RAOs.

- Identify and screen technologies applicable to each general response action. Technologies and process options that are not technically implementable are eliminated. Representative process options for the remaining technologies are then evaluated for their effectiveness, implementability, and cost.

- Assemble and screen remedial alternatives from the retained technologies.

- Prepare a detailed analysis of individual alternatives following the criteria specified in the National Contingency Plan (NCP) and the RI/FS guidance document. Finally, compare and evaluate the alternatives.

Remedial Action Objectives (RAOs)

Based on the baseline human health risk assessment, the ecological risk assessment, and the RI results, RAOs were developed to address contaminated environmental media (soils, groundwater) present at Sites 3 and 10.

Site 3

Protection of Human Health RAOs

- Prevent potential human exposure to metals in groundwater.
- Prevent potential contact with landfill contents.

Protection of the Environment RAO

- Minimize migration of landfill contaminants to the adjacent wetlands.
- Prevent potential contact with landfill contents.

Site 10

Protection of Human Health RAO

- Prevent potential human exposure to landfill materials since cover material has been eroded.

Protection of the Environmental RAO

- Minimize exposure to exposed corroded metal wastes.

Because Sites 3 and 10 were military landfills, two EPA Office of Solid Waste and Emergency Response (OSWER) Directives guidance documents were considered in developing remedial alternatives that employ presumptive remedies. These guidance documents are OSWER Directive 9355.0-62F5, Application of the CERCLA Municipal Landfill Presumptive Remedy to Military Landfills (Interim Guidance - April 1996); and OSWER Directive 93550.0-49FS, Presumptive Remedy for CERCLA Municipal Landfill Sites (September 1993).

Alternatives Development

Following the technology screening and detailed evaluation, remedial technologies were assembled into alternatives that address contaminated soils and groundwater and the RAOs. These alternatives provide variable levels of protection to human health and the environment, as well as compliance with ARARs. Remedial alternatives for OU-6 included no action; limited action (institutional controls); and consolidation and capping. Summaries of remedial alternatives that passed the screening step for each site are presented in the following section.

Site 3 Remedial Alternatives

Three remedial alternatives were developed for Site 3. A brief discussion of each alternative is included. A more detailed discussion of each alternative can be found in Section 3.1.2 of the FS.

Alternative 1: No Action

The no-action alternative was developed as a baseline to which other alternatives may be compared, as required by the NCP. No remedial actions would be taken to protect human health or the environment. The purpose of the alliterative is to evaluate the overall human health and environmental protection provided by the site in its present state. Periodic reviews of site conditions, typically every 5 years, and long-term periodic monitoring of groundwater, surface water, and sediments would be the only activities conducted under this alternative.

Alternative 2: Institutional Controls and Long-Term Monitoring

Alternative 2 includes institutional controls to limit exposures to site-related contaminants. This alternative does not employ engineered treatment or containment to address groundwater contamination; however, the groundwater contaminant concentrations [which just exceed New Jersey Groundwater Quality Standards (GWQS)] are expected to decline naturally (through dissipation and dilution) over time (assuming the levels of metals are not naturally elevated) because no new disposal has occurred or will be allowed at the site.

Alternative 2 would include removal of exposed debris, installation of additional soil cover, limited grading of the site to promote stormwater drainage, and revegetation of disturbed areas. Restrictions would be attached to the Base Master Plan (access restrictions) to limit future uses of the site and prevent disturbance of the soil cover or direct contact with contaminated media. A fence would be erected around the perimeter of the landfill to limit access to the site, to restrict human contact with contaminated landfill materials, and to protect the integrity of the cover. Long-term periodic monitoring would be conducted to assess contaminant status and potential threats to human health and the environment. Since wastes would be left in place, site conditions and risks would be reviewed every 5 years.

Alternative 3: Capping, Institutional Controls, and Long-Term Monitoring

Alternative 3 relies on containment and institutional controls to limit exposures to hazardous substances and minimize migration of contaminants to groundwater and surface water. Active treatment is not employed to address site contamination. Over time, the concentrations of contaminants in groundwater would likely decline naturally through physical, biological, and chemical processes. Contaminant concentrations in groundwater would also decrease as a result of reduced infiltration of precipitation through contaminated landfill materials.

A low-permeability cover system that complies with federal and state regulatory requirements would be used to prevent potential human and animal contact with contaminants in landfill materials, limit contaminant leaching to groundwater, and minimize contaminant migration via surface runoff and erosion. The cover system would be installed over all former landfill areas of the site. Access restrictions would be enacted to limit future uses of the site that may result in disturbance of the cover or direct contact with contaminated media.

Long-term, periodic monitoring would be conducted to assess contaminant status and potential threats to human health and the environment. Since wastes would be left in place, site conditions and risks would be reviewed every 5 years.

Site 10 Remedial Alternatives

Three remedial alternatives were developed for Site 10. A brief discussion of each alternative is included. A more detailed discussion of each alternative can be found in Section 3.1.3 of the FS.

Alternative 1: No Action

The no-action alternative was developed as a baseline to which other alternatives may be compared, as required by the NCP. No remedial actions would be taken to protect human health or the environment. The purpose of the alternative is to evaluate the overall human health and environmental protection provided by the site in its present state. Periodic reviews of site conditions, typically every 5 years, and long-term periodic monitoring of groundwater, surface water, and sediments would be the only activities conducted under this alternative.

Alternative 2: Institutional Controls

Alternative 2 relies on institutional controls to limit exposures to landfill materials. A fence would be erected around the landfill to limit access to the site, to restrict human contact with exposed landfill materials and to protect the integrity of the cover. Restrictions would be attached to the Base Master Plan (access restrictions) to limit future uses of the site and prevent disturbance of the soil cover or direct contact with contaminated media.

Alternative 3: Capping and Institutional Controls

Alternative 3 relies on containment and institutional controls to limit exposures to landfill contents. A cover system would be used to prevent potential human and animal contact with landfill materials. The cover system would be installed over all former landfill areas of the site. Access restrictions would be enacted to limit future uses of the site that may result in disturbance of the cover or direct contact with landfill contents.

Individual and Comparative Analysis of Alternatives

Detailed evaluations of remedial alternatives were performed for this FS in accordance with the requirements of the NCP and the EPA RI/FS Guidance Document. As part of the detailed analysis, the remedial alternatives were compared to identify differences and compare how site contaminant threats are

addressed. The following seven criteria, as established by the NCP, were used for the detailed analysis of alternatives:

- Overall protection of human health and the environment
- Compliance with ARARs
- Long-term effectiveness and permanence
- Reduction of mobility, toxicity, or volume through treatment
- Short-term effectiveness
- Implementability
- Cost

A detailed analysis of each alternative with respect to these seven evaluation criteria is provided in Section 4 of the FS. Two other evaluation criteria, state and community acceptance, will be addressed in the Record of Decision following the receipt of comments during the public comment period, after the Proposed Plan has been presented to the public.

1.0 INTRODUCTION AND BACKGROUND INFORMATION

This feasibility study (FS) report presents an executive summary (preceding this section), a summary of previous investigations for the three sites addressed in this FS (Section 1.0), identification and screening of remedial technologies for the three sites (Section 2.0), development and screening of remedial action alternatives (Section 3.0), and a detailed analysis of the alternatives, including a no-action alternative (Section 4.0).

Section 1.0 consists of an overview of NWS Earle operations and regional environmental settings. A summary of previous investigative activities and results and a discussion of human health and ecological risks for the four sites have also been presented. For a full understanding of site conditions, the Final Remedial Investigation (RI) Report, July 1996, and the Remedial Investigation Addendum (RIA) Report, February 1997, must be reviewed. The RI and RIA reports are essential companion documents to this FS because they were prepared as part of the prescribed CERCLA RI/FS development procedure.

Section 2.0 provides a discussion on potential chemical-specific, location-specific, and action-specific applicable or relevant and appropriate requirements (ARARs) and other guidance to be considered (TBCs). This section also addresses remedial action objectives (RAOs), preliminary remedial goals (PRGs), and general response actions. RAOs and PRGs are addressed on a site-specific basis for the identification, screening, and evaluation of remedial technologies and process options. Selected site-specific remedial options are also presented.

Selected remedial alternatives for the individual sites are addressed in Section 3.0. The rationale for selection of the alternatives and a description of each alternative, including a no-action alternative, are presented.

Section 4.0 provides a detailed analysis and comparison of the alternatives discussed in Section 3.0.

1.1 SITE DESCRIPTION AND SETTING

This FS report includes a discussion of remedial alternatives for Operable Unit 6 (OU-6), which includes Site 3 (Landfill Southwest of "F" Group) and Site 10 (Scrap Metal Landfill). The OU-6 sites are both located within the Mainside area of Naval Weapons Station (NWS) Earle.

NWS Earle is located in Monmouth County in east-central New Jersey. It is situated on approximately 11,134 acres and includes a Mainside area, which is approximately 10 miles inland from the Atlantic Ocean at Sandy Hook Bay, and a Waterfront area, which includes an ammunition depot and associated piers. The

Mainside and Waterfront areas are linked by a narrow tract of land that serves as a right-of-way for a government road and railroad. Figure 1-1 shows the Mainside area Installation Restoration (IR) program sites and highlights the OU-6 sites.

The main entrance to NWS Earle is located off State Route 34, and the entrance to the Waterfront area is located adjacent to State Route 36.

An estimated 2,500 people reside and/or work at NWS Earle. The total population of Monmouth County is approximately 550,000. Colts Neck Township, which is the location of the Mainside facility, has a total population of approximately 8,560 people. Middletown Township, which is the location of the Waterfront area, has a total population of approximately 68,200 people (United States Department of Commerce, 1990).

The majority of the land at the Mainside area is undeveloped land associated with ordnance operations, production, and storage facilities; the undeveloped land is encumbered by explosive safety quantity distance (ESQD) arcs. Land use at the Mainside facility includes residences, office buildings, workshops and warehouses, recreational areas, open space, and undeveloped land. The area around the Mainside facility includes agricultural areas, vacant land, and low-density residential land.

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 all the sites included in OU-6, 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.

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 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. Site-specific hydrology for each site is discussed in Section 1.3.

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

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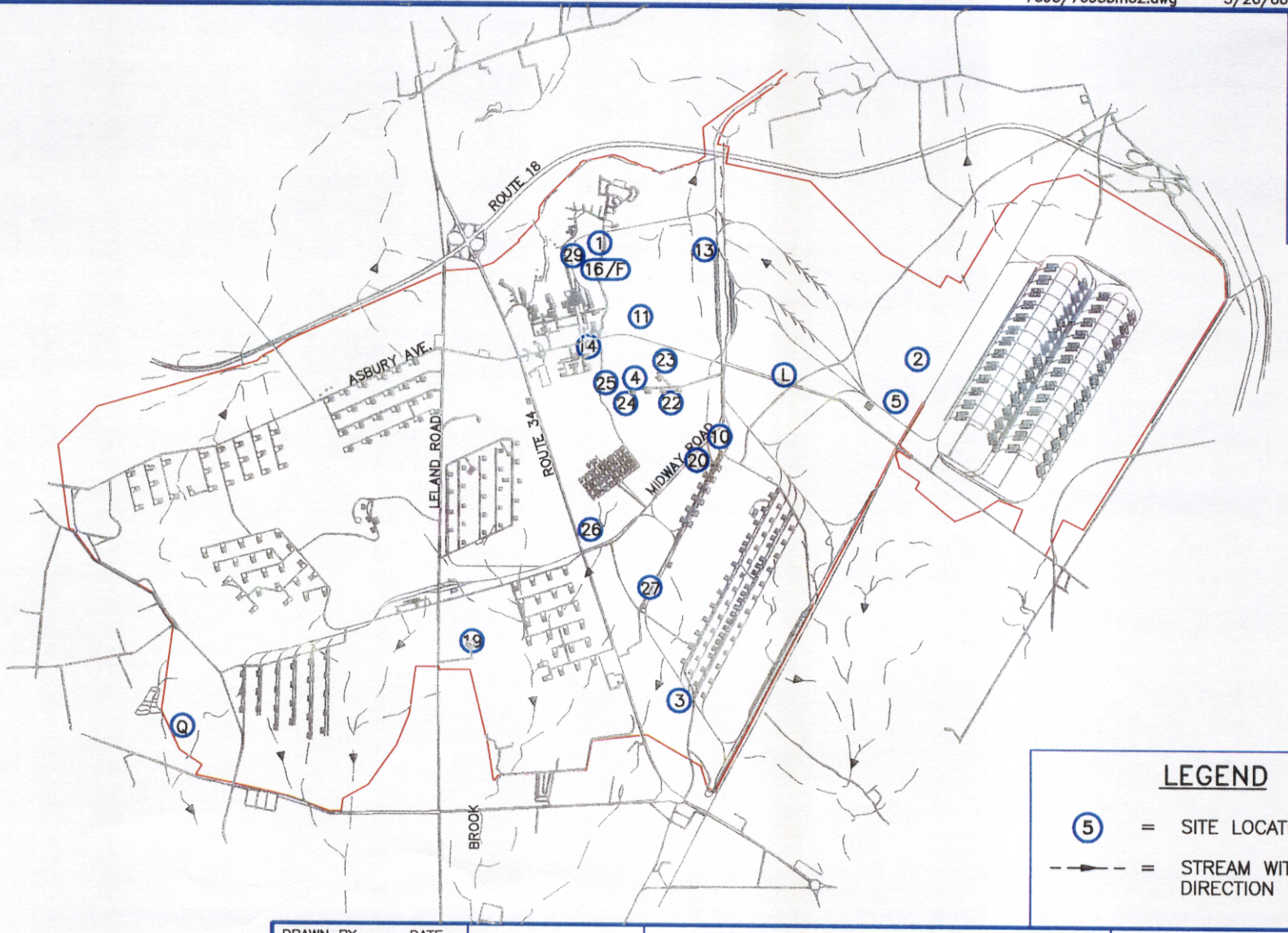

LEGEND

(5) = SITE LOCATION

- - —►- - = STREAM WITH FLOW DIRECTION

0 5,000 10,000

SCALE IN FEET

DRAWN BY	DATE
LDL/EEH	5/26/00
CHECKED BY	DATE
REVISED BY	DATE
SCALE AS SHOWN	

Tetra Tech NUS, Inc.

MAINSIDE SITE LOCATIONS

NAVAL WEAPONS STATION EARLE

COLTS NECK, NEW JERSEY

1-3

CONTRACT NO. 7695	
OWNER NO. 0300	
APPROVED BY	DATE
DRAWING NO. FIGURE 1-1	REV.

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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 erosional truncation of the dipping sedimentary wedge. Where these formations are not exposed, they are covered by essentially flat-lying post-Miocene surficial deposits. Site-specific geology and soils for each site are discussed in the site summary sections (Section 1.3).

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.

The Coastal Plain sediments are the most important source of potable water in the Coastal Plain of New Jersey, with wells supplying greater than 75 percent of the potable water supply. Water-supply problems associated with the increased demand for groundwater in the Coastal Plain include decreased groundwater levels and the induced recharge of fresh, brackish, or saline water from surface water or adjacent aquifers. The five principal Coastal Plain aquifers are the

- Kirkwood-Cohansey aquifer system
- Atlantic City 800-foot sand
- Wenonah-Mount Laurel aquifer system
- Englishtown aquifer
- Potomac-Raritan-Magothy aquifer system

Minor Coastal Plain aquifers include the

- Piney Point aquifer
- Vincentown aquifer
- Red Bank Sand aquifer

The five principal aquifers are capable of yielding large quantities of water for public supply use. The minor aquifers generally yield small to moderate quantities of water in or near their outcrop areas. All the Coastal Plain aquifers except the Kirkwood-Cohansey aquifer system are confined to semi-confined, except where

they crop out or are overlain by permeable surficial deposits. Increased groundwater withdrawals have produced large regional cones of depression in the major artesian aquifers.

The OU-6 sites are 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 on the federal and New Jersey State endangered lists, has been seen on the station, and the swamp pink (Helonias bullata), also on the federal and New Jersey State endangered lists, may be present. 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.

Resources and habitats of the drainage potentially impacted by sites investigated in the RI were summarized as follows [Source: National Oceanic and Atmospheric Administration (NOAA) in a letter from EPA Region II dated August 19, 1992, signed by Paul G. Ingrisano, project manager]:

- Manasquan River - Mingamahone Brook and East Branch of Mingamahone Brook
    - American eel, alewife, white perch, and blueback herring are likely present in the upper reaches of the Manasquan River and may migrate to Mingamahone Brook.
- Swimming River - Pine Brook and Hockhockson Brook

- Hockhockson and Pine Brooks originate within NWS Earle. Hockhockson Brook joins Pine Brook north of the facility. Pine Brook discharges to the Swimming River about 2 kilometers below the Swimming River Reservoir. Swimming River is tidally influenced below its confluence with Pine Brook and flows from there about 4 kilometers to the Navesink River.

- Alewife and blueback herring are known to migrate in the Swimming River and have been sampled in Pine Brook. Their presence in Hockhockson Brook is expected.

- Navesink River

  - The Navesink River is a tidal embayment. NOAA trust species present in the Navesink River include striped bass, alewife, blueback herring, menhaden, bluefish, American eel, blue crab, and sea lamprey. Resource utilization is believed to be limited to foraging activity, with the exception of winter flounder and blue crab spawning.

- McClees Creek

  - McClees Creek flows about 5 kilometers to the Navesink River. The creek has not been studied but is free-flowing and could provide habitat for blueback herring, alewife, American eel, white perch, and blue crab.

Ecological risk assessments were performed for the sites; results are discussed in Section 1.3.

1.2 SITE OPERATING HISTORY

NWS Earle was commissioned as a Naval Ammunition Depot on December 13, 1943, with the primary responsibility of furnishing ammunition to the Naval fleet. The station's Ordnance Department coordinates all port services and logistic support for home-ported and visiting ships, conducts safety inspections, supervises ammunition loading for the United States Coast Guard, and provides afloat firefighting capability and standby tug services. Other major active divisions include the Ammunition Distribution and Control Division, responsible for ensuring that a balanced, purified stock of ammunition is maintained in support of Navy, Coast Guard, and Marine Corps programs; the Operations Division, which performs ammunition movement, ship loading, demilitarization of obsolete ammunition, and reclaiming/renovation of various munitions; the Anti-Submarine Warfare (ASW) and Special Weapons Division, which plans and carries out station-level

maintenance of air and antisubmarine weapons and provides shore-based support to various commands; and the Port Services Division, responsible for operating the station fireboat, service craft, and oil pollution containment equipment.

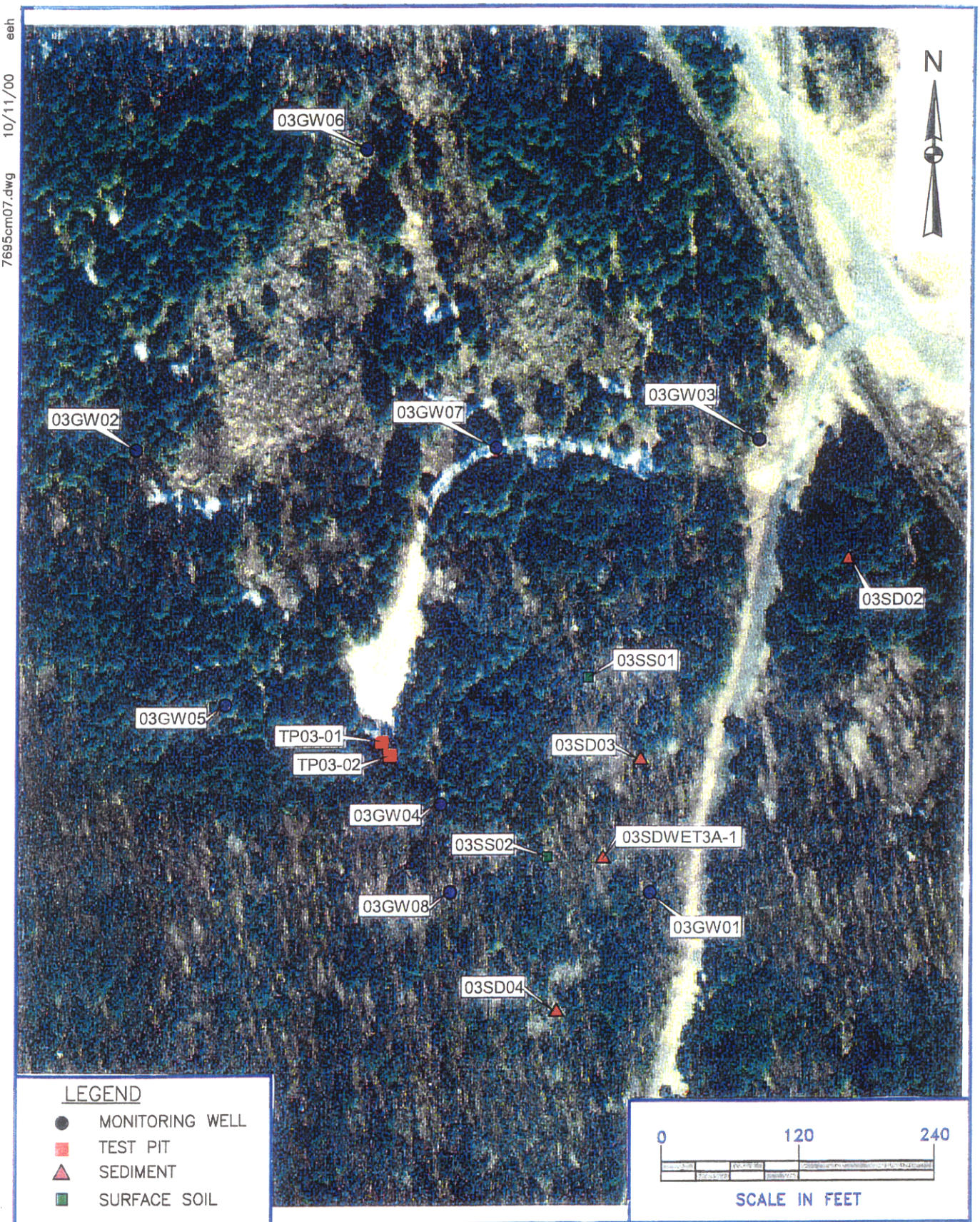
Over 90 percent of the acreage at NWS Earle is dedicated to its primary mission of storage and delivery of ordnance. The actual amount of land used for storage and distribution facilities is much less than this, but ESQD arcs are established around each facility. Any development within these arcs is extremely restricted by safety requirements. The formal disestablishment or reclassification of a facility is required before any development can occur within an ESQD arc.

Two areas of NWS Earle, the Mainside Administration and Housing area and the Waterfront Administrative area, are not encumbered by ESQD arcs. These areas are used for offices, base support, housing, and recreational facilities. Any future development would be expected to occur in one of these areas unless the development had an ordnance-specific use. Sites 1, 14, 16, and 29 are within the Mainside Administration and Housing area. Sites 6, 12, 15, and 17 are within the Waterfront Administration area. None of these sites are included in OU-6. Future land use is not expected to vary significantly from current land use unless a major base realignment were to occur. If this were to happen, an Environmental Baseline Survey would be conducted to evaluate the impact of any proposed land-use change.

Sites 3 and 10 are located at least partially within ESQD arcs. Therefore, future development at these sites is severely restricted.

The sites were utilized for various purposes. The landfill southwest of "F" group (Site 3) is a 5-acre site that was used from 1960 to 1968 for the disposal of domestic and industrial wastes (Figure 1-2). Industrial wastes disposed at Site 3 consist of paints and paint thinners, solvents, varnishes, shellac, acids, alcohols, caustics, pesticide containers and rinse water, wood, and small amounts of asbestos. Records indicate that the industrial wastes comprise only a small portion of the approximately 4,800 tons of wastes.

The scrap metal landfill (Site 10) is a 2-acre site that was used from 1953 to 1965 for the disposal of demilitarized items (Figure 1-3). Approximately 65,000 cubic yards of waste shell casings from the deactivation furnace (certified-inert metal waste), aluminum and steel containers, and spent grit and paint chips were reportedly interred here with soil cover materials. There is no known evidence that any live ammunition is interred at Site 10. Only certified-inert (i.e., no energetic potential remaining) materials were reported disposed here. Since site closure, the cover material has eroded and 40-mm shell casings have been uncovered.



DRAWN BY EEH DATE 10/11/00	Tetra Tech NUS, Inc.	SAMPLE LOCATIONS SITE 3 – LANDFILL SOUTHWEST OF "F" GROUP NAVAL WEAPONS STATION EARLE COLTS NECK, NEW JERSEY	CONTRACT NO. 7695
CHECKED BY DATE			OWNER NO. 0202
REVISED BY DATE			APPROVED BY DATE
SCALE AS NOTED			DRAWING NO. FIGURE 1–2 REV.

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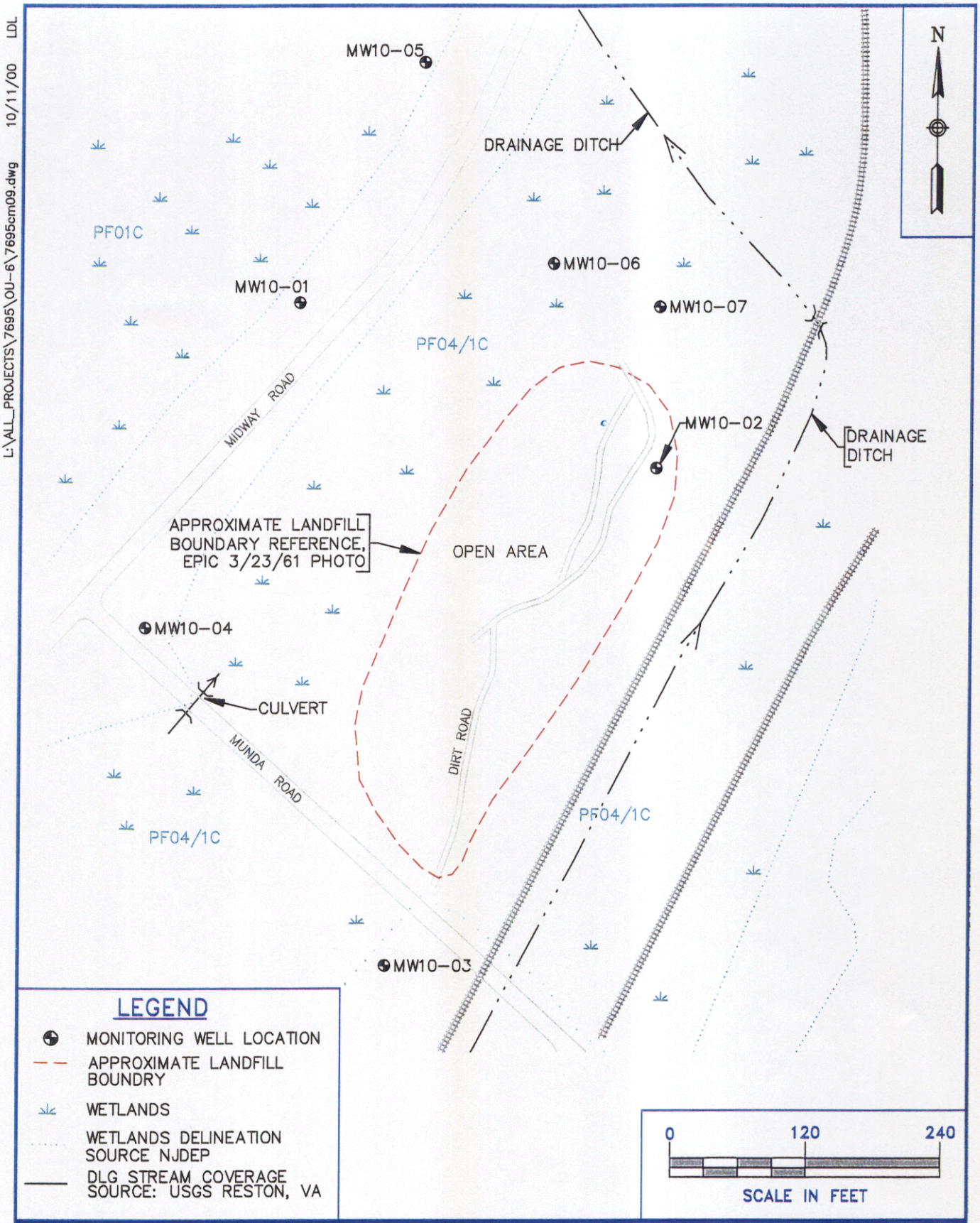

DRAWN BY	DATE	Tetra Tech NUS, Inc.	SAMPLE LOCATIONS SITE 10 SCRAP METAL LANDFILL NAVAL WEAPONS STATION EARLE COLTS NECK, NEW JERSEY	CONTRACT NO. 7695	
LDL	10/11/00			OWNER NO. OU-6	
CHECKED BY	DATE			APPROVED BY	DATE
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SCALE AS NOTED					

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1.3 SITE INVESTIGATION SUMMARY

Site investigation activities related to areas of potential environmental concern at NWS Earle have been undertaken by the Navy since approximately 1982. Early work included an Initial Assessment Study (IAS) conducted by Fred C. Hart and Associates; the results are included in a report prepared in 1982. Studies and field investigation efforts continued under the Installation Restoration Program (IRP) by Roy F. Weston, Incorporated. Several documents prepared by Weston were submitted to the Navy, NJDEP, and the United States Environmental Protection Agency (EPA). These documents include the Draft Report for Naval Weapons Station Earle, Colts Neck, New Jersey, IRP Phase II Confirmation Study, dated September 1986; the Draft Report of Current Situation and Draft Plan of Action, dated December 1988; an IRP Phase II Site Inspection Work Plan dated September 1991; a Draft Phase II Site Inspection Study for Naval Weapons Station Earle, Colts Neck, New Jersey, dated February 1993; and a final version of the Site Inspection (SI) report, dated December 1993. In addition, in September 1993, Weston submitted the Installation Restoration Program Remedial Investigations/Feasibility Study for 11 Sites at NWS Earle, Colts Neck, New Jersey, Volumes 1 to 3.

In 1995-96, Brown & Root Environmental (B&R Environmental) conducted a remedial investigation (RI) for 27 sites at NWS Earle. The RI included field investigations performed in 1995 and a review of data generated during previous investigations. The final RI report was prepared in July 1996. Results of the RI indicated that further RI data collection activities were required at seven sites. The results of the additional RI data collection activities are presented in the draft RI Addendum Report, dated February 1997.

Results of the previous investigations for OU-6 sites are discussed below.

1.3.1 Background Sampling

In order to determine the background level of chemicals present in and around NWS Earle, B&R Environmental collected samples from media at locations on the station that were selected on the expectation that past or present operations have not impacted site media. The field team collected samples of surface soil, subsurface soil, sediment, surface water, and groundwater from areas throughout the station. The samples were collected in areas hydraulically upgradient and, where possible, upwind of station areas where industrial operations or other potential sources of contaminant accumulation in site media may have occurred. The results of the background sampling were used for comparison with analytical results obtained from the sampling activities at the RI sites. A total of four background samples were collected for each of the five media. The BG-4 suite of sampled background media was split between the Mainside (surface water

and sediment) and Waterfront (groundwater and subsurface soils) areas because surface water and sediment were not available at the Waterfront BG-4 location.

Three background sampling locations were located on the Mainside (BG-1, BG-2, and BG-4) and two background sampling locations were located at the Waterfront area (BG-3 and BG-4).

1.3.1.1 Background Sample Location 1

Background Sample Location 1 (BG-1) is situated in the northeastern portion of the Mainside southeast of Macedonia. This location is upgradient of the station and several thousand feet from an industrial area of the station. A full suite of background samples (surface soil, subsurface soil, sediment, surface water, and groundwater) was collected.

1.3.1.2 Background Sample Location 2

Background Sample Location 2 is situated on the north side of Hominy Hills, approximately 1 mile southwest of the intersection of Guadalcanal Road and Asbury Avenue. A full suite of background samples (surface soil, subsurface soil, sediment, surface water, and groundwater) was collected.

1.3.1.3 Background Sample Location 3

Background Sample Location 3 is situated at the Waterfront area of the station, approximately 1,000 feet northwest of High Point Chapel. This location is upgradient and generally upwind of all industrial operations at the Waterfront portion of the station. Surface soil, subsurface soil, and groundwater samples were collected. Surface water and sediment samples were not collected.

1.3.1.4 Background Sample Location 4

Background Sample Location 4 is situated approximately 250 feet east of Site 15. B&R Environmental installed a monitoring well and collected soil samples at this location to provide data on background conditions near the shoreline. No surface water or sediment samples were collected at this location. The surface water and sediment samples for Background Location 4 were collected from the Mainside, on the south side of Hominy Hills, west of the intersection of Route 34 and Midway Road, due to a lack of available surface water/sediment sample locations at the Waterfront area.

1.3.1.5 Background Well Geology

Table 1-1 provides a summary of the characteristics of each background well. Table 1-2 provides a summary of the static water level measurements for each background well.

The four background monitoring wells were completed in distinct geological formations across the facility. The surficial soils outcrop found at the monitoring well location was not necessarily the same geologic unit into which the well screen was installed.

Regional mapping places BGMW-01 within the outcrop of the Kirkwood Formation. The Kirkwood Formation ranges between 60 and 100 feet in thickness and the boring is 27 feet deep. The lithology of the sediments encountered in this background boring generally agrees with the published description of the Kirkwood Formation. The well was screened from 17 to 27 feet below grade and is assumed to be screened in the Kirkwood Formation.

Regional mapping places BGMW-02 within the outcrop area of the Cohansey Sand; Quaternary surficial deposits may be present at this location. Quaternary surficial deposits in this area generally are 10 feet or less in thickness, and the Cohansey Sand ranges between 0 and 35 feet in thickness. The lithology of the sediments encountered in the soil boring generally agrees with the published description of the Cohansey Sand. However, because the boring reached a depth of 80 feet, it is likely that the boring also encountered the Kirkwood Formation. The Kirkwood Formation ranges between 60 and 100 feet in thickness. The well was screened to 67 to 77 feet below grade and is therefore assumed to be screened in the Kirkwood Formation.

Regional mapping places BGMW-03 within the outcrop area of the Red Bank Sand and Tinton Sand, which, combined, range between 35 and 135 feet in thickness. The soil boring is 70 feet deep. The lithology of the sediments encountered in the boring generally agrees with the published description of the Red Bank Sand and Navesink Formation. Assuming a portion of the Red Bank Sand was removed by erosion, it is possible that the boring penetrated the underlying Navesink Formation. The well was screened from 59 to 69 feet and is assumed to be screened in the Red Bank Sand and Navesink Formation.

Regional mapping places BGMW-04 within the outcrop area of the Englishtown Formation. The Englishtown Formation ranges between 35 and 150 feet in thickness and the soil boring is 21 feet deep. The lithology of the sediments encountered in the boring generally agrees with the published description of the Englishtown Formation. The well was screened from 10 to 20 feet below grade and is assumed to be screened in the Englishtown Formation.

Table 1-1

BACKGROUND MONITORING WELL CHARACTERISTICS SUMMARY

OU-6 FEASIBILITY STUDY

NWS EARLE, COLTS NECK, NEW JERSEY

Monitoring Well Number	Total Depth[1] (feet)	Ground Surface Evaluation[2]			Diameter (inches)	Screened Interval Depth[1] (feet)	Filter Pack Interval Depth[1] (feet)	Date Installed
		Top of Concrete Pad[2] (feet)	Top of PVC Riser[2]	Top of Standpipe[2]				
BGMW-01	27	94.16	96.31	96.79	2	17 - 27	15 - 27	6/23/95
BGMW-02	77	231.19	233.70	233.32	2	67 - 77	65 - 77	6/22/95
BGMW-03	69	201.75	203.80	204.20	2	59 - 69	57 - 69	6/26/95
BGMW-04	20	26.82	28.96	29.51	2	10 - 20	8 - 20	6/28/95

Note: All wells are constructed of Schedule 40 polyvinyl chloride (PVC) well casing.

(1) In feet below grade. Reading obtained during monitoring well installation. See Table 30-2 of the RI for report more accurate measurements.

(2) In feet above mean sea level.

TABLE 1-2

BACKGROUND STATIC-WATER-LEVEL MEASUREMENT SUMMARY

OU-6 FEASIBILITY STUDY

NWS EARLE, COLTS NECK, NEW JERSEY

Monitoring Well Number	August 7, 1995			October 17, 1995		
	Depth to Water Table[1] (feet)	Top of PVC Riser[2]	Elevation of Water Table[2]	Depth to Water Table[1] (feet)	Top of PVC Riser[2]	Elevation of Water Table[2]
BGMW-01	21.93	96.31	74.38	22.70	96.31	73.61
BGMW-02	70.30	233.70	163.40	71.20	233.70	162.50
BGMW-03	63.38	203.80	140.42	64.89	203.80	138.91
BGMW-04	15.45	28.96	13.51	17.13	28.96	11.83

(1) In feet below top of riser

(2) In feet above mean sea level

1.3.1.6 Background Groundwater Statistical Analysis

In order to compare site-related metals concentrations found during RI sampling to facility-wide naturally occurring (background) groundwater concentrations, it was necessary to choose additional facility monitoring wells deemed to have been installed in "background" locations upgradient of RI sites. The Navy proposed a list of existing monitoring wells to be used. After EPA and NJDEP comment and revision, a list of additional monitoring wells to be used for background statistical comparisons was agreed to. Table 1-3 shows the chosen background and upgradient wells grouped by interpreted aquifer. Formations were grouped according to similarity and intimate association of certain geologic units found across NWS Earle.

Table 1-4 presents a summary of the statistical evaluation of background metals data for monitoring wells completed in the Cohansey Sand, Kirkwood, and Vincentown Formations. Table 1-5 presents a summary of the statistical evaluation of background metals data for monitoring wells completed in the Red Bank Sand and Navesink Formations. Table 1-6 presents a summary of the statistical evaluation of background metals data for monitoring wells completed in fill and the Englishtown Formation at the Waterfront. The 95 percent Upper Tolerance Limits (UTLs) presented in these tables were compared to the individual maximum site-related results for corresponding wells grouped in the same interpreted aquifer.

1.3.1.7 Background Surface Soil Statistical Analysis

In order to compare site-related metals concentrations found during RI sampling to facility-wide naturally occurring (background) surface soil concentrations, a statistical evaluation was performed as described in Section 2.4.6.1 of the RI report. Table 1-7 presents a summary of the statistical evaluation of background surface soil results, showing the UTLs that were compared to individual maximum site-related results.

1.3.1.8 Background Subsurface Soil Statistical Analysis

In order to compare site-related metals concentrations found during RI sampling to facility-wide naturally occurring (background) subsurface soil concentrations, a statistical evaluation was performed as described in Section 2.4.6.1 of the RI Report. Table 1-8 presents a summary of the statistical evaluation of background subsurface soil results showing the UTLs that were compared to individual maximum site-related results.

TABLE 1-3

BACKGROUND WELLS AND UPGRADIENT WELLS GROUPED BY INTERPRETED AQUIFER

OU-6 FEASIBILITY STUDY

NWS EARLE, COLTS NECK, NEW JERSEY

Interpreted Aquifer[1]	Well No.	Site
Cohansey Sand	MW4-04	4
Cohansey Sand and Kirkwood Formation	BGMW-02	Background 2
Kirkwood Formation	BGMW-01	Background 1
	MW26-03	26
Kirkwood Formation	MW3-06	3
Kirkwood and Vincentown Formations	MW5-02	5
	MW5-03	5
	MW19-01	19
Vincentown Formation	MW1-03	1
	MW5-08	5
	MW11-03	11
Red Bank Sand and Navesink Formation	BGMW-3	Background 3
Red Bank Sand	MW7-03	7
Englishtown Formation	BGMW-04	Background 4
Fill and Englishtown Formation	MW6-01	6
	MW17-01	17

Reference: Remedial Investigation Report, July 1996

TABLE 1-4
STATISTICAL EVALUATION OF BACKGROUND GROUNDWATER METALS DATA
COHANSEY SAND, KIRKWOOD, AND VINCENTOWN FORMATIONS
OU-6 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY

Substance	Background Distribution	No. of Detects	No. of Results	Mean or Geometric Mean ug/L	Standard Deviation or Log Standard Deviation	Student's t-Distribution Coefficient	95 % Upper Tolerance Limit - ug/L
Aluminum	Lognormal	11	11	1560	1.14	1.812	13500
Arsenic	Lognormal	1	11	1.85	0.379	1.812	3.79
Barium	Lognormal	11	11	39.5	1.51	1.812	687
Beryllium	Lognormal	4	11	0.111	1.11	1.812	0.914
Cadmium	Lognormal	5	11	0.403	0.919	1.812	2.3
Calcium	Lognormal	11	11	2520	1.03	1.812	17600
Chromium, Total	Lognormal	9	11	5.53	1.71	1.812	141
Cobalt	Lognormal	6	11	0.905	1.28	1.812	10.2
Copper	Lognormal	9	11	1.67	1.18	1.812	15.6
Iron	Lognormal	11	11	1110	1.24	1.812	11500
Lead	Lognormal	3	11	1.03	0.557	1.812	2.97
Magnesium	Lognormal	11	11	1950	1.15	1.812	17100
Manganese	Lognormal	11	11	17	0.888	1.812	91.4
Mercury	Lognormal	11	11	0.034	1.24	1.812	0.355
Nickel	Lognormal	10	11	3.06	1.24	1.812	31.8
Potassium	Lognormal	11	11	1080	0.797	1.812	4900
Selenium	Lognormal	1	11	2.38	0.265	1.812	3.94
Sodium	Lognormal	11	11	3730	0.491	1.812	9460
Thallium	Lognormal	3	11	2.33	0.443	1.812	5.38
Vanadium	Lognormal	10	11	2.92	1.57	1.812	56.5
Zinc	Lognormal	6	9	12.8	2.52	1.86	1780

Notes:

(1) Background statistics are based on the estimated distribution type (normal or lognormal).

(2) The tolerance limit defines the concentration range that, on the average, is estimated to contain 95 % of all data points from the background population.

(3) If a site-related sample exceeds the tolerance limit, statistical evidence suggests the sample comes from a population with a different distribution and higher concentrations than the background data.

TABLE 1-5
STATISTICAL EVALUATION OF BACKGROUND GROUNDWATER METALS DATA
RED BANK SAND AND NAVESINK FORMATIONS
OU-6 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY

Substance	Background Distribution	No. of Detects	No. of Results	Geometric Mean ug/L	Log Standard Deviation	Student's t-Distribution Coefficient	95 % Upper Tolerance Limit - ug/L	
Aluminum	Lognormal	2	2	308	0.343	6.314	4370	
Barium	Lognormal	2	2	46	0.123	6.314	119	
Beryllium	Lognormal	1	2	0.148	1.4	6.314	1.32	*
Calcium	Lognormal	2	2	2930	0.984	6.314	17587	*
Chromium, Total	Lognormal	1	2	2.68	2.42	6.314	52.83	*
Cobalt	Lognormal	2	2	15.4	0.856	6.314	80.81	*
Iron	Lognormal	2	2	459	0.61	6.314	1790	*
Magnesium	Lognormal	2	2	1950	0.116	6.314	4780	
Manganese	Lognormal	2	2	217	0.175	6.314	843	
Mercury	Lognormal	1	2	0.0097	2.23	6.314	0.17	*
Nickel	Lognormal	2	2	6.2	0.849	6.314	32.29	*
Potassium	Lognormal	2	2	1230	0.766	6.314	5819	*
Sodium	Lognormal	2	2	6050	0.353	6.314	92710	
Vanadium	Lognormal	1	2	0.653	1.08	6.314	4.31	*
Zinc	Lognormal	2	2	6.63	0.4	6.314	146	

Notes:

(1) Background statistics are calculated using the EPA default lognormal distribution (too few samples to statistically verify type of distribution).

(2) The tolerance limit defines the concentration range that, on the average, is estimated to contain 95 % of all data points from the background population.

(3) If a site-related sample exceeds the tolerance limit, statistical evidence suggests the sample comes from a population with a different distribution and higher concentrations than the background data.

(*) The EPA Region II test (2X background arithmetic mean) is shown because the tolerance limit is impractical (large uncertainties are caused by too few samples and a high lognormal standard deviation).

TABLE 1-6
STATISTICAL EVALUATION OF BACKGROUND GROUNDWATER METALS DATA
FILL AND ENGLISHTOWN FORMATION
OU-6 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY

Substance	Background Distribution Type Used	No. of Detects	No. of Results	Mean or Geometric Mean ug/L	Standard Deviation or Log Standard Deviation	Student's t-Distribution Coefficient	95 % Upper Tolerance Limit - ug/L
Aluminum	Lognormal	3	3	1660	0.23	2.92	3610
Arsenic	Lognormal	1	3	2.4	0.652	2.92	21.6
Barium	Lognormal	3	3	49	0.472	2.92	241
Beryllium	Lognormal	2	3	0.385	2.25	2.92	5.84 *
Cadmium	Lognormal	3	3	1.15	1.56	2.92	9.00286 *
Calcium	Lognormal	3	3	18000	0.429	2.92	76450
Chromium, Total	Lognormal	1	3	0.637	0.473	2.92	3.14
Cobalt	Lognormal	3	3	8.44	1.03	2.92	30.98 *
Iron	Lognormal	3	3	7880	2.21	2.92	123637 *
Magnesium	Normal	3	3	13500	4440	2.92	28430
Manganese	Normal	3	3	1860	1160	2.92	5770
Mercury	Lognormal	1	3	0.0056	1.78	2.92	0.06 *
Nickel	Lognormal	3	3	11.9	1.23	2.92	54.73 *
Potassium	Normal	3	3	3390	340	2.92	4530
Sodium	Normal	3	3	63800	41800	2.92	204850
Vanadium	Lognormal	1	3	0.468	0.741	2.92	5.68
Zinc	Lognormal	2	2	24.2	0.348	6.314	355

Notes:

(1) Background statistics are calculated assuming the EPA default lognormal distribution, except where this assumption is statistically improbable in cases where a normal distribution assumption is not improbable (based on the W-test using a P level of 0.05).

(2) The tolerance limit defines the concentration range that, on the average, is estimated to contain 95% of all data points from the background population.

(3) If a site-related sample exceeds the tolerance limit, statistical evidence suggests the sample comes from a population with a different distribution and higher concentrations than the background data.

(*) The EPA Region II test (2X background arithmetic mean) is presented for this metal because the tolerance limit is impractical (large uncertainties are caused by too few sampling points along with a moderate to high lognormal standard deviation).

TABLE 1-7
STATISTICAL EVALUATION OF BACKGROUND SURFACE SOIL METALS DATA
OU-6 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY

Metal	Background Distribution Type Used	No. of Detects	No. of Results	Mean or Geometric Mean mg/kg	Standard Deviation or Log Standard Deviation	Student's t-Distribution Coefficient	95 % Upper Tolerance Limit - mg/kg
Aluminum	Lognormal	4	4	2760	0.538	2.353	11300
Antimony	---	0	4	---	---	---	---
Arsenic	Lognormal	4	4	4.38	1.13	2.353	86.6
Barium	Lognormal	4	4	6.15	1.29	2.353	184
Beryllium	Normal	1	4	0.194	0.161	2.353	0.617 *
Cadmium	Lognormal	1	4	0.31	0.412	2.353	0.916
Calcium	Normal	4	4	276	272	2.353	992 *
Chromium	Lognormal	4	4	24.4	1.03	2.353	368
Cobalt	Lognormal	2	4	0.733	1.36	2.353	26.5
Copper	Lognormal	4	4	3.61	1.04	2.353	55.5
Iron	Lognormal	4	4	16000	1.23	2.353	409600
Lead	Normal	4	4	18.7	16.4	2.353	61.9 *
Magnesium	Lognormal	4	4	222	0.882	2.353	2260
Manganese	Lognormal	4	4	20.5	1.81	2.353	2420
Mercury	Normal	4	4	0.0909	0.0658	2.353	0.264
Nickel	Lognormal	2	4	1.56	1.12	2.353	29.7
Potassium	Normal	4	4	456	287	2.353	1210
Selenium	Lognormal	2	4	0.453	0.587	2.353	2.12
Silver	Lognormal	2	4	0.29	0.672	2.353	1.7
Sodium	Lognormal	4	4	31.7	0.715	2.353	208
Thallium	Lognormal	2	4	0.625	0.818	2.353	5.38
Vanadium	Normal	4	4	35.1	22	2.353	92.8
Zinc	Normal	3	4	11.4	12.9	2.353	45.3 *

Notes:
(1) Background statistics are calculated assuming the EPA default lognormal distribution, except where this assumption is statistically improbable in cases where a normal distribution assumption is not improbable (based on the W-test using a P level of 0.05).
(2) The tolerance limit defines the concentration range that, on the average, is estimated to contain 95% of all data points from the background population.
(3) If a site-related sample exceeds the tolerance limit, statistical evidence suggests the sample comes from a population with a different distribution and higher concentrations than the background data.
(*) The EPA Region II test (2X background arithmetic mean) is presented for this metal because the tolerance limit is impractical (large uncertainties are caused by too few sampling points along with a moderate to high lognormal standard deviation).

TABLE 1-8
STATISTICAL EVALUATION OF BACKGROUND SUBSURFACE SOIL METALS DATA
OU-6 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY

Metal	Background Distribution Type Used	No. of Detects	No. of Results	Mean or Geometric Mean mg/kg	Standard Deviation or Log Standard Deviation	Student's t-Distribution Coefficient	95 % Upper Tolerance Limit - mg/kg
Aluminum	Lognormal	8	8	2260	0.656	1.895	8470
Arsenic	Lognormal	8	8	4.62	0.971	1.895	32.5
Barium	Lognormal	8	8	4.75	1.27	1.895	60.5
Beryllium	Normal	2	8	0.141	0.134	1.895	0.41
Cadmium	Lognormal	1	8	0.274	0.303	1.895	0.505
Calcium	Lognormal	8	8	155	1.32	1.895	2200
Chromium	Lognormal	8	8	19	0.958	1.895	130
Cobalt	Lognormal	4	8	0.753	1.17	1.895	7.89
Copper	Lognormal	8	8	3.15	0.881	1.895	18.5
Iron	Lognormal	8	8	13800	0.978	1.895	98400
Lead	Lognormal	8	8	6.22	1.31	1.895	87.1
Magnesium	Normal	8	8	252	191	1.895	636
Manganese	Lognormal	8	8	16.7	1.59	1.895	410
Mercury	Lognormal	8	8	0.0516	0.675	1.895	0.201
Nickel	Lognormal	4	8	1.54	0.977	1.895	10.9
Potassium	Normal	7	8	397	246	1.895	891
Selenium	Lognormal	2	8	0.354	0.469	1.895	0.908
Silver	Lognormal	2	8	0.219	0.535	1.895	0.643
Sodium	Lognormal	8	8	31.7	0.67	1.895	122
Thallium	Lognormal	4	8	0.566	0.625	1.895	1.99
Vanadium	Normal	8	8	32.4	18.1	1.895	68.7
Zinc	Lognormal	6	8	7.18	1.53	1.895	155

Notes:
(1) Background statistics are calculated assuming the EPA default lognormal distribution, except where this assumption is statistically improbable in cases where a normal distribution assumption is not improbable (based on the W-test using a P level of 0.05).
(2) The tolerance limit defines the concentration range that, on the average, is estimated to contain 95 % of all data points from the background population.
(3) If a site-related sample exceeds the tolerance limit, statistical evidence suggests the sample comes from a population with a different distribution and higher concentrations than the background data.

1.3.2 Site 3

1.3.2.1 Initial Assessment and Confirmation Study

The 1983 IAS consisted of interviews and on-site observations. Based on the potential for groundwater impacts to the Kirkwood Aquifer, the site was recommended for a confirmation study. The 1986 SI included the installation and sampling of three monitoring wells (MW3-01 through MW3-03).

1.3.2.2 Phase I Remedial Investigation

Phase I RI/FS activities were conducted by Weston in 1993 at NWS Earle. The OU-5 and OU-6 sites were included for investigation. During the RI/FS, seven test pits were excavated and four additional monitoring wells were installed, one upgradient of the landfill (MW3-06) and three downgradient of the landfill (MW3-04, MW3-05, and MW3-06). The well depths ranged from 15 to 20 feet. Two soil samples collected from the test pits were analyzed for Target Compound List (TCL) organics and Target Analyte List (TAL) inorganics. Groundwater from all seven wells was collected and analyzed for full TCL/TAL analytes. Later rounds of groundwater samples were analyzed for Volatile Organic Compounds (VOCs), drinking water metals, and inorganic landfill indicator parameters at a limited number of wells.

Based on visual inspection of test pit excavations, the landfill contains typical municipal waste. In groundwater samples, an elevated level of arsenic (0.37 ppm) was found in one downgradient well (MW3-01). Elevated levels of volatiles and semivolatiles were found in some wells (particularly monitoring well MW3-04). Wells MW3-04 and MW3-05 had low levels of several pesticide compounds. However, the concentrations were not high enough to indicate that the landfill was generating a highly concentrated leachate.

1.3.2.3 Phase II Remedial Investigation

B&R Environmental conducted Phase II RI activities in 1995; the final report included a human health risk assessment and an ecological risk assessment that were performed for 27 sites at NWS Earle, including the sites in OU-6. Activities performed during this investigation of Site 3 are summarized below.

Between May and October 1995, B&R Environmental conducted the following field investigation activities:

- Soil gas survey and analysis at 25 locations
- Excavation of two test pits
- Drilling and installation of one shallow permanent monitoring well

- Sampling and analysis of groundwater from monitoring wells
- Measurement of static water levels in monitoring wells
- Sampling and analysis of one surface soil in the wetlands southeast of the landfill

On October 29 and 30, 1996, B&R Environmental conducted the following field activities at Site 3:

- Sampling and analysis of surface soil
- Sampling and analysis of sediment

B&R Environmental surveyed the horizontal locations and vertical elevations of soil gas grid corners, test pit locations, the newly installed monitoring well, selected existing wells, and the wetlands surface soil sample location.

1.3.2.4 Summary of 1995/1996 RI Results

The site is accessible by a dirt road from the southeast and is characterized as an open area surrounded by woodlands. The landfill is primarily covered with a sandy soil and is not closed with an impermeable cap. The site is moderately vegetated with grasses and some scrub pines. There are several scarred areas with no vegetation in the northeastern portion of the site. The ground surface is relatively flat, and ground elevations are typically between 115 and 125 feet above MSL. Wetlands are located southeast of the site. Groundwater flow is generally to the southeast, based on measured groundwater levels.

1.3.2.4.1 Site Geology, Hydrogeology, and Hydrology

Geology

Regional mapping places Site 3 within the outcrop area of the Kirkwood Formation. The Kirkwood Formation ranges between 60 and 100 feet in thickness. The lithology of the sediments encountered in the on-site borings generally agrees with the published description of the Kirkwood and Vincentown Formations. 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 white and yellowish-brown, very fine- to fine-grained sand with minor silt and clay layers, dark gray silt, and clay (probably representative of the Kirkwood Formation) and glauconitic, medium- to coarse-grained sand (probably representative of the Vincentown Formation). The Mainside 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.

Based upon the boring log descriptions, wells MW3-02 through MW3-07 penetrated the Kirkwood Formation and well MW3-01 penetrated the Kirkwood and Vincentown Formations.

Hydrogeology

Groundwater in the Kirkwood and Vincentown aquifer beneath the site occurs under unconfined conditions and the formations are interpreted to be hydraulically interconnected. Static-water-level measurements and water-table elevations are summarized in Table 1-9. Groundwater elevations for August 1995 are contoured on Figure 1-4; all but one of the wells was dry in October 1995. The direction of shallow groundwater flow in the aquifer, as indicated by the August groundwater contour map, is toward the southeast. Water levels in general could not be measured in October because all but one of the wells was dry. There is a significant seasonal variation in the elevation of the water table.

Based on boring log descriptions, well MW3-01 is screened across the contact between the Kirkwood and Vincentown Formations, and wells MW3-02 through MW3-07 are screened in the Kirkwood Formation. The hydraulic conductivities calculated for MW3-03 and MW3-06, both of which are screened in the Kirkwood Formation, are 7.16×10^{-4} cm/sec (2.03 ft/day) and 5.50×10^{-4} cm/sec (1.56 ft/day), respectively.

1.3.2.4.2 Nature and Extent of Contamination

This section evaluates the occurrence and distribution of samples from the 1995 RI and 1996 RI Addendum field activities. Tables 1-10 through 1-14 compare the results at background samples to samples collected at Site 3. Figure 1-5 shows sample locations and concentrations of compounds that exceed ARARs and other TBCs.

Surface Soil

Two surface soil samples (03 SS 01 and 03 SS 02) were collected from the southeastern face of the landfill to determine whether contaminants of concern detected in the wetlands are site related. Concentrations of metals in surface soils were similar to the range detected in background samples. Antimony was detected at low levels in 03 SS 01 (0.48 mg/kg) but was not detected in background samples.

Polycylic aromatic hydrocarbons (PAHs), including benz(a)anthracene (44 ug/kg), benzo(a)pyrene (48 ug/kg), benzo(b)fluoranthene (80 ug/kg), chrysene (69.5 ug/kg), phenanthrene (97 ug/kg), and pyrene (105 ug/kg), were detected at location 03 SS 01. These compounds, with the exception of pyrene, were not detected in background samples. Pyrene was detected at levels approximately two times background. Phenol (50 ug/kg) was detected at 03 SS 01 but was not detected in background samples.

Table 1-9

SITE 3 STATIC-WATER-LEVEL MEASUREMENT SUMMARY

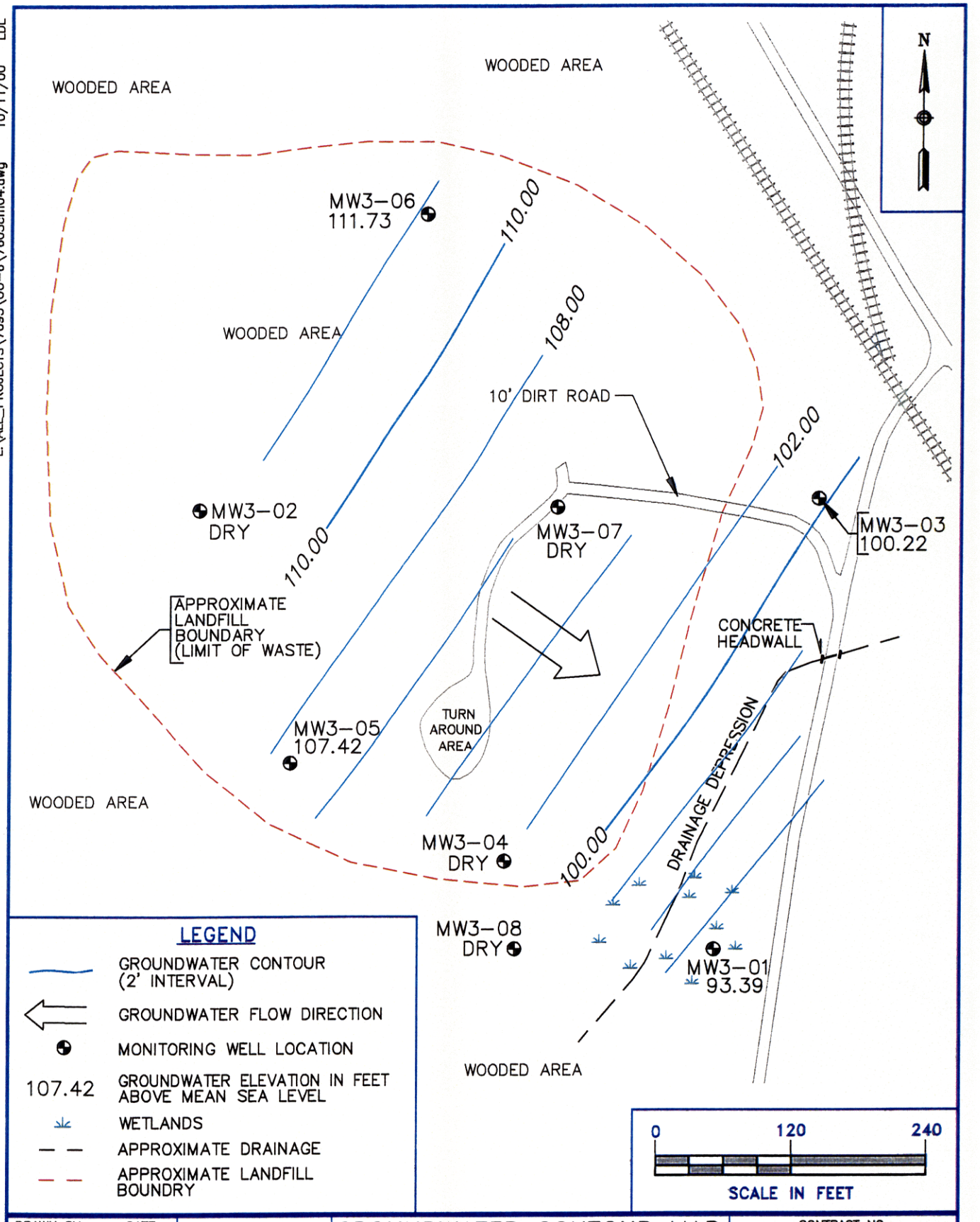
OU-6 FEASIBILITY STUDY

NWS EARLE, COLTS NECK, NEW JERSEY

Monitoring Well Number	August 7, 1995			October 17, 1995		
	Depth to Water Table[1] (feet)	Top of PVC Riser[2] (feet)	Elevation of Water Table[2] (feet)	Depth to Water Table[1]	Top of PVC Riser[2] (feet)	Elevation of Water Table[2] (feet)
MW3-01	22.53	115.92	93.39	Dry	115.92	-
MW3-02	Dry	124.87	-	Dry	124.87	-
MW3-03	24.18	124.40	100.22	Dry	124.40	-
MW3-04	Dry	122.16	-	Dry	122.16	-
MW3-05	17.48	124.90	107.42	Dry	124.90	-
MW3-06	13.92	125.65	111.73	15.21	125.65	110.44
MW3-07	Dry	124.50	-	Dry	124.50	-
MW3-08	Dry	118.22	-	Dry	118.22	-

(1) In feet below top of riser

(2) In feet above mean sea level



DRAWN BY LDL DATE 10/11/00	Tetra Tech NUS, Inc.	GROUNDWATER CONTOUR MAP AUGUST 7, 1995 SITE 3 LANDFILL SOUTHWEST OF "F" GROUP NAVAL WEAPONS STATION EARLE COLTS NECK, NEW JERSEY	CONTRACT NO. 7695
CHECKED BY DATE			OWNER NO. OU-6
REVISED BY DATE			APPROVED BY DATE
SCALE AS NOTED			DRAWING NO. FIGURE 1-4 REV.

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OU-6\7695cm04.dwg

TABLE 1-10
OCCURRENCE AND DISTRIBUTION OF INORGANICS IN SURFACE SOILS AT SITE 3
OU-6 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY
(mg/kg)

	BACKGROUND***				SITE-RELATED					
SUBSTANC	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	UTL**	2 X AVERAGE CONCENTRATION	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	AVERAGE CONCENTRATION	MEAN > 2 X BKGD?	MEAN > ACK UTL	REPRESENTATIVE CONCENTRATION
ALUMINUM	4 / 4	1710 - 5310	4.6E+09	6153	2 / 2	319 - 339.5	329.25	NO	NO	339.50
ANTIMONY	NOT DETECTED	-	-	-	1 / 2	0.48 - 0.48	0.34	YES	-	0.48
ARSENIC *	4 / 4	1.35 - 14.4	9.6E+02	13.43	1 / 2	1.3 - 1.3	0.83	NO	NO	1.30
BARIUM	4 / 4	1.85 - 31	3.6E+03	22.53	2 / 2	4 - 5.95	4.98	NO	NO	5.95
CADMIUM	1 / 4	0.3975 - 0.3975	6.7E-02	0.58	1 / 2	0.0905 - 0.0905	0.06	NO	NO	0.09
CALCIUM	4 / 4	40.1 - 519	2.3E+07	551.80	2 / 2	42 - 71	56.50	NO	NO	71.00
COBALT	2 / 4	0.75 - 5	1.0E+01	3.15	2 / 2	0.36 - 0.64	0.50	NO	NO	0.64
COPPER	4 / 4	0.97 - 8.4	4.5E+02	10.06	2 / 2	1.7 - 5.7	3.70	NO	NO	5.70
IRON	4 / 4	3745 - 62500	3.0E+12	52403	2 / 2	457 - 773.5	615.25	NO	NO	773.50
LEAD	4 / 4	1.8 - 39.4	2.1E+04	37.30	2 / 2	10.9 - 27.05	18.98	NO	NO	27.05
MANGANES	4 / 4	3.45 - 214	4.3E+02	128.33	2 / 2	5.85 - 7.8	6.83	NO	NO	7.80
NICKEL	2 / 4	1.8 - 7.2	6.2E+01	5.18	2 / 2	0.39 - 1.25	0.82	NO	NO	1.25
POTASSIUM	4 / 4	95 - 792	5.9E+07	912.50	2 / 2	64.1 - 86.65	75.38	NO	NO	86.65
SILVER	2 / 4	0.37 - 0.67	2.3E-01	0.69	2 / 2	0.17 - 0.205	0.19	NO	NO	0.21
VANADIUM	4 / 4	11.05 - 64	5.0E+04	70.13	2 / 2	4.2 - 4.85	4.53	NO	NO	4.85
ZINC	3 / 4	0.665 - 27.6	6.1E+03	22.58	2 / 2	2.3 - 6.55	4.43	NO	NO	6.55

* - Selected as a COPC
** - Upper Tolerance Limit = UTL is the concentration that is estimated to contain a designated portion (95%) of all possible sample measurements.
*** - Background samples are as follows: BGSB0100, BGSB0200 (AND A DUPLICATE, DUP-4), BGSB0300, BGSB0400

TABLE 1-11
OCCURRENCE AND DISTRIBUTION OF ORGANICS IN SURFACE SOILS AT SITE 3
OU-6 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY
(ug/kg)

SUBSTANCE	BACKGROUND			SITE-RELATED		
	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	REPRESENTATIVE CONCENTRATION	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	REPRESENTATIVE CONCENTRATION
4,4'-DDD *	NOT DETECTED	-	-	1 / 2	4.8 - 4.8	4.8
4,4'-DDE *	2 / 4	16 - 330	277.86	1 / 2	21.5 - 21.5	21.5
4,4'-DDT *	2 / 4	43 - 420	355.71	2 / 2	2.6 - 78	78
HEPTACHLOR EPOXIDE *	NOT DETECTED	-	-	1 / 2	1.35 - 1.35	1.35
BENZ(A)ANTHRACENE *	NOT DETECTED	-	-	1 / 2	44 - 44	44
BENZO(A)PYRENE *	NOT DETECTED	-	-	1 / 2	48 - 48	48
BENZO(B)FLUORANTHENE	NOT DETECTED	-	-	1 / 2	80.5 - 80.5	80.5
CHRYSENE *	NOT DETECTED	-	-	1 / 2	69.5 - 69.5	69.5
FLUORANTHENE *	2 / 4	40 - 84	84	1 / 2	99.5 - 99.5	99.5
PHENANTHRENE *	NOT DETECTED	-	-	1 / 2	97 - 97	97
PHENOL *	NOT DETECTED	-	-	1 / 2	50 - 50	50
PYRENE *	1 / 4	46 - 46	46	1 / 2	105 - 105	105

* - Selected as a COPC

TABLE 1-12
OCCURRENCE AND DISTRIBUTION OF INORGANICS IN SEDIMENT AT SITE 3
OU-6 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY
(mg/kg)

	BACKGROUND***				SITE-RELATED					
SUBSTANCE	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	UTL**	2 X AVERAGE CONCENTRATION	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	AVERAGE CONCENTRATION	MEAN > 2 X BKGD	MEAN > ACK UTL	REPRESENTATIVE CONCENTRATION
ALUMINUM	6 / 6	839 - 3940	8.1E+07	5460	4 / 4	615 - 9870	4896	NO	NO	9870
ANTIMONY *	NOT DETECTED	-	-	-	1 / 4	1.3 - 1.3	0.50	YES	-	1.13
ARSENIC *	5 / 6	2.4 - 9.9	2.9E+02	11.23	3 / 4	1.1 - 11	4.69	NO	NO	11.00
BARIUM	6 / 6	3.2 - 15.8	2.9E+02	16.80	4 / 4	2.6 - 60.8	23.00	YES	NO	60.80
BERYLLIUM	4 / 6	0.34 - 0.57	3.3E-01	0.72	2 / 4	0.26 - 0.47	0.20	NO	NO	0.47
CADMIUM	2 / 6	0.44 - 0.46	1.1E+00	0.93	3 / 4	0.083 - 2.1	0.57	NO	NO	1.77
CALCIUM	6 / 6	179 - 518	6.7E+05	690.83	3 / 3	59.2 - 2570	957.07	YES	NO	2570
CHROMIUM	6 / 6	4.3 - 56	2.6E+03	40.42	2 / 2	22.1 - 24.3	23.20	NO	NO	24.30
COBALT	4 / 6	0.51 - 2.1	6.4E+00	2.85	4 / 4	0.43 - 2.3	1.05	NO	NO	2.30
COPPER	6 / 6	1 - 13	1.9E+01	9.08	4 / 4	1.6 - 24.3	8.55	NO	NO	24.30
IRON	6 / 6	228 - 21400	7.2E+09	23589	4 / 4	613 - 21200	9663	NO	NO	21200
LEAD	6 / 6	4 - 34.3	4.8E+01	21.07	4 / 4	6.5 - 89.1	29.43	YES	NO	76.44
MAGNESIUM	6 / 6	60.7 - 880	2.0E+06	809.90	2 / 4	545 - 1400	507.34	NO	NO	1400
MANGANESE	6 / 6	3.9 - 63.1	8.9E+01	36.22	4 / 4	5.2 - 59.5	28.38	NO	NO	59.50
MERCURY *	1 / 6	0.068 - 0.068	8.5E-03	0.09	1 / 4	0.26 - 0.26	0.12	YES	YES	0.23
NICKEL	5 / 6	1.6 - 6	3.4E+01	6.90	4 / 4	0.67 - 9.5	3.78	NO	NO	9.50
POTASSIUM	5 / 6	86.1 - 2900	1.4E+07	1892	4 / 4	85.5 - 2640	824.38	NO	NO	2258
SILVER	2 / 6	0.1125 - 0.15	2.8E+00	1.13	3 / 4	0.16 - 0.44	0.22	NO	NO	0.44
SODIUM	4 / 6	26.6 - 2280	2.9E+03	876.80	2 / 4	85.3 - 226	120.83	NO	NO	203.65
VANADIUM	6 / 6	5.9 - 42.7	2.1E+03	39.42	4 / 4	2.6 - 31.7	18.08	NO	NO	31.70
ZINC	6 / 6	12.5 - 34.7	1.5E+03	41.23	3 / 3	5.1 - 10.4	7.43	NO	NO	10.40

* - Selected as a COPC

** - Upper Tolerance Limit = UTL is the concentration that is estimated to contain a designated portion (95%) of all possible sample measurements.

*** - Background samples are as follows: BGSD01, BGSD02, BGSD04 through BGSD07

TABLE 1-13
OCCURRENCE AND DISTRIBUTION OF ORGANICS IN SEDIMENT AT SITE 3
OU-6 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY
(ug/kg)

	BACKGROUND**			SITE-RELATED		
SUBSTANCE	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	REPRESENTATIVE CONCENTRATION	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	REPRESENTATIVE CONCENTRATION
4,4'-DDT *	1 / 6	19 19	10.64	2 / 4	3 - 4	4
ALPHA-BHC *	NOT DETECTED	-	-	1 / 4	0.082 - 0.082	0.082
ALPHA-CHLORDANE *	NOT DETECTED	-	-	1 / 4	2.1 - 2.1	2.1
HEPTACHLOR EPOXIDE *	NOT DETECTED	-	-	1 / 4	2.2 - 2.2	2.2
2-METHYLNAPHTHALENE *	NOT DETECTED	-	-	1 / 4	140 - 140	140
ACENAPHTHENE *	NOT DETECTED	-	-	1 / 4	52 - 52	52
ACENAPHTHYLENE *	NOT DETECTED	-	-	1 / 4	130 - 130	130
ANTHRACENE *	NOT DETECTED	-	-	1 / 4	140 - 140	140
BENZO(A)ANTHRACENE *	3 / 6	85 - 560	560	3 / 4	68 - 1300	1117
BENZO(A)PYRENE *	3 / 6	110 - 590	393.60	3 / 4	81 - 1400	1200
BENZO(B)FLUORANTHENE *	3 / 6	150 490	346.54	3 / 4	110 - 2000	1704
BENZO(G,H,I)PERYLENE *	3 / 6	51 - 380	380	1 / 4	1000 - 1000	874.24
BENZO(K)FLUORANTHENE *	3 / 6	63 - 470	470	1 / 4	50 - 50	50
BIS(2-ETHYLHEXYL)PHTHALAT	NOT DETECTED	-	-	1 / 4	82 - 82	82
BUTYLBENZYLPHTHALATE *	NOT DETECTED	-	-	1 / 4	64 - 64	64
CARBAZOLE *	NOT DETECTED	-	-	1 / 4	70 - 70	70
CHRYSENE *	3 / 6	130 - 940	577.87	3 / 4	130 - 1800	1538
DIBENZ(A,H)ANTHRACENE *	NOT DETECTED	-	-	1 / 4	240 - 240	240
FLUORANTHENE *	3 / 6	240 - 1800	1024	3 / 4	160 - 2200	1876
FLUORENE *	1 / 6	190 190	190	1 / 4	260 - 260	260
INDENO(1,2,3-CD)PYRENE *	3 / 6	55 - 310	310	1 / 4	880 - 880	773.69
NAPHTHALENE *	NOT DETECTED	-	-	1 / 4	130 - 130	130
PHENANTHRENE *	3 / 6	110 - 1900	1052	3 / 4	180 - 2400	2047
PYRENE *	3 / 6	200 - 1900	1077	3 / 4	190 - 3400	2886

* - Selected as a COPC
** - Background samples are as follows: BGSD01, BGSD02, BGSD04 through BGSD07

TABLE 1-14
OCCURRENCE AND DISTRIBUTION OF INORGANICS IN GROUNDWATER AT SITE 3
OU-6 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY
(ug/L)

	BACKGROUND				SITE-RELATED					
SUBSTANCE	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	UTL**	2 X AVERAGE CONCENTRATION	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	AVERAGE CONCENTRATION	MEAN > 2 X BKGD	MEAN > BACK UTL	REPRESENTATIVE CONCENTRATION
ALUMINUM	11 / 11	287 - 7870	9.6E+06	5098	4 / 4	268 - 7930	2286	NO	NO	6715
ARSENIC *	1 / 11	5.8 - 5.8	6.6E+00	4.05	1 / 4	15.1 - 15.1	5.01	YES	NO	15.10
BARIUM	11 / 11	2.6 - 518	5.8E+02	229.60	4 / 4	2.6 - 689	187.45	NO	NO	581.36
CADMIUM *	5 / 11	0.6 - 1.9	2.3E+00	1.21	3 / 4	2.3 - 11.7	5.17	YES	YES	11.70
CALCIUM	11 / 11	506 - 17200	1.7E+04	8307	4 / 4	3920 - 7260	5515	NO	NO	7260
CHROMIUM *	NOT DETECTED	-	-	-	3 / 4	1.3 - 9.8	3.25	YES	-	8.41
COBALT	6 / 11	0.7 - 10.1	9.6E+00	4.06	2 / 4	4.4 - 8.4	3.35	NO	NO	8.40
COPPER	9 / 11	0.79 - 13.5	1.4E+01	6.53	4 / 4	0.79 - 16.3	4.80	NO	NO	13.82
IRON	11 / 11	153 - 7690	8.5E+03	4197	4 / 4	440 - 26000	7090	YES	NO	21927
LEAD	3 / 11	2.1 - 3	3.1E+00	2.44	1 / 4	5.1 - 5.1	1.84	NO	NO	5.10
MAGNESIUM	11 / 11	273 - 27400	2.3E+04	8450	4 / 4	603 - 3240	1803	NO	NO	3240
MANGANESE	11 / 11	3.3 - 65	1.2E+03	46.18	4 / 4	4.4 - 534	147.68	YES	NO	451.42
MERCURY	11 / 11	0.005 - 0.12	2.0E-01	0.12	4 / 4	0.008 - 0.12	0.06	NO	NO	0.12
NICKEL	10 / 11	0.81 - 25.5	2.6E+01	11.98	4 / 4	1.1 - 22.7	9.23	NO	NO	22.70
POTASSIUM	11 / 11	350 - 3245	2.5E+06	2811	4 / 4	309 - 2270	1019	NO	NO	2270
SODIUM	11 / 11	1850 - 11650	1.3E+04	8449	4 / 4	3490 - 7460	4878	NO	NO	7460
THALLIUM	3 / 11	4 - 5.1	1.1E+01	5.15	1 / 4	4 - 4	2.35	NO	NO	4.00
VANADIUM	10 / 11	0.69 - 42.25	4.0E+01	16.48	2 / 4	0.69 - 11.3	3.15	NO	NO	9.55
ZINC	6 / 9	3.7 - 348	4.4E+02	178.61	3 / 4	109 - 623	247.95	YES	NO	623.00

* - Selected as a COPC
** - Upper Tolerance Limit

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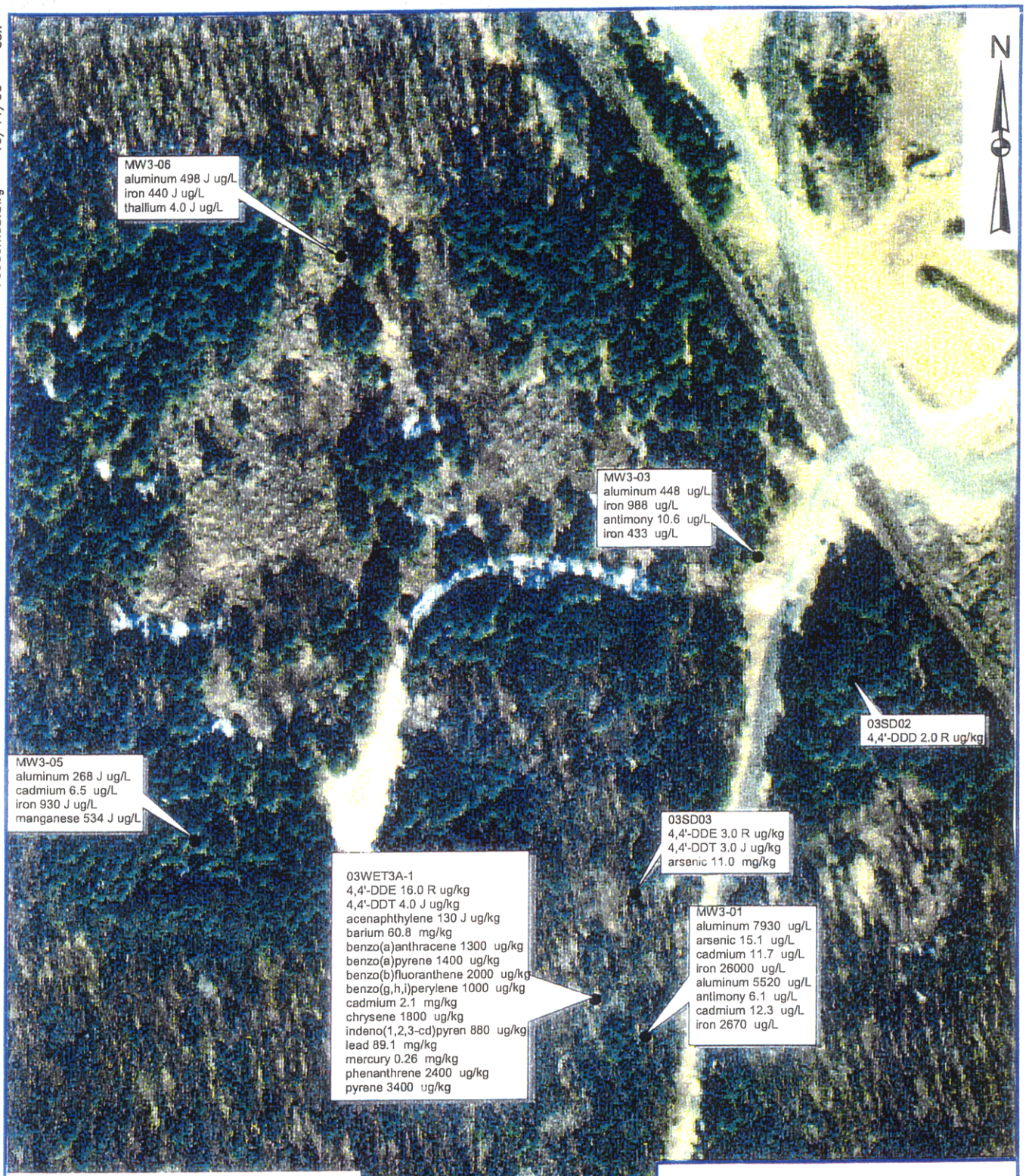

LEGEND

⊗ Sample Locations With Exceedances

0 120 240

SCALE IN FEET

DRAWN BY EEH DATE 10/11/00	Tetra Tech NUS, Inc.	CONCENTRATIONS ABOVE SCREENING LEVELS SITE 3 – LANDFILL SOUTHWEST OF "F" GROUP NAVAL WEAPONS STATION EARLE COLTS NECK, NEW JERSEY	CONTRACT NO. 7695
CHECKED BY DATE			OWNER NO. 0202
REVISED BY DATE			APPROVED BY DATE
SCALE AS NOTED			DRAWING NO. FIGURE 1–5 REV.

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Two pesticides, 4,4'-DDD (4.8 ug/kg) and heptachlor epoxide (1.35 ug/kg), were detected at 03 SS 01 but not in background samples. 4,4'-DDT was detected at 03 SS 01 (78 ug/kg) and 03 SS 02 (2.6 ug/kg). These levels were similar to the range exhibited in background samples. No organics other than 4,4'-DDT were detected at location 03 SS02.

Sediment

Four sediment samples were collected from the drainage swale southwest of the site to determine potential impacts on the wetlands. Concentrations of metals in surface soils were similar to the range detected in background samples except for antimony, which was detected at low levels in 03 SD WET3A-1 (1.3 mg/kg) but was not detected in background samples.

PAHs, including benz(a)anthracene, benzo(a)pyrene, chrysene, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene, fluoranthene, fluorene, and pyrene, were detected in 03 SD WET3A-1 at concentrations two to three times higher than background concentrations. 4,4'-DDT was detected in sediment samples from 3 to 4 ug/kg; however, background concentrations as high as 19 ug/kg were detected. Alpha-BHC and heptachlor epoxide were detected in sample 03 SD WET3A-1 at 0.082 ug/kg and 2.2 ug/kg, respectively.

Groundwater

Four site-related groundwater samples (03 GW 01, 03 GW 03, 03 GW 05, and 03 GW 06) were collected. With the exception of beryllium, the site-related samples also showed the presence of all the metals found in background, in addition to arsenic and thallium. The highest concentrations of metals in Site 3 groundwater samples were detected in the sample collected at 03 GW 01. This well and one other (03 GW 03) required sample filtering in the field. The filtered sample from the downgradient location, 03 GW 01, exhibited fairly high aluminum levels (5,520 ug/L) and also displayed concentrations greater than background ranges for antimony and cadmium. Other metals, such as iron, zinc, and barium, were present at considerably lower levels in the filtered sample. Sample 03 GW 05, collected from a well cross-gradient from the landfill, displayed an elevated level of manganese, and sample 03 GW 06 (an upgradient location) exhibited thallium at a low level. Due to dry conditions in the summer of 1995, four monitoring wells (MW3-02, MW3-04, MW2-07, and MW3-08) were found to be dry. One of these wells, MW3-04, was found to have high levels of volatile organic compounds (VOCs) during a previous sampling event in March 1991. MW3-04 has been dry in all subsequent sampling events. VOCs detected above the NJDEP Groundwater Quality Standards (GWQS) in MW3-04 were acetone (970 ug/L) and xylene (470 ug/L). 2-Butanone (5 ug/L) and gamma-chlordane (0.0081 ug/L) were each detected in one groundwater sample collected at Site 3. Neither of these compounds were detected in background groundwater samples.

1.3.2.4.3 Contaminant Fate and Transport

One organic groundwater contaminant, 2-butanone, is considered volatile and mobile in the environment (either through soil gas migration or groundwater transport). This compound may have originated at source locations within or near the landfill, which may or may not have been depleted of this contaminant. Despite their relatively high water solubilities, volatile organics were not detected at significant levels in groundwater. 2-Butanone and the pesticide gamma-chlordane were each detected in only one groundwater sample and were below quantitation limits.

Chemical constituents detected in the sediments at Site 3 have low potential for impact to groundwater. Runoff and erosional dispersion may allow limited migration of contaminated sediments. Detected chemicals in the groundwater do not conclusively demonstrate groundwater impact or identify a particular source location. Filtered samples collected from MW3-01 indicated several metals present in suspension rather than in the dissolved phase, which would diminish the potential for long-range transport of these metals in groundwater. However, the filtered sample collected from downgradient well MW3-01 also exhibited cadmium and aluminum at levels greater than background, which suggests their presence in solution.

1.3.2.4.4 Baseline Human Health Risk Assessment

The potential receptors considered for this site were future industrial, residential, and recreational receptors. The RME cancer risks associated with future residential and future industrial (groundwater) exposure scenarios did not exceed the upper end of the conservative EPA guidance target risk range. Arsenic (via ingestion of and dermal contact with groundwater) is the principal chemical of potential concern (COPC) that contributed to the cancer risks for these exposure scenarios.

The reasonable maximum exposure (RME) estimates for noncarcinogenic HIs associated with future residential (groundwater) exposure scenario exceeded 1.0, the cutoff point below which adverse noncarcinogenic effects are not expected to occur. Arsenic is the COPC that exceeded 1.0 for this exposure scenario. In addition, CTE risk estimates for future residential exposure to groundwater yielded an HI greater than 1.0; the affected target organ is the skin.

Lead groundwater concentrations at the site were below the EPA action level for public water supplies and are not expected to be associated with a significant increase in blood-lead levels based on the results of the IEUBK Lead Model (v. 0.99).

1.3.2.4.5 Ecological Risk Assessment

Site 3 is a former landfill that received a variety of wastes in the 1960s. The former landfill area is covered with brush and small trees, although a few bare areas with exposed debris are present. A small forested wetland is located directly southeast of the former landfill, and runoff from most of the landfill flows toward the wetland.

Some metals and several polycyclic aromatic hydrocarbons (PAHs) were detected in wetland sediments during 1995 RI sampling activities. Most of these contaminants exceeded screening values used in the 1995 RI ecological risk assessment and were, therefore, retained as compounds of concern (COCs). The COCs were either not detected or were detected at relatively low concentrations in groundwater, suggesting that contaminants may be migrating from the former landfill to the wetlands via overland runoff/erosion. In landfill surface soil samples collected at the landfill toe, concentrations of contaminants that were sediment COCs were relatively low. Concentrations of these COCs were also relatively low in 1995 RI groundwater samples.

The assessment endpoint chosen for Site 3 was the protection of individuals inhabiting the wetland area. For the reasons discussed above, the RI concluded that impacts to the wetlands appear to be minor and potential ecological risks to wetland receptors appear to be insignificant. Therefore, no remedial action based on potential risks to ecological receptors or additional ecological study is recommended at Site 3.

1.3.3 Site 10

1.3.3.1 Initial Assessment and Confirmation Study

An IAS in 1983 consisting of a document search, interviews, and on-site observations concluded that materials present in the landfill were inert or not leaching due to the moderate range of pH values in the environment. Erosion of the very thin cover material was noted, along with the exposed corroded shell casings. The site was not selected for a confirmation study.

During the 1993 SI, three monitoring wells were installed, and surface water and groundwater samples were analyzed. Methylene chloride (possible laboratory artifact) was detected at MW10-01, MW10-02, and MW10-03. One metal and one semivolatile were detected in surface water samples.

1.3.3.2 Phase I Remedial Investigation

During the 1993 Weston RI/FS, four test pits were excavated and four monitoring wells were installed. One sample from Test Pit 1 was analyzed for TCL/TAL analytes and total petroleum hydrocarbon (TPH). Waste was encountered in two of the four test pits. A layer of decomposed natural organic material (i.e., leaf, root, and organic silty matter) was encountered in all four test pits at a level between 3.5 and 5.5 feet. The waste consisted of metallic debris, such as rusted shell casings, at a level of 0 to 2 feet below the landfill surface. The cover material was thin to nonexistent. No sustained organic vapor readings were detected in any of the test pits. Two organics (possibly laboratory contaminants) and a low level of TPH were detected. Groundwater samples were collected from all seven wells and analyzed for TCL/TAL analytes, VOCs, drinking water metals, and landfill parameters. Elevated levels of metals were detected in several wells. Results of landfill parameters showed no distinction between downgradient wells and the upgradient wells. VOCs were detected, although these compounds are consistent with common laboratory artifacts. Additionally, three surface water and sediment samples were collected and analyzed for TCL/TAL analytes. The sediment samples were also analyzed for TPH and VOCs. Low levels of semivolatile organic compounds (SVOCs) and inorganics were detected in the sediment samples. It was considered likely that the SVOCs were associated with runoff from the adjacent railroad bed. Several VOCs typically associated with laboratory contaminants were detected in surface water samples. Metals concentrations were relatively low, and no polychlorinated biphenyl (PCB) or pesticide compounds were detected. For the surface water samples, low levels of VOCs and metals were detected.

1.3.3.3 Phase II Remedial Investigation

Between July and October 1995, B&R Environmental conducted the following field investigation activities at Site 10:

- Sampling and analysis of groundwater samples from the seven existing monitoring wells using low flow techniques.
- Measurement of static-water levels in the seven existing wells.

Phase II RI results are discussed in Section 1.3.3.4.2.

1.3.3.4 Summary of Results

The scrap metal landfill is characterized as an open area surrounded by wetlands. The site is accessible via a dirt road from the south and is bordered by railroad tracks to the southeast, a wetland to the north, and a drainage ditch to the east. The landfill is primarily covered with a sandy soil and is not closed with an

impermeable cap. The site is vegetated with grasses and scrub pines, except for the access road and an open disturbed area (vehicle turn-around area) in the middle where no vegetation exists. The ground surface is relatively flat, and the average elevation is approximately 110 feet above MSL. The groundwater flow direction is to the northwest, north, and northeast based on measured groundwater levels.

1.3.3.4.1 Site Geology, Hydrogeology, and Hydrology

Geology

Regional mapping places Site 10 within the outcrop area of the Kirkwood Formation; upper colluvium may be present at the site. The upper colluvium has a maximum thickness of 10 feet, the Kirkwood Formation ranges between 60 to 100 feet in thickness, and the soil borings are no more than 27.5 feet deep. The lithology of the sediments encountered in the on-site borings generally agrees with the published description of the upper colluvium and the Kirkwood and Vincentown Formations. 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 gray pebbly sand (possibly representative of the upper colluvium), brownish-yellow, fine- to medium-grained sand (probably representative of the Kirkwood Formation), and olive and dark greenish-gray, glauconitic, fine- to medium-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.

Based upon the boring log descriptions, wells MW10-05 and MW10-07 penetrated the upper colluvium, Kirkwood Formation, and Vincentown Formation, and wells MW10-01 through MW10-04 and MW10-06 penetrated the Kirkwood and Vincentown Formations.

Hydrogeology

Groundwater in the upper colluvium, Kirkwood, and Vincentown aquifer beneath the site occurs under unconfined conditions and the geologic units are interpreted to be hydraulically interconnected. Static-water-level measurements and water-table elevations are summarized in Table 1-15. Groundwater elevations for August 1995 and October 1995 are contoured on Figures 1-6 and 1-7, respectively. The direction of shallow groundwater flow in the aquifer, as indicated by both the August and October groundwater contour maps, is toward the northwest, north, and north-northeast. There does not appear to be a significant seasonal variation in groundwater flow direction.

TABLE 1-15

SITE 10 STATIC-WATER-LEVEL MEASUREMENT SUMMARY

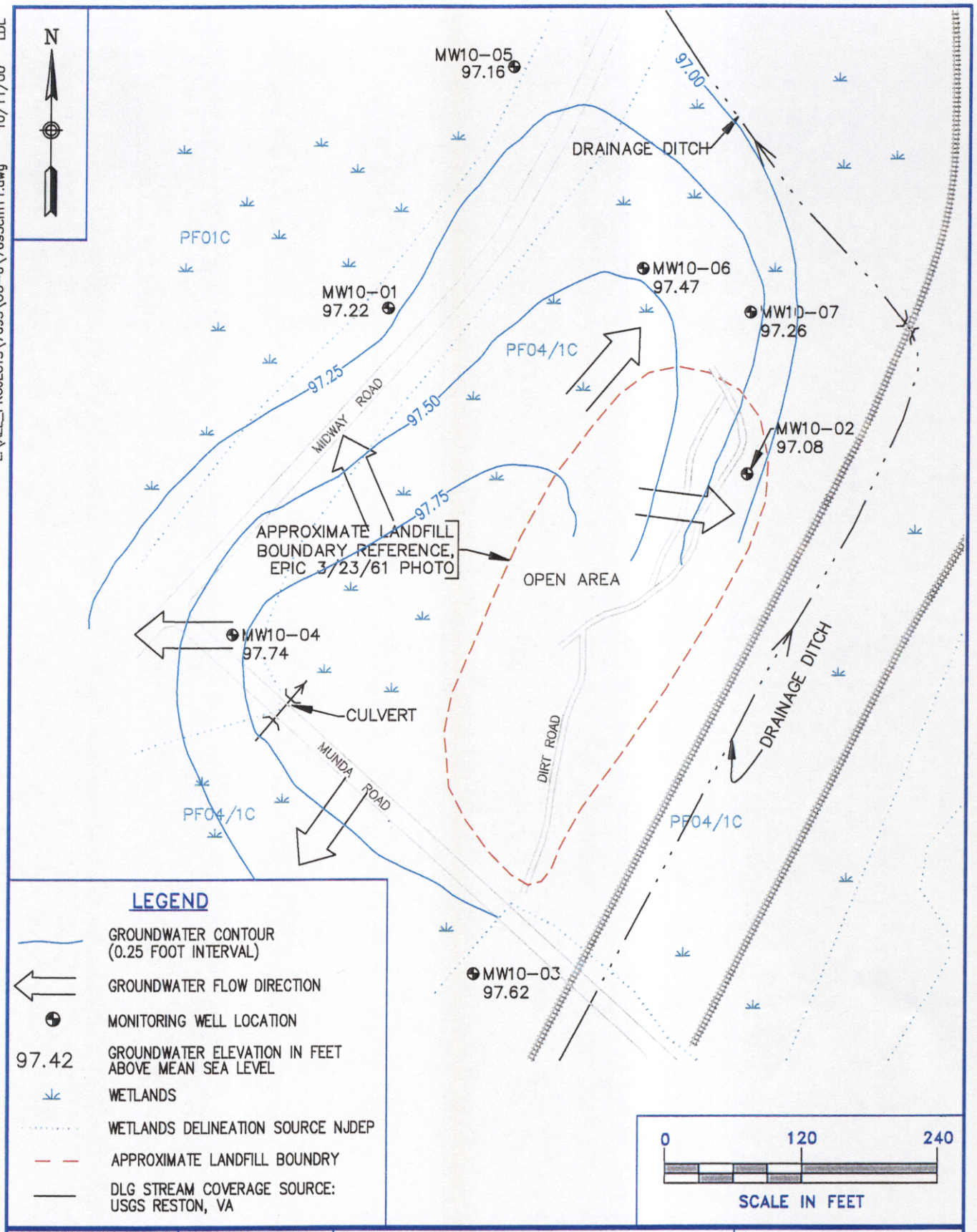
OU-6 FEASIBILITY STUDY

NWS EARLE, COLTS NECK, NEW JERSEY

Monitoring Well Number	August 7, 1995			October 17, 1995		
	Depth to Water Table[1] (feet)	Top of PVC Riser[2]	Elevation of Water Table[2]	Depth to Water Table[1] (feet)	Top of PVC Riser[2]	Elevation of Water Table[2]
MW10-01	15.64	112.86	97.22	16.62	112.86	96.24
MW10-02	13.14	110.22	97.08	14.14	110.22	96.08
MW10-03	12.15	109.77	97.62	13.11	109.77	96.66
MW10-04	15.26	113.00	97.74	16.29	113.00	96.71
MW10-05	14.15	111.31	97.16	15.35	111.31	95.96
MW10-06	8.88	106.35	97.47	9.43	106.35	96.92
MW10-07	10.71	107.97	97.26	11.87	107.97	96.10

(1) In feet below top of riser

(2) In feet above mean sea level



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REVISED BY	DATE		APPROVED BY / DATE
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GROUNDWATER CONTOUR MAP
AUGUST 7, 1995
SITE 10
SCRAP METAL LANDFILL
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

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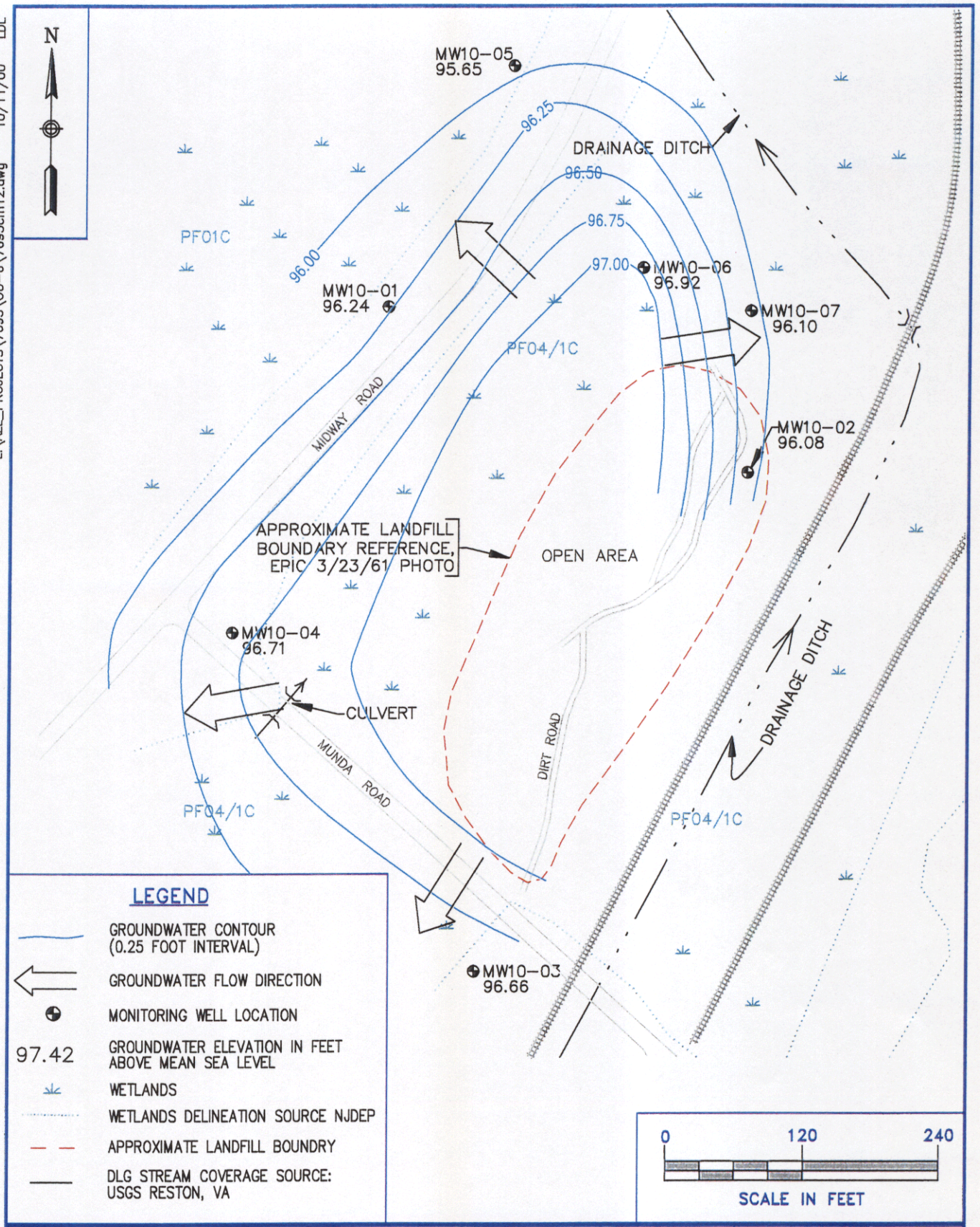

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DRAWN BY LDL DATE 10/11/00	Tetra Tech NUS, Inc.	GROUNDWATER CONTOUR MAP OCTOBER 17, 1995 SITE 10 SCRAP METAL LANDFILL NAVAL WEAPONS STATION EARLE COLTS NECK, NEW JERSEY	CONTRACT NO. 7695
CHECKED BY DATE			OWNER NO. OU-6
REVISED BY DATE			APPROVED BY DATE
SCALE AS NOTED			DRAWING NO. FIGURE 1-7 REV.

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Based on boring log descriptions, wells MW10-05 and MW10-07 wells were screened across the contact between the upper colluvium and the Kirkwood Formation and the contact between the Kirkwood and Vincentown Formations, and wells MW10-01 through MW10-04 and MW10-06 were screened across the contact between the Kirkwood and Vincentown Formations. The hydraulic conductivities calculated for MW10-04 (Kirkwood and Vincentown Formations), MW10-05 (upper colluvium, Kirkwood Formation, and Vincentown Formation), and MW10-07 (upper colluvium, Kirkwood Formation, and Vincentown Formation) are 2.54×10^{-4} cm/sec (0.72 ft/day), 6.99×10^{-4} cm/sec (1.98 ft/day), and 1.75×10^{-3} cm/sec (4.97 ft/day), respectively.

1.3.3.4.2 Nature and Extent of Contamination

Seven site-related groundwater samples (10 GW 01 through 10 GW 07) were collected at Site 10. Table 1-16 compares the results at background samples to samples collected at Site 10. Figure 1-8 shows sample locations and concentrations of compounds that exceed ARARs and TBCs.

Inorganics

Concentrations of most metals in Site 10 groundwater were within the range of background results; arsenic (4.7 ug/L in 10 GW 05), silver (1.5 ug/L in 10 GW 05), and thallium (3.7 ug/L in 10 GW 04) were found in addition to the metals found in background samples. Iron was detected at an elevated concentration in 10 GW 04 (16,000 mg/L).

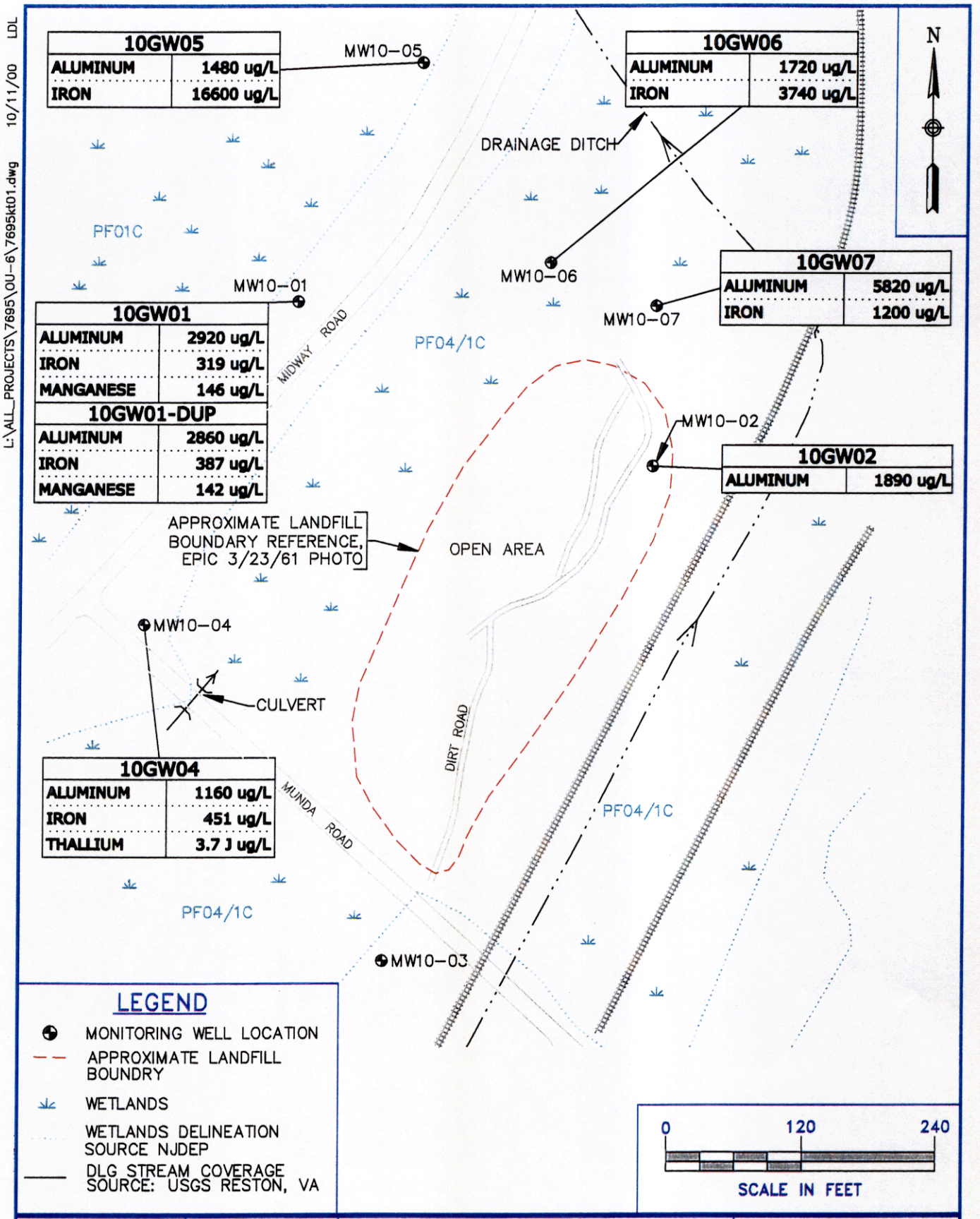
Miscellaneous Parameters

Miscellaneous parameter analyses of seven groundwater samples at Site 10 consisted of ammonia, biochemical oxygen demand (BOD), chemical oxygen demand (COD), chlorides, nitrates, sulfates, total organic carbon (TOC), phosphates, and turbidity. The landfill is on a topographically high area; therefore, all monitoring wells are hydraulically downgradient of the landfill. TOC concentrations were greater than background levels, except in MW10-02. Ammonium and COD levels were above background levels in MW10-05, MW10-06, and MW10-07. Concentrations of sulfate exceeding background levels were detected in MW10-01 and MW10-07. BOD concentrations above background were detected in MW10-04 and MW10-05. Maximum detected concentrations were generally consistent with the results of the 1993 RI. Indicator parameter results are below the range associated with concentrated landfill leachate (Chian and DeWalle, 1976; ASCE, 1976; Brunner and Keller, 1972).

TABLE 1-16
OCCURRENCE AND DISTRIBUTION OF INORGANICS IN GROUNDWATER AT SITE 10
OU-6 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY
(ug/L)

	BACKGROUND			SITE-RELATED				
SUBSTANCE	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	2 X AVERAGE CONCENTRATION	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	AVERAGE CONCENTRATION	MEAN > 2 X BKGD?	REPRESENTATIVE CONCENTRATION
ALUMINUM*	11 - 11	287 - 7870	5097.82	7 / 7	195 - 5820	2165.00	NO	5820.00
ARSENIC	1 - 11	5.8 - 5.8	4.05	1 / 7	4.7	2.09	NO	2.99
BARIUM	11 - 11	2.6 - 518	229.60	7 / 7	2 - 75.6	40.75	NO	75.60
BERYLLIUM*	4 - 11	0.21 - 1.6	0.49	6 / 7	0.14 - 1.8	0.49	NO	0.93
CADMIUM*	5 - 11	0.6 - 1.9	1.21	3 / 7	0.45 - 0.85	0.36	NO	0.55
CALCIUM	11 - 11	506 - 17200	8306.55	7 / 7	1100 - 6945	2745.00	NO	5938.13
CHROMIUM	NOT DETECTED	-	-	7 / 7	3.2 - 22.8	8.89	YES	13.75
COBALT	6 - 11	0.7 - 10.1	4.06	7 / 7	2.1 - 5	3.16	NO	4.11
COPPER*	9 - 11	0.79 - 13.5	6.53	1 / 7	6.7	1.29	NO	5.85
IRON*	11 - 11	153 - 7690	4197.09	7 / 7	186 - 16600	3258.43	NO	7676.42
LEAD*	3 - 11	2.1 - 3	2.44	2 / 7	2.1 - 2.55	1.20	NO	2.15
MAGNESIUM	11 - 11	273 - 27400	8449.64	7 / 7	380 - 3285	1796.43	NO	3285.00
MANGANESE	11 - 11	3.3 - 65	46.18	7 / 7	2.9 - 144	39.37	NO	74.58
MERCURY*	11 - 11	0.005 - 0.12	0.12	7 / 7	0.084 - 0.11	0.10	NO	0.11
NICKEL	10 - 11	0.81 - 25.5	11.98	7 / 7	1.6 - 9.35	5.68	NO	9.35
POTASSIUM	11 - 11	350 - 3245	2810.55	7 / 7	574 - 6950	2283.00	NO	3939.99
SILVER	NOT DETECTED	-	-	1 / 7	1.5	0.62	YES	0.93
SODIUM	11 - 11	1850 - 11650	8449.09	7 / 7	2150 - 30800	10730.00	YES	17566.96
THALLIUM*	3 - 11	4 - 5.1	5.15	1 / 7	3.7	2.07	NO	2.61
VANADIUM	10 - 11	0.69 - 42.25	16.48	7 / 7	0.71 - 15	5.02	NO	15.00

Note: Selected COPCs are indicated in boldface type.
* - Indicates COPCs eliminated based on amended risk assessment.



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1.3.3.4.3 Contaminant Fate and Transport

Analytical results for the media sampled at the Site 10 indicate limited concentrations of metals in groundwater. No soil samples were collected at the site. Most inorganic constituents detected in Site 10 groundwater samples were within similar concentration ranges as background groundwater samples. Arsenic, silver, and thallium results were near the limit of detection, which generally suggests no significant groundwater impact has been identified for these metals. A slightly elevated level of iron in one monitoring well (MW10-04), which is located near the intersection of Midway and Munda Roads, may be due to its proximity to the landfill but is not definitive because of the very flat groundwater contour in this area. The scrap metal disposal area contains shell casings that characteristically are comprised of iron, aluminum, zinc, and possibly other metal alloy components.

A previous investigation conducted in 1993 indicated elevated levels of several metals in groundwater samples at Site 10. However, these samples were collected as unfiltered groundwater using standard purging methods that can contribute to the presence of suspended solids due to turbidity. Results of the current sampling do not indicate elevated metals in groundwater at Site 10.

Substances detected in the groundwater at Site 10 do not demonstrate significant impacts from site-related disposal. Although a previous investigation indicated elevated levels of metals in groundwater, the sample collection process may have created an artificial high bias due to generation of suspended metals during sampling. Data from the current investigation were collected using low-flow purge methods that are considered more reliable and less likely to generate suspended solids during well sampling.

1.3.3.4.4 Baseline Human Health Risk Assessment

Groundwater was sampled at Site 10. The potential receptors considered for this site were future industrial and residential receptors of groundwater. The cancer risk associated with the future residential (groundwater) exposure scenario was approximately 7E-05, within the conservative EPA guideline target acceptable risk range. The cancer risk associated with the future industrial (groundwater) exposure scenario was within the mid-range of the target acceptable risk range. The noncarcinogenic HIs associated with the future industrial and future residential (groundwater) exposure scenarios were below 1.0, the cutoff point below which adverse effects are not expected to occur. Lead groundwater concentrations at the site were below the EPA action level for public water supplies and are not expected to be associated with significant increases in blood-lead levels based on the results of the IEUBK Lead Model (v. 0.99).

Human health risk assessment calculations did not include data from field sampling prior to the 1995 RI. Therefore, only groundwater scenarios were considered in this risk assessment. Conclusions from previous investigations indicated that Site 10 surface water or sediment pathways were not contributing a significant

human health risk to potential receptors. However, a surface or subsurface soil sample taken in an area of exposed corroded shell casings would almost certainly show high metals concentrations.

1.3.3.4.5 Ecological Risk Assessment

Site 10 consists of a relatively small upland area consisting of some grasses and small pines, with an open area in the middle. The open area is mostly comprised of the dirt road that leads into the site and areas of exposed debris where soils have eroded. A railroad bed is located 50 feet southeast of the landfill. A drainage ditch is located adjacent to the railroad tracks. The ditch runs northeastward along the eastern side of the tracks and bends and flows to the northwest approximately 300 feet northeast of the site. The ditch converges with a branch of Hockhockson Brook about 500 feet northwest of the site, so the site is located within the Hockhockson Brook Watershed. Site 10 is mostly surrounded by forested wetlands that are primarily dominated by red maple. The ditch provides limited aquatic habitat, and the surrounding upland and wetland areas provide excellent habitat, primarily for terrestrial receptors. Several species of mammals, such as white-tailed deer, red fox, and gray fox, are expected to utilize these areas, as are most avian species that inhabit forested areas on the base. No sensitive habitats, other than the wetlands, and no threatened or endangered species are known to occur in the area.

The area is surrounded by a forested wetland and some upland areas that contain no surface water. These areas are probably utilized by a variety of wildlife found on the base. Runoff from the site is to the east to a drainage ditch that connects with a branch of Hockhockson Brook northwest of the site. Groundwater flow at the site is generally northward, making groundwater to surface water discharge to the drainage ditch possible. Aquatic migration pathways and exposure routes are the main concern for Site 10.

No contaminants were detected in surface water that were not found at comparable concentrations in blanks. In sediments, only antimony exceed the most conservative ecotox thresholds (ET), but antimony's Hazard Quotient (HQ) value was indicative of low potential risk. Aluminum and vanadium were conservatively retained as final COPCs in sediments since no ETs were available, but both were present at concentrations lower than in the upstream sample.

Some elevated levels of metals were found in 1993 RI/FS groundwater samples, including lead, chromium, arsenic, and cadmium. In 1995 RI groundwater samples, no organics were detected and most metals were within the range of background values. No metals detected in groundwater were present at elevated levels in drainage ditch sediments, suggesting the absence of groundwater discharge. In addition, the low levels of organics in drainage ditch sediments are more likely attributable to the railroad bed than the landfill.

For these reasons, potential risks to ecological receptors at Site 10 and contaminant contributions to the Hockhockson Brook Watershed appear insignificant, and further study or remediation at the site based on

ecological concerns is considered unwarranted. However, since cover material has eroded heavily, an additional cover could be placed on the landfill to prevent any further erosion and runoff and may expedite ecological succession and increase vegetation cover on the landfill.

2.0 IDENTIFICATION AND SCREENING OF TECHNOLOGIES

Remedial alternatives are developed by assembling combinations of technologies and the media to which they would be applied into an appropriate range of alternatives that address site contamination, risks, or threats. This section presents the preliminary phase of the remedial alternatives development process, which consists of the identification and screening of remedial technologies and includes the following:

- Developing remedial action objectives (RAOs) that are protective of human health and the environment with regard to the contaminants and media of concern, exposure pathways, and the preliminary remediation goals (PRGs) and that permit a range of treatment and containment alternatives to be developed.

- Developing general response actions for each medium of interest that define measures that may be taken singly or in combination to satisfy the RAOs for the site.

- Identifying the numbers, volumes, or areas of media to which the general response actions might be applied.

- Identifying and screening the technologies applicable to each general response action.

Section 2.1 presents a preliminary listing of applicable or relevant and appropriate requirements (ARARs) and other guidance to be considered (TBCs) in the development of RAOs for the NWS Earle OU-6 Sites. Section 2.2 briefly presents the overall approach used to develop RAOs. Section 2.3 summarizes the overall approach used in development of PRGs. Section 2.4 identifies the general response actions that may be implemented at NWS Earle. Section 2.5 discusses the methods used for identification, screening, and evaluation of remedial alternatives. The site-specific development of RAOs, PRGs, and general response actions and screening of remedial technologies and process options for Sites 3 are presented in Section 2.6. Section 2.7 contains the corresponding Site 10 site-specific development.

2.1 POTENTIAL ARARs AND TBCs

ARARs are promulgated, enforceable federal and state environmental or public health requirements that are determined to be legally applicable or relevant and appropriate to the hazardous substances, remedial actions, or other circumstances at a CERCLA site. The National Contingency Plan (NCP) Section 300.430 states that on-site remedial actions at CERCLA sites must meet ARARs unless there are grounds for invoking a waiver. A waiver is required if ARARs cannot be achieved. The two classes of ARARs, "applicable" and "relevant and appropriate," are defined below.

- **Applicable Requirements** - Section 300.5 of the NCP defines applicable requirements as those clean-up standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site. For example, if a new municipal landfill is being considered, then regulatory requirements that specifically govern its construction, operation, and closure are applicable.

- **Relevant and Appropriate Requirements** - Section 300.5 of the NCP defines relevant and appropriate requirements as those clean-up standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at a CERCLA site that their use is well suited to the particular site. For example, a municipal landfill that was constructed and operated prior to the promulgation of landfill regulations may be closed in accordance with the "relevant and appropriate" requirements of those regulations that identify activities needed to close the landfill.

TBCs (standards and guidance to be considered) are non-promulgated advisories or guidance issued by federal or state governments that are not legally binding but may be considered during development of remedial alternatives. For example, EPA Health Advisories and Reference Doses are non-promulgated criteria that are used to assess health risks from contaminants present on CERCLA sites.

ARARs and TBCs are divided into three categories: chemical specific, location specific, and action specific. In Sections 2.1.1 through 2.1.3, these categories are briefly described and general types of potential ARARs and TBCs that may be applied to the site are identified. The detailed discussions of the potential ARARs and TBCs for specific remedial alternatives are provided in Section 4.0.

2.1.1 Potential Chemical-Specific ARARs and TBCs

Chemical-specific ARARs and TBCs are usually health- or risk-based numerical values that are used to establish the acceptable amount or concentration of a chemical that may remain in or be discharged to the environment. In general, chemical-specific requirements are set for a single chemical or a closely related group of chemicals. These requirements do not consider the mixture of chemicals. Typical chemical-specific ARARs are federal and state drinking water standards. Summaries of the potential

federal and state chemical-specific ARARs and TBCs and their consideration in the FS are provided in Tables 2-1 and 2-2, respectively.

The aquifer underlying NWS Earle is classified as Class II-A, a potential source of potable water under New Jersey regulations [N.J.A.C. 7:9-6]. Groundwater at Sites 3 and 10 is not currently used for drinking water and potable water is provided by a public water supply. Federal chemical-specific ARARs such as the Safe Drinking Water Act (SDWA) Maximum Containment Levels (MCLs) [40 CFR 141] and the Resource Conservation and Recovery Act (RCRA) MCLs and Alternate Concentration Limits (ACLs) [40 CFR 264.94] may be relevant and appropriate requirements in establishing groundwater cleanup levels, or may be used to help derive potential soil remediation levels. Non-zero MCL Goals (MCLGs) are non-promulgated health-based drinking water supply limits that are to be considered during the development of groundwater clean-up goals. EPA reference doses, carcinogen potency factors, and health advisories, when available, are all factors used to assess potential risks and can be used to derive risk-based clean-up limits. The disposal of contaminated soils may be restricted by the RCRA Land Disposal Restrictions [40 CFR 268], which may potentially be applicable.

Chemical-specific ARARs for the NWS Earle Sites include the New Jersey Ground Water Quality Standards (GWQSs) [N.J.A.C. 7:9-6] that regulate groundwater quality. Potential chemical-specific ARARs include the Surface Water Quality Standards [N.J.A.C. 7:9B] that provide guidelines for surface water quality. These state ARARs may potentially be relevant and appropriate and may be used to establish clean-up levels that are protective of human health and the environment.

While there are no specific promulgated soil clean-up standards, OSWER Directive No. 9355.4-12, Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities, and the New Jersey Soil Cleanup Criteria may be considered in developing site-specific clean-up levels.

2.1.2 Potential Location-Specific ARARs and TBCs

Location-specific ARARs are restrictions placed on the concentrations of hazardous substances or the conduct of activities solely because the substances or activities are in specific areas. The general types of location-specific ARARs that may be applied to the sites are briefly described below. Summaries of the potential federal and state location-specific ARARs and TBCs and their consideration in this FS are provided in Tables 2-3 and 2-4, respectively.

TABLE 2-1
POTENTIAL FEDERAL CHEMICAL-SPECIFIC ARARs AND TBCs
OU-6 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY

REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION IN THE FS
Safe Drinking Water Act (SDWA) - Maximum Contaminant Levels (MCLs) (40 CFR 141.11-141.16)	Potentially Relevant and Appropriate	MCLs have been promulgated for a number of common organic and inorganic contaminants to regulate the concentration of contaminants in public drinking water supply systems. MCLs may be relevant and appropriate for groundwater because the aquifer beneath the site is a potential drinking water supply.	MCLs may be used to establish clean-up levels for the portion of the aquifer underlying the OU-6 sites. MCLs can be used to derive potential soil clean-up levels.
Resource Conservation and Recovery Act (RCRA) - Groundwater Protection Standard (40 CFR 264.94)	Potentially Relevant and Appropriate	The RCRA groundwater protection standard is established for groundwater monitoring of RCRA-permitted treatment, storage, or disposal facilities. The standard is set at either an existing or proposed RCRA MCL, background concentration, or an alternate concentration limit (ACL) protective of human health and the environment.	RCRA MCLs may be used or ACLs may be developed to identify levels of contamination in the aquifer above which human health and the environment are at risk and to provide an indicator when corrective action is necessary.
RCRA Land Disposal Restrictions (40 CFR 268)	Potentially Applicable	These regulations identify hazardous wastes that are restricted from land disposal and establish waste analysis and recordkeeping requirements and "treatment standards" (concentration levels or methods of treatment) that wastes must meet in order to be eligible for land disposal.	Contaminated soil must be analyzed and disposed in accordance with the requirements of these regulations. If necessary, soils will be treated to attain applicable "treatment standards" prior to placement in a landfill or other land disposal facility. This requirement would be considered for alternatives involving land disposal.
Clean Water Act – Ambient Water Quality Criteria (AWQCs)	To be Considered	AWQCs are non-promulgated health-based surface water quality criteria that have been developed for carcinogenic and non-carcinogenic compounds for the protection of human health. AWQCs have also been developed for the protection of aquatic organisms.	AWQC may be used to assess need for remediation of discharges to surface water or to use as benchmarks during long-term monitoring.

TABLE 2-1
POTENTIAL FEDERAL CHEMICAL-SPECIFIC ARARs AND TBCs
OU-6 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY

REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION IN THE FS
SDWA Maximum Contaminant Level Goals (MCLGs) (40 CFR 141.50 and 141.51)	To Be Considered	MCLGs are health-based limits for contaminant concentrations in drinking water. MCLGs are established at levels at which no known or anticipated adverse effects on human health are anticipated and that allow for an adequate margin of safety. MCLGs are set without regard for cost or feasibility.	Non-zero MCLGs may be used as clean-up levels if conditions at the site justify setting clean-up levels lower than MCLs.
Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities (OSWER Directive No. 9355.4-12) (Jul 1994)	To Be Considered	This OSWER directive recommends a lead soil screening level of 400 ppm for residential land use based on the IEUBK model. The screening value may be used to determine whether sites or portions of sites warrant further evaluation and evaluations of risks.	If any of the OU-6 sites is to be considered for eventual residential use, then the screening value may be used to assess whether site-specific lead levels require further evaluation and possible remediation.
EPA Groundwater Protection Strategy	To Be Considered	Provides classification and restoration goals for groundwater based on its vulnerability, use, and value.	This strategy was considered in conjunction with the federal SDWA and state Groundwater Protection Rules in order to determine groundwater clean-up levels.
EPA Risk Reference Doses (RfDs)	To Be Considered	RfDs are dose levels developed by EPA for use in estimating the non-carcinogenic risk resulting from exposure to toxic substances.	RfDs were used to assess health risks due to exposure to non-carcinogenic contaminants present at the site. RfDs may also be used in the development of acceptable contaminant concentrations.
EPA Carcinogen Assessment Group Potency Factors (CPFs)	To Be Considered	EPA CPFs are used to compute the individual incremental cancer risk resulting from exposure to carcinogens.	CPFs were used to assess health risks from carcinogens present at the site. These factors may also be used in the development of acceptable contaminant concentrations.

TABLE 2-1
POTENTIAL FEDERAL CHEMICAL-SPECIFIC ARARs AND TBCs
OU-6 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY
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REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION IN THE FS
EPA Health Advisories and Acceptable Intake Health Assessment Documents	To Be Considered	Intended for use in qualitative human health evaluation of remedial alternatives.	These advisories and health assessment documents were used in assessing health risks from contaminants present at the site.
Clean Air Act – Standards for Air Emissions from Municipal Solid Waste Landfills (40 CFR 60.752 and 60.753)	Potentially Relevant and Appropriate	Active landfills with design capacities equal to or greater than 2.5 million cubic meters are required to have landfill gas collection and control systems if greater than 50 megagrams of non-methane organic compounds are expected to be emitted. The collection system shall be operated so that the methane concentration is less than 500 ppm above background at the surface of the landfill.	Both Sites 3 and 10 landfills are estimated to be much less than 2 million cubic feet in capacity. However, soil gas studies and measurement of methane concentrations at the landfill surfaces need to be conducted during the pre-design phase to determine whether landfill gas controls need to be included as part of the control systems.

TABLE 2-2
POTENTIAL STATE CHEMICAL-SPECIFIC ARARs AND TBCs
OU-6 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY

REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION IN THE FS
New Jersey Ground Water Quality Standards (GWQS) (N.J.A.C. 7:9-6)	Applicable	This regulation establishes the rules to protect ambient groundwater quality through establishing groundwater protection and clean-up standards and setting numerical criteria limits for discharges to groundwater. The Groundwater Quality Criteria (GWQC) (N.J.A.C. 7:9-6.7) are the maximum allowable pollutant concentrations in groundwater that are protective of human health. This regulation also prohibits the discharges to groundwater that subsequently discharges to surface water that do not comply with the Surface Water Quality Standards (SWQS).	Because contaminated groundwater is present underneath the OU-6 sites in excess of GWQS, these regulations will be considered in determining groundwater action levels. Application for Classification Exception Area (CEA) may be required if GWQS will not be met during the term of proposed remediation. The CEA procedure ensures that designated groundwater uses at remediation sites are suspended for the term of the CEA.
New Jersey Surface Water Quality Standards (SWQS) (N.J.A.C. 7:9B)	Applicable	These standards establish rules to protect and enhance surface water resources, define surface water classifications and uses, and establish water-quality-based criteria and effluent discharge limitations. The Surface Water Quality Criteria (SWQC) (N.J.A.C. 7:9B-14) are the maximum allowable pollutant concentrations in surface water for the designated use.	For alternatives where surface water may be affected, remedial measures may be needed so that the SWQC are attained in the long term. Remedial alternatives shall consider action to mitigate the continued contamination of surface waters.
New Jersey Safe Drinking Water Act (N.J.A.C. 7:10)	Potentially Relevant and Appropriate	These regulations were promulgated to assure the provision of safe drinking water to consumers in public community water systems. Maximum Contaminant Levels (MCLs) (N.J.A.C. 7:10-16) have been established to regulate the concentration of organic and metal contaminants in water supplies. MCLs may be relevant and appropriate for groundwater because the aquifer beneath the site is a potential drinking water supply.	MCLs may be used to establish clean-up levels for groundwater underlying the OU-6 sites. MCLs can be used to derive potential soil clean-up levels.

TABLE 2-2
POTENTIAL STATE CHEMICAL-SPECIFIC ARARs AND TBCs
OU-6 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY
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REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION IN THE FS
New Jersey Soil Cleanup Criteria	To Be Considered	These are non-promulgated soils clean-up criteria for residential direct contact, non-residential direct contact, and impact to groundwater (through leaching).	These criteria will be considered in the development of soil clean-up goals.

TABLE 2-3
POTENTIAL FEDERAL LOCATION-SPECIFIC ARARs AND TBCs
OU-6 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY

REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION IN THE FS
Wetlands Executive Order (E.O. 11990) & 40 CFR 6, App. A (Policy on Implementing E.O. 11990)	Potentially Applicable	Federal agencies are required to minimize the destruction, loss, or degradation of wetlands and preserve and enhance natural and beneficial values of wetlands.	Remedial alternatives that involve excavation or deposition of materials will include all practicable means of minimizing harm to the wetlands adjacent to the OU-6 sites. Wetlands protection consideration will be incorporated into the planning, decision making, and implementation of remedial alternatives.
Floodplains Executive Order (E.O. 11988) & 40 CFR 6, App. A (Policy on Implementing E.O. 11988)	Potentially Applicable	Federal agencies are required to reduce the risk of flood loss, minimize impact of floods, and restore and preserve the natural and beneficial value of floodplains.	The potential effects on floodplains will be considered during the development and evaluation of remedial alternatives. All practicable measures will be taken to minimize adverse effects on floodplains.
Resource Conservation and Recovery Act (RCRA) Location Standards, Floodplains (40 CFR 264.18 (a))	Potentially Applicable	Any RCRA facility that treats, stores, or disposes of hazardous waste, if situated in a 100-year floodplain, must be designed, constructed, operated, and maintained to avoid washout.	Where possible, remedial alternatives that include construction of a treatment, storage, or disposal facility will be sited outside a 100-year floodplain.
Endangered Species Act of 1973 (16 USC 1531 et seq.); (50 CFR Part 200)	Potentially Applicable, if present	Actions shall be taken to conserve endangered or threatened species or to protect critical habitats. Consultation with the Department of the Interior is required.	The RI determined that there were no sensitive habitats (except for wetlands) or endangered or threatened species present at the OU-6 sites.
Fish and Wildlife Coordination Act Of 1958 (16 U.S.C. 661) Protection of Wildlife Habitats	Potentially Applicable	This regulation requires that any federal agency that proposes to modify a body of water must consult with the United States Fish and Wildlife Service and requires that actions be taken to avoid adverse effects, minimize potential harm to fish or wildlife, and preserve natural and beneficial uses of the land.	During the evaluation of alternatives, potential remediation effects on the wetlands and floodplains are evaluated. If it is determined that an impact may occur, then the United States Fish and Wildlife Service, NJDEP, and EPA would be consulted.

TABLE 2-3
POTENTIAL FEDERAL LOCATION-SPECIFIC ARARs AND TBCs
OU-6 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY
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REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION IN THE FS
National Historic Preservation Act of 1966 Section 106 (16 USC 470 et. seq.)	Potentially Applicable, if present	Action will be taken to recover and to preserve historic artifacts that may be threatened as the result of terrain alteration.	Potential ARAR . If artifacts are encountered during active site remediation (e.g. excavation, consolidation, grading) additional investigation would be warranted. To date, no such artifacts have been encountered at the OU-6 sites.
National Archeological and Historic Preservation Act of 1974 (132 CFR 229)	Potentially Applicable, if present	Action will be taken to recover and to preserve scientific, prehistoric, historic, or archaeologic artifacts that may be threatened as the result of terrain alteration.	Potential ARAR. If artifacts are encountered during active site remediation (e.g., excavation, consolidation, grading) additional investigation would be warranted. To date, no such artifacts have been encountered at the OU-6 sites.

TABLE 2-4
POTENTIAL STATE LOCATION-SPECIFIC ARARs AND TBCs
OU-6 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY

REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION IN THE FS
New Jersey Freshwater Wetlands Protection Act Rules (N.J.A.C. 7:7A)	Potentially Applicable	Regulate activities that result in the disturbance in and around freshwater wetland areas including removing or dredging wetland soils, disturbing the water level or water table, driving piles, placing obstructions, destroying plant life, and discharging dredged or fill materials into open water.	Remedial alternatives will be developed to avoid activities that would be detrimental to the wetlands located adjacent to the OU-6 sites.
New Jersey Freshwater Wetlands Protection Act Rules, Mitigation (N.J.A.C. 7:7A-14)	Potentially Applicable	This regulation requires mitigation of the disturbed wetlands or filled open water. Generally requires the restoration, creation, or enhancement of area, or donations to the Mitigation Bank, of equal ecological value.	If a remedial alternative action results in the loss of wetlands through dredging, filling, or construction activities, then mitigation measures will need to be incorporated into the alternative's design.
New Jersey Flood Hazard Area Control (N.J.A.C. 7:14)	Potentially Applicable	These regulations control development in floodplains and water courses that may adversely affect the flood-carrying capacity of these features, subject new facilities to flooding, increase storm water runoff, degrade water quality, or result in increased sedimentation, erosion, or environmental damage.	This requirement is applicable to remedial alternative actions that may adversely affect floodplains adjacent to the OU-6 sites.

TABLE 2-4
POTENTIAL STATE LOCATION-SPECIFIC ARARs AND TBCs
OU-6 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY
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REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION IN THE FS
New Jersey Siting Criteria for New Major Commercial Hazardous Waste Facilities (N.J.A.C. 7:26-13)	Potentially Relevant and Appropriate	These regulations specify siting requirements and limitations for commercial hazardous waste facilities including protection of nearby residents, surface water, groundwater, air, and environmentally sensitive areas.	No on-site or on-base treatment schemes are anticipated for the OU-6 sites. However, if remedial alternatives employs an on-site or on-base treatment scenarios, then remediation activities will need to be consistent with these requirements.

Several federal and state regulations govern activities in wetlands and floodplains that may result in their degradation or impairment of their functions. Potential location-specific ARARs include Executive Orders 11990 and 11988 for wetlands and floodplains, respectively; the RCRA Location Standards governing the siting of treatment, storage, and disposal facilities in a 100-year floodplain; the New Jersey Freshwater Wetlands Protection Act Rules; the New Jersey Flood Hazard Area Control regulations; and the State Siting Criteria for New Major Commercial Hazardous Waste Facilities (no on-base treatment of contaminated materials is anticipated).

The Federal Fish and Wildlife Coordination Act and the Endangered Species Act are potential ARARs that are promulgated protect wildlife and endangered species (if present or encountered) during remediation.

If historic or archeological artifacts are encountered during remediation, then the National Historic Preservation Act of 1966 and the National Archeological and Historic Preservation Act of 1974 may be potential ARARs that would be invoked to prevent their loss.

2.1.3 Potential Action-Specific ARARs and TBCs

Action-specific ARARs are usually technology- or activity-based requirements or limitations on actions taken with respect to hazardous wastes. These requirements are generally focused on actions taken to remediate, handle, treat, transport, or dispose of hazardous wastes. These action-specific requirements do not in themselves determine the remedial alternative; rather, they indicate how a selected alternative must be achieved. Summaries of the potential action-specific ARARs and TBCs and their consideration in the FS are provided in Tables 2-5 and 2-6, respectively.

If site soils, sediments, or landfill materials are determined to be hazardous by characteristic or are listed wastes (per RCRA Identification and Listing of Hazardous Waste [40 CFR 261]), then these action-specific ARARs may potentially be applicable to the how they are treated, stored, or disposed or to the treatment processes considered. These ARARs include federal regulations governing the off-site transport of hazardous wastes [40 CFR 262 and 263], general facility standards [40 CFR 265 Subpart B], preparedness and prevention [40 CFR 265 Subpart C], contingency plan and emergency procedures [40 CFR 265 Subpart D], manifesting and recordkeeping [40 CFR 265 Subpart E], closure and postclosure of municipal landfills [40 CFR 258 Subpart F], land treatment [40 CFR 265 Subpart P], thermal treatment [40 CFR 265 Subpart X], and miscellaneous treatment units [40 CFR 264 Subpart X].

State ARAR regulations that may be applicable to remedial actions for hazardous wastes include off-site transport of hazardous wastes [N.J.A.C. 7:26-7]; general facility standards, preparedness and prevention, contingency, and emergency procedures, record keeping, and closure and post-closure requirements

TABLE 2-5
POTENTIAL FEDERAL ACTION-SPECIFIC ARARs AND TBCs
OU-6 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY

REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION IN THE FS
Resource Conservation and Recovery Act (RCRA) - Hazardous Waste Generator and Transporter Requirements (40 CFR parts 262 and 263)	Potentially Applicable	These regulations establish the responsibilities of generators and transporters of hazardous waste in the handling, transportation, and management of waste. The regulations specify the packaging, labeling, recordkeeping, and manifest requirements.	Activities performed in connection with off-site transport of hazardous wastes will comply with the requirements of these regulations.
RCRA - General Facility Standards (40 CFR 265 Subpart B)	Potentially Applicable	General facility requirements outline general waste analysis, security measures, inspections, and training requirements.	If a remedial alternative includes the establishment of an on-base treatment facility for hazardous wastes (characteristic or listed), then this regulation will be considered. This regulation specifies TSD facilities construction, fencing, postings, and operations. All workers will be properly trained. Process wastes will be evaluated for the characteristics of hazardous wastes to assess further handling requirements.
RCRA - Preparedness and Prevention (40 CFR 265 Subpart C)	Potentially Applicable	Outlines requirements for safety equipment and spill control.	If a remedial alternative includes treatment, storage, or disposal of hazardous wastes, then this regulation will be considered. Safety and communication equipment will be maintained at the site. Local authorities will be familiarized with the site operations.
RCRA - Contingency Plan and Emergency Procedures (40 CFR 265 Subpart D)	Potentially Applicable	Outlines requirements for emergency procedures to be used following explosions, fires, etc.	If the alternative includes treatment, storage, or disposal of hazardous wastes, then contingency plans will be developed. Copies of the plans will be kept on site.
RCRA - Manifesting Recordkeeping, and Reporting (40 CFR 265 Subpart E)	Potentially Applicable	Specifies the recordkeeping and reporting requirements for RCRA facilities.	If the alternative includes treatment, storage, or disposal of hazardous wastes, then records of facility activities will be developed and maintained during remedial actions.

TABLE 2-5
POTENTIAL FEDERAL ACTION-SPECIFIC ARARs AND TBCs
OU-6 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY
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REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION IN THE FS
RCRA - Closure and Post-Closure (40 CFR 258, Subpart F)	Potentially Relevant and Appropriate	Details specific requirements for closure and post-closure of municipal solid waste landfills. Final cover requirements that address minimizing infiltration and erosion are identified in this regulation. Following closure, post-closure requirements include preparing a post-closure plan, maintaining integrity and effectiveness of the final cover, groundwater monitoring, and maintaining and operating a gas collection system.	If an alternative includes closure of a solid waste landfill, then these requirements will be considered in formulating the alternative.
RCRA - Land Treatment (40 CFR 265 Subpart M)	Potentially Applicable	These regulations detail the requirements for conducting land treatment of RCRA hazardous waste.	Alternatives that involve on-site treatment of hazardous wastes (contaminated soil or sediments) will comply with these regulations.
RCRA - Thermal Treatment (40 CFR 265 Subpart P)	Potentially Applicable	This regulation details operating requirements and performance standards for thermal treatment of hazardous wastes.	Alternatives that include thermal or catalytic oxidation of offgases would be designed and operated in compliance with this regulation.
RCRA - Miscellaneous Treatment Units (40 CFR 264 Subpart X)	Potentially Applicable	This regulation details design and operating standards for units in which hazardous waste is treated.	Hazardous waste treatment units used for on-site or on-base treatment of contaminated media must meet these requirements.
RCRA - Air Emission Standards for Process Vents (40 CFR 265 Subpart AA)	Potentially Applicable	This regulation contains air pollutant emission standards for process vents, closed-vent systems, and control devices at hazardous waste TSD facilities. This subpart applies to equipment associated with solvent extraction or air/steam stripping operations that treat wastes that are identified or listed RCRA hazardous wastes and have a total organics concentration of 10 ppm or greater.	These standards will be considered during the development and design of alternatives that include treatment of VOC-contaminated soils. Air emissions from treatment units will be monitored to ensure compliance with this ARAR.

TABLE 2-5
POTENTIAL FEDERAL ACTION-SPECIFIC ARARs AND TBCs
OU-6 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY
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REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION IN THE FS
OSWER Directive 9355.0-62FS Application of the CERCLA Municipal Landfill Presumptive Remedy to Military Landfills (Interim Guidance) (April 1996)	To Be Considered	This EPA directive provides guidance in evaluating military landfill sites and determining whether presumptive remedies can be applied.	The procedures and suggested remedial actions will be considered in formulating remedial alternatives for Sites 3 and 10.
OSWER Directive 9355.0-49FS Presumptive Remedy for CERCLA Municipal Landfill Sites (Sep 1993)	To Be Considered	This EPA directive provides guidance in evaluating CERCLA municipal landfill sites and determining if presumptive remedies can be applied.	The procedures and suggested remedial actions will be considered in formulating remedial alternatives for Sites 3 and 10.

TABLE 2-6
POTENTIAL STATE ACTION-SPECIFIC ARARs AND TBCs
OU-6 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY

REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	COMMENTS
New Jersey Labeling, Records, and Transportation Requirements (N.J.A.C. 7:26-7)	Potentially Applicable	These regulations establish the responsibilities of generators and transporters of hazardous waste in the handling, transportation, and management of waste. The regulations specify the packaging, labeling, recordkeeping, and manifest requirements.	Activities performed in connection with off-site transport of hazardous wastes will comply with the requirements of these regulations.
New Jersey Requirements for Hazardous Waste Facilities (N.J.A.C. 7:26-9)	Potentially Applicable	These regulations identify requirements for facilities in general, groundwater monitoring, preparedness and prevention, contingency and emergency procedures, and general closure and post-closure.	If a remedial alternative includes the establishment of an on-base treatment facility for contaminated soils and materials, then this regulation will be complied with during implementation.
New Jersey Closure and Post-Closure Care of Sanitary Landfills Regulations (N.J.A.C. 7:26-2A.9)	Potentially Relevant and Appropriate	Details specific requirements for closure and post-closure of municipal solid waste landfills. Final cover requirements that address minimizing infiltration and erosion are identified in this regulation. Following closure, post-closure requirements include preparing a post-closure plan, maintaining integrity and effectiveness of final cover, groundwater monitoring, and maintaining and operating a gas collection system.	If an alternative includes closure of a solid waste landfill, then these requirements will be considered in formulating the alternative.
New Jersey Thermal Treatment Regulations (N.J.A.C. 7:26-11.6)	Potentially Applicable	These regulations detail operating requirements, waste analyses and monitoring of treatment conditions, performance standards, and closure of existing facilities that thermally treat hazardous wastes.	Alternatives that include thermal treatment of contaminated soils, sediments, and materials would be designed and operated in consistent with this regulation.

TABLE 2-6
POTENTIAL STATE ACTION-SPECIFIC ARARs AND TBCs
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REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	COMMENTS
New Jersey Chemical, Physical, and Biological Treatment Regulations (N.J.A.C. 7:26-11.7)	Potentially Applicable	These regulations detail operating requirements, waste analyses and monitoring of treatment conditions, and closure of existing facilities that physically, chemically, or biologically treat hazardous wastes. Also governs handling and compatibility of wastes in treatment processes.	Alternatives that include physical, chemical, or biological treatment of contaminated soils, sediments, and materials would be designed and operated in consistent with this regulation.
New Jersey Control and Prohibition of Air Pollution by Toxic Substances (N.J.A.C. 7:27-17)	Potentially Applicable if emissions greater than 45.4 g/hr (0.1 lb/hr)	These regulations govern the emission of Group I and Group II toxic volatile organic compounds (TXS) to the ambient air. Group I TXS would be addressed through adequate stack height or prevention of aerodynamic downwash. Group II TXS would be addressed through reasonably available control technology.	Alternatives that may result in the release of Group I or Group II TXS to the ambient air, exceeding 0.1 lb/hr, would incorporate appropriate vapor control measure to comply with these requirements.

[N.J.A.C. 7:26-9]; closure and post-closure of sanitary landfills [N.J.A.C. 7:26-2A.9]; thermal treatment [N.J.A.C. 7:26-11.6]; and physical, chemical, and biological treatment [N.J.A.C. 7:26-11.7].

Because Sites 3 and 10 are military landfills, two OSWER Directives are TBC guidance documents that may be considered in developing remedial alternatives that employ presumptive remedies.

These guidance documents are OSWER Directive 9355.0-62FS, Application of the CERCLA Municipal Landfill Presumptive Remedy to Military Landfills (Interim Guidance) (April 1996); and OSWER Directive 93550.0-49FS, Presumptive Remedy for CERCLA Municipal Landfill Sites (September 1993).

2.2 METHOD USED FOR DEVELOPMENT OF REMEDIAL ACTION OBJECTIVES

The development of the medium-specific RAOs for a site is typically based on the risks posed by site-related contaminants to human and ecological receptors, threats or continued degradation of environmental media (groundwater, surface water, and wetlands), and comparison of detected contaminant levels with available regulatory standards.

Generally, human health RAOs are formulated to prevent exposures to site-related contaminants that result in excess carcinogenic and non-carcinogenic health risks or to contaminants that exceed regulatory requirements (e.g., MCLs in potable water).

Ecological RAOs are formulated to reduce or prevent the detrimental effects of site-related contaminants on environmental media (e.g., degradation of groundwater quality) or to address contaminant concentrations that exceed regulatory standards (e.g., New Jersey GWQS).

RAO development for Sites 3 and 10 is presented in Sections 2.6 and 2.7, respectively.

2.3 METHOD USED FOR DEVELOPMENT OF PRELIMINARY REMEDIATION GOALS

The determination of numerical remediation goals is an iterative process beginning with the development of a range of medium- and chemical-specific contaminant levels that would be protective of human health or the environment if present in site soils and groundwater. Remediation goals that establish acceptable contaminant levels or ranges of levels that must be achieved under the remedial action are ultimately chosen from the range of PRGs when the remedy is selected.

A range of PRGs for each site was developed for soil and groundwater COCs based on the results of the RI, human health risk assessment, and chemical-specific ARARs. Additionally, background concentrations of COCs and analytical detection limits were identified as potential PRGs to ensure

selection of clean-up goals that are reasonably attainable and measurable. Each type of PRG is briefly discussed below. For each site, a set of PRGs was developed and the basis for selection is presented.

Typically, a promulgated regulated ARAR is selected as the proposed PRG unless background levels or the analytical detection limit is higher. If no ARAR is available, then the higher of either the risk-based value or the maximum background value (inorganic) was selected, assuming that value was higher than the detection limit.

Each type of PRG is briefly discussed below. PRGs developed for each site are presented in Sections 2.6 and 2.7, respectively.

2.3.1 ARAR/TBCs Basis

There are no promulgated chemical-specific federal or state ARARs for soils. However, the state has established a set of non-promulgated soil clean-up criteria (TBCs) for residential direct contact, non-residential direct contact, and impact to groundwater. The Interim Soil Lead Guidance (EPA, 1994) is a TBC for lead in soils. Although the screening criterion presented in the guidance is not intended for use as a PRG, the guidance will be considered in the development of PRGs.

There are chemical-specific federal and state groundwater ARARs. The state GWQS are promulgated under the New Jersey Administrative Code Title 7, Chapter 9-6 (N.J.A.C. 7:9-6) and establish allowable contaminant concentrations in groundwater. The New Jersey surface water quality criteria (SWQCs) are promulgated under N.J.A.C. 7:9B and establish allowable contaminant concentrations in surface water.

2.3.2 Human Health Risk Basis

Human-health-risk-based PRGs were developed for the future industrial worker and resident exposure scenarios, based on carcinogenic risks of 10^{-6} and a Hazard Index (HI) of 0.1. Risk-based concentrations (RBCs) will be considered in the PRGs development. It should be noted that there are no plans to use any of the sites for residential purposes.

2.3.3 Ecological Risk Basis

Ecotox threshold (ET) values were used for screening potential risks to ecological receptors from contaminants detected in the site-related samples. The ecological risk assessment endpoint was the protection of individuals inhabiting the wetland area and the Hockhockson Brook Watershed.

2.3.4 Protection of Groundwater Basis

The PRGs for protection of groundwater represent soil contaminant concentrations that, when leached into groundwater, would be protective of groundwater. The New Jersey Soil Clean-up Criteria identified a set of non-promulgated soil organic chemical concentrations that would be protective of groundwater if leaching of contaminants occurred.

2.3.5 Background Concentrations Basis

Some inorganic COCs (natural components of soil) are present in site soils and in the background locations (areas deemed not to be affected by the sites) at concentrations higher than the risk-based or groundwater protection-based PRGs calculated for the sites. Section 31 of the RI report presents background results. Because it is not reasonable and may not be possible to remediate site soils to concentrations lower than are present naturally in area soils, background concentrations may be considered as reasonable PRGs for inorganics. Under the RI, eight representative background soil samples were collected and the mean and 95 percent upper tolerance limit (UTL) values were calculated and are presented in Tables 1-7 and 1-8. Representative background groundwater concentration values for formations underlying NWS Earle are presented in Tables 1-4, 1-5, and 1-6. These values are also presented in the site-specific PRG tables of this FS.

2.4 METHOD USED FOR DEVELOPMENT OF GENERAL RESPONSE ACTIONS

The RAOs were used to develop general response actions that describe medium-specific measures that will satisfy the RAOs. General response actions presented in OSWER Directive No. 9355.3-01, Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA, were evaluated for their applicability to each site's specific conditions, environmental media, the nature of the contaminants, and how the potential risks would be mitigated.

General response actions that may be applicable to the contaminated soils and landfill materials at the sites include the following:

- No Action
- Limited Action (Institutional Controls)
- Containment
- Excavation and Treatment Actions
- Excavation, Treatment, and Disposal Actions

The soil general response actions can also be applied to sites where contaminated sediments need to be addressed.

General response actions that may be applicable to the contaminated groundwater include the following:

- No Action
- Limited Action (Institutional Controls)
- Containment Actions
- Collection and Discharge (clean groundwater only)
- Collection, Treatment, and Discharge Actions
- In-Situ Treatment

General response actions specific to Sites 3 and 10 are presented in Sections 2.6 and 2.7of this FS.

2.5 METHOD USED FOR IDENTIFICATION, SCREENING, AND EVALUATION OF REMEDIAL TECHNOLOGIES

During this phase of alternatives formulation, preliminary screening is performed to reduce the universe of potentially applicable technology types and process options. The purpose of screening is to investigate all available technologies and process options and to eliminate those obviously not applicable to specific conditions at each site, based on the established remedial action objectives and general response actions. The technology identification considers the demonstrated performance of each technology with site conditions and contaminants.

Potential remedial technologies and process options are identified and screened according to their overall applicability (technical implementability) to the media (soils, groundwater, etc.), primary contaminants of concern (metals, volatile organic compounds), and conditions present at each of the sites, including heterogeneous soils, landfill materials, leaching of contaminants to underlying groundwater, erosion and runoff of contaminated materials, vertical hydraulic gradients, etc.

A detailed evaluation of technologies and process options retained in the preliminary screening step is conducted to further focus the alternatives development process. In this step, process options are evaluated with respect to other processes in the same technology category. One representative process option is selected, if possible, for each technology type, to simplify the subsequent development and evaluation of alternatives without limiting flexibility during remedy selection or remedial design. The evaluation of technologies and process options utilizes three criteria: effectiveness, implementability, and relative cost. The Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA (Interim Final),

(EPA, 1988) suggests that this evaluation focus on the effectiveness criterion, with less emphasis directed at the implementability and relative cost criteria. Brief definitions of effectiveness, implementability, and relative cost, as they apply to the evaluation process, follow:

- Effectiveness - This criterion focuses on the potential effectiveness of process options in handling the estimated volume of media and meeting the remediation goals; the potential impacts to human health and the environment during construction and implementation; and how proven and reliable the process is with respect to the contaminants and conditions at the site.

- Implementability - The implementability evaluation encompasses both the technical and institutional feasibility of implementing a process. Technical implementability was used in developing general response actions as an initial screen of technology types and process options, to eliminate those that are clearly ineffective or unworkable at a site. Therefore, this subsequent, more detailed evaluation of process options places greater emphasis on the institutional aspects of implementability, such as the ability to obtain permits, availability of treatment, storage, and disposal services, and availability of necessary equipment and resources.

- Cost - Cost plays a limited role in this screening. The cost analysis is based on engineering judgment, and each process is evaluated as to whether costs are high, low, or medium relative to the other options in the same technology type. If there is only one process option, costs are compared to other candidate technologies.

The screening and detailed evaluation of technology types and process options are presented in summary tables for each site.

2.6 SITE 3 TECHNOLOGY SCREENING

The selection of viable remedial technologies and process options for assemblage into remedial alternatives for Site 3 is presented in this section.

2.6.1 Site 3 Remedial Action Objectives

The results of the RI, previous investigations, and the human health and ecological risk assessments for Site 3 were evaluated to determine the remedial action objectives that may be needed to protect human health and the environment.

Human Health Protection Considerations

Because Site 3 is an inactive landfill with no known deposition of military-specific wastes (e.g., chemical warfare agents), the presumptive remedy guidance for CERCLA municipal landfills was applied to the site. Sediment, groundwater, and surface water were sampled at Site 3. The potential receptors considered for this site were future industrial, residential, and recreational receptors.

The estimated Reasonable Maximum Exposure (RME) (groundwater) cancer risk for the future industrial employee and the future residential receptor is within the conservative EPA target cancer risk range guideline, assuming dermal contact and ingestion of groundwater. The estimated RME noncancer HI for the future residential receptor exceeds 1.0, based mainly on ingestion of groundwater. The estimated CTE noncancer risk for the future residential receptor exceeds 1.0, based mainly on ingestion of groundwater.

The underlying groundwater is not used as a potable water supply, and there are no plans for base closure or realignment that would result in Site 3 being considered for future residential land use.

Ecological Receptors Risk Considerations

The Site 3 ecological risk assessment (ERA) identified the presence of wetlands adjacent to the landfill and indicated that runoff could convey landfill contaminants into the wetlands. Of the inorganics detected in sediment samples collected in the wetlands southeast of the landfill, only arsenic and barium exceeded sediment benchmarks. These exceedances were quite low; arsenic had a Hazard Quotient (HQ) of 1.8 and barium had an HQ of 1.1. Also, arsenic was only detected in one sample and the detected concentration did not exceed the Ecotox threshold (ET) for this inorganic. The inorganics, aluminum, beryllium, cobalt, and vanadium, were retained as COCs since no suitable sediment benchmark values were available from any source. The ERA concluded that, because of the low contaminant concentrations present in the sediment adjacent to the landfill, Site 3 poses the possibility of only minor, insignificant impacts to ecological receptors. Therefore, no remedial action based on potential risks to ecological receptors or additional ecological study is recommended at Site 3.

Environmental Media Protection Considerations

The RI determined that groundwater adjacent to the landfill contained contaminants at concentrations in excess of the state GWQS (see Table 2-7). Review of the RI data revealed that aluminum, arsenic, cadmium, and iron levels exceeded the GWQS. The extent of groundwater contamination is limited, and only a few chemicals exceeded the state ARARs. Runoff and erosional dispersion may allow limited migration of contaminated sediments.

TABLE 2-7
SITE 3 GROUNDWATER CONTAMINANTS OF CONCERN
OU-6 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY

Contaminant of Concern	Exceeds NJ GWQS	Exceeds SDWA MCLs	Poses Human Health Risk
Aluminum	X	(1)	--
Arsenic	X	(1)	X (2)
Cadmium	X	X	--
Iron	X	(1)	--

Notes:

- X indicates the basis for selection of the compound or element as a COC.
- New Jersey state Ground Water Quality Standards (GWQS) [N.J.A.C. 7:9-6] are ARARs.
- Safe Drinking Water Act (SDWA) Maximum Contaminant Levels (MCL) regulate organic and inorganic constituents in public drinking water supplies and are included for comparison purposes.

(1) No SDWA MCL for this analyte.
(2) COC contributes to HI greater than 1.0 for future residential child under RME and CT exposures.

Chemical constituents detected in the surface soil and sediments at Site 3 have low potential for impact to groundwater. Detected chemicals in the groundwater do not conclusively demonstrate groundwater impact or identify a particular source location. Filtered samples collected from MW3-01 indicated several metals present in suspension rather than in the dissolved phase, which would diminish the potential for long-range transport of these metals in groundwater. However, the filtered sample collected from downgradient well MW3-01 also exhibited cadmium and aluminum at levels greater than background, which suggests their presence in solution. Filtered results for arsenic were approximately one-third of the concentration of the unfiltered results and are considered more representative of dissolved-phase concentrations. The risk calculations, based on unfiltered arsenic results, are considered conservative and slightly over estimated.

RAOs Selection

For the reasons provided above, the following remedial action objectives have been selected for Site 3:

Protection of Human Health RAOs

- Prevent potential human exposure to metals in groundwater.
- Prevent potential contact with landfill contents.

Protection of the Environment RAO

- Minimize migration of landfill contaminants to the adjacent wetlands.
- Prevent potential contact with landfill contents.

2.6.2 Site 3 Preliminary Remediation Goals

Data from the RI, the human health risk assessment, and ARARs were reviewed to identify COCs for Site 3. A summary and the basis for selecting the COCs are provided in Table 2-7.

Arsenic in groundwater that could contribute to an HI greater than 1.0 was selected as human health risk-based COC (Table 2-8).

Because several metal contaminants in groundwater underlying and adjacent to the site exceed the state GWQS, these COCs were selected and the GWQS were selected as the ARAR-based PRGs. Table 2-8 lists the metal contaminants whose concentration ranges exceeded those of the maximum detected

TABLE 2-8
SITE 3 GROUNDWATER PRELIMINARY REMEDIATION GOALS (μg/L)
OU-6 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY

Contaminant of Concern	ARARS NJ GWQS	SDWA MCLs	PRG(2) Based on HI = 0.1 [non-carcinogen]	Maximum Background Conc.	Maximum Detected Site Conc.
Aluminum	200	(1)	1510	7,870	7,930
Arsenic	8.0	50	0.46	5.8	15.1
Cadmium	4.0	5.0	0.77	1.9	12.3
Iron	300	(1)	452	7,690	26,000

Notes:
- NJ GWQSs are the state groundwater quality standards, which are ARARs
- Safe Drinking Water Act (SDWA) MCL regulate organic and inorganic constituents in public drinking water supplies and are presented for comparison purposes.
- -- Not a COC under this parameter.
- BDL - Below detection limit.

(1) No MCL established for this constituent.

(2) PRG numerical values for carcinogens and non-carcinogens are based on exposure scenarios and factors applied in the NWS Earle human health risk assessment and are calculated using the equation - PRG concentration @1E-6risk = representative concentration of COPC X (1E-6)/calculated cancer risk for COPC from the RI report.

background groundwater concentrations. Potential PRGs based on ARARs/TBCs and the maximum detected background concentrations are presented in Table 2-8.

A set of proposed groundwater PRGs for Site 3 is presented on Table 2-9, along with the basis for selection. These proposed PRGs may be used to assist in the delineation of the volume of contaminated groundwater that may need to be evaluated for potential remedial action and may also be used in establishing CEAs as defined under the N.J.A.C. 7:9-6.

2.6.3 Site 3 General Response Actions

General response actions were selected based on the RAOs for Site 3 and the consideration that the site is an inactive military municipal landfill, therefore incorporating the application of a presumptive remedy. Treatment of landfill soils and materials is considered technically impracticable. The general response actions for Site 3 that address potential human exposures to potential contaminant migration into groundwater and the wetlands include

- No action
- Institutional controls (limited action)
- Containment
- Removal and disposal

General response actions that address potential human exposure to groundwater contaminants associated with the landfill materials include

- No action
- Institutional controls (limited action)

2.6.4 Identification, Screening, and Evaluation of Technologies and Process Options for Site 3

Table 2-10 presents a summary of potential remedial technologies and process options that apply to the Site 3 RAOs and general response actions. Screening of the remedial technologies considered their overall applicability to the media of concern (soil and landfill materials, groundwater), primary contaminants (metals), and current site conditions. During the screening step, process options and entire technology types were eliminated from further consideration on the basis of technical implementability.

Site conditions that were considered include fill materials consisting of heterogeneous municipal-type waste possibly mixed with minor quantities of military waste materials, the location of the landfill adjacent to a

TABLE 2-9
SITE 3 PROPOSED GROUNDWATER PRGs
OU-6 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY

Contaminant of Concern	Proposed PRG	Basis of Selection
Aluminum	7870	Background
Arsenic	8.0	NJ GWQS
Cadmium	4.0	NJ GWQS
Iron	7690	Background

Notes:

- All units in mg/L
- New Jersey GWQS [N.J.A.C. 7:9-6] are ARARs.

TABLE 2-10
SITE 3 REMEDIAL ACTION OBJECTIVES, GENERAL RESPONSE ACTIONS, TECHNOLOGY TYPES, AND PROCESS OPTIONS
OU-6 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY

Environmental Medium	Remedial Action Objectives (from site characterization)	General Response Action (for all RAOs)	Remedial Technology Type (for general response actions)	Process Options
Landfill Materials	**Protection of Human Health** Prevent human exposure to landfill materials.	No Action	No Action	Not Applicable
		Limited Action	Institutional Controls	- Deed restrictions - Local ordinances
			Access Restrictions	- Fencing
			Monitoring	- Monitoring of groundwater (to assess contaminant status)
	Protection of the Environment Minimize contaminant migration of landfill contaminants to adjacent wetlands. Prevent potential contact with landfill contents.	Containment	Surface Controls	- Grading - Revegetation
			Cap	- Soil cover - Single barrier - Double barrier
		Removal and Disposal	Excavation	- Mechanical excavation
			Disposal On Site	- Consolidation (into existing landfill) - New landfill
			Disposal Off Site	- RCRA Landfill
Groundwater	**Protection of Human Health** Prevent human exposure to metal contaminants in groundwater.	No Action	No Action	- Not applicable
		Natural Attenuation	Natural Attenuation	- Biological processes - Chemical processes - Physical processes
		Limited Action	Limited Action Technologies - Institutional Controls - Long-Term Monitoring	- Deed restrictions - Groundwater monitoring

wetlands area, relatively sparse top cover of the landfilled materials, and erosion and runoff from landfill soils and materials into the adjacent wetlands.

The preliminary screening of soils and landfill material remedial technologies is presented and summarized in Table 2-11, and the screening of groundwater response remedial technologies is summarized in Table 2-12. Detailed evaluations of the remedial technologies and process options for contaminated soils/landfill materials and groundwater are presented in Tables 2-13 and 2-14, respectively.

2.6.5 Summary of Site 3 Selected Remedial Technologies and Process Options

Tables 2-13 and 2-14 identify the remedial technologies that were retained after the detailed evaluation process. The technologies and process options that are not likely to be implementable and effective or that would result in higher implementation costs were eliminated from further consideration.

For the contaminated soils and landfill materials options, local ordinances were eliminated from further consideration because this action may be difficult to implement and would not offer any greater protection than other institutional controls. The composite cap was eliminated since it did not offer substantially greater protectiveness than the single barrier cap, and the current leaching of landfill contaminants does not appear to constitute a major problem.

All candidate technologies and process options to address contaminated groundwater were retained after the screening phase.

2.7 SITE 10 TECHNOLOGY SCREENING

The selection of viable remedial technologies and process options for assemblage into remedial alternatives for Site 10 is presented in this section. The identification and evaluation of remedial technologies and process options for Site 10 are similar to these performed for Site 3 because both are inactive military municipal landfills. However, Site 10 received scrap metal which resembles construction/ demolition debris which consisted primarily of aluminum and steel containers.

2.7.1 Site 10 Remedial Action Objectives

The results of the RI, previous investigations, and the human health and ecological risk assessments for Site 10 were evaluated to determine the remedial action objectives that may be needed to protect human health and the environment.

TABLE 2-11
PRELIMINARY SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS FOR SITE 3 LANDFILL MATERIALS
OU-6 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	DESCRIPTION	SCREENING COMMENTS
No Action	No Action	No Action	No remedial actions taken.	Retained as baseline for comparison, in accordance with the NCP.
Limited Action	Institutional Controls	Land Use Restrictions	Administrative action used to restrict future site activities on NWS Earle within potentially contaminated area. Activities such as excavation, installation of drinking water supply wells (without treatment), or residential development could be restricted or prohibited.	Potentially viable. Retained.
		Local Ordinances	Administrative actions, such as zoning by-laws and Board of Health regulations, used to limit property use and activities such as well installation.	Not viable, local ordinances may not be applicable to military bases. Eliminated.
	Access Restrictions	Fencing	Security fence installed around contaminated areas to restrict access.	Potentially viable. Retained.
	Monitoring	Groundwater Monitoring	Periodic monitoring of groundwater to evaluate contaminant presence and migration from the landfill.	Potentially viable. Retained.
Containment	Surface Controls	Grading	Reshaping of topography to manage precipitation infiltration and surface runoff.	Grading of current cover material of varied thickness may not be effective in promoting precipitation infiltration management. Grading would be potentially viable if additional cover materials added. Retained.
		Revegetation	Seeding and maintaining site surface to establish vegetation to minimize erosion and to promote evapotranspiration of precipitation, thus reducing infiltration.	Potentially viable. Retained.

TABLE 2-11
PRELIMINARY SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS FOR SITE 3 LANDFILL MATERIALS
OU-6 FEASIBILITY STUDY
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GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	DESCRIPTION	SCREENING COMMENTS
Containment (continued)	Cap	Soil (Permeable) Cover	Soil with a vegetative cover to prevent direct contact and minimize erosion and surface migration of contaminated soils.	Potentially viable if direct contact and erosion are the prime threats. Offers limited effectiveness for reducing infiltration. Retained.
		Single Barrier	Cap constructed with one low-permeability layer (clay or synthetic membrane) over the site to prevent direct contact, to minimize erosion, and to reduce leaching of contaminants from the landfill into groundwater. Additional layers would be required to protect the barrier.	Potentially viable to prevent direct contact and to reduce erosion and infiltration. Retained.
		Composite (Double) Barrier	Multi-media cap with two low-permeability layers (clay and/or synthetic membranes) constructed over the site to prevent direct contact and reduce leaching of landfill contaminants into groundwater. Provides greater reduction in infiltration and better protection against failure than a single-barrier cap.	Potentially viable to prevent direct contact and to reduce erosion and infiltration. Retained.
Removal and Disposal	Excavation	Mechanical Excavation	Mechanical removal of solid materials using common construction equipment such as bulldozers, excavators, and front-end loaders.	Potentially viable for hot spot areas if encountered. However, no hot spots were identified at Site 3. Retained.
	Disposal Off Base	RCRA Landfill	Transport and disposal of excavated materials in a RCRA-permitted landfill.	Technically impracticable to excavate and dispose of entire landfill, the bulk of which is metal debris. Eliminated.

TABLE 2-11
PRELIMINARY SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS FOR SITE 3 LANDFILL MATERIALS
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GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	DESCRIPTION	SCREENING COMMENTS
Removal and Disposal (continued)	Disposal On Site	New RCRA-Type Landfill	Disposal of untreated bulk landfill materials in a specially constructed on-base landfill.	Technically impracticable to excavate and dispose of entire landfill, the bulk of which is metal debris. Eliminated.
		Consolidation (into existing landfill)	Relocation of landfill materials into another on-base landfill. Or relocation of small, isolated quantities of contaminated materials into an existing on-base landfill so that one closure action can accommodate both.	Technically impracticable to excavate and relocate landfill. Eliminated. Retained for consolidating small quantities of contaminated materials into existing on-base landfill.

TABLE 2-12
PRELIMINARY SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS
FOR SITE 3 CONTAMINATED GROUNDWATER
OU-6 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	DESCRIPTION	SCREENING COMMENTS
No Action	No Action	No Action	No active remediation would be conducted to address contamination.	Retained for baseline comparison purposes in accordance with NCP.
	Natural Attenuation	Natural Attenuation	Natural subsurface biological, chemical, or physical processes would attenuate dissolved inorganics and limit migration of the contaminants.	Potentially applicable.
Limited Action	Institutional Controls	Land Use Restrictions	Administrative action used to restrict future activities on base properties. Installation of drinking water wells without treatment would be prohibited under property deeds.	Potentially applicable.
	Long-Term Monitoring	Groundwater Monitoring	Periodic sampling and analysis of media to assess groundwater contaminant status and potential migration downgradient.	Potentially applicable.

TABLE 2-13
DETAILED EVALUATION OF TECHNOLOGIES AND PROCESS OPTIONS FOR SITE 3 LANDFILL MATERIALS
OU-6 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	EFFECTIVENESS	IMPLEMENTABILITY	COST	CONCLUSION
No Action	No Action	No Action	Would not achieve remedial action objectives.	Implementable.	Capital: None O & M: Low	Retained.
Limited Action	Institutional Controls	Land Use Restrictions	Effectiveness dependent on continued future enforcement to prevent use of underlying groundwater or use of landfill for development. No contaminant reduction anticipated.	Can be added to property deed (or Base Master Plan) and is implementable.	Capital: Low O & M: Low	Retained.
	Access Restrictions	Fencing	Would limit access to landfill materials. No contamination reduction.	Readily implementable; numerous companies available to perform construction.	Capital: Low O & M: Low	Retained.
	Monitoring	Groundwater Monitoring	Would allow assessment of landfill contaminant status and leaching/migration in groundwater. Would enable action to be taken to reduce continuing groundwater contamination. No contaminant reduction.	Readily implementable; numerous companies with personnel and equipment to perform sampling.	Capital: Low O & M: Low	Retained.

TABLE 2-13
DETAILED EVALUATION OF TECHNOLOGIES AND PROCESS OPTIONS FOR SITE 3 LANDFILL MATERIALS
OU-6 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY
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GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	EFFECTIVENESS	IMPLEMENTABILITY	COST	CONCLUSION
Containment (continued)	Surface Controls	Grading	Would be effective in promoting precipitation runoff, thus decreasing infiltration and potential contaminant leaching. Would be applicable to top layer of cap system.	Implementable, numerous companies with personnel and heavy equipment to perform earth moving and grading.	Capital: Low O & M: None	Retained.
		Revegetation	Would be effective in reducing precipitation infiltration through promotion of evapotranspiration and reduction of surface erosion.	Implementable; numerous companies with personnel and equipment available to perform revegetation.	Capital: Low O & M: Low	Retained.
	Cap	Soil (Permeable) Cover	Would prevent direct exposure to landfill materials. Would reduce precipitation infiltration and contaminant leaching to groundwater and would reduce erosion of landfill materials to adjacent wetlands. No contaminant reduction.	Implementable using standard methods and readily available equipment.	Capital: Low O & M: Low	Retained.
		Single Barrier	Would limit infiltration and significantly reduce contaminant leaching to groundwater. Would prevent exposure to contaminated soils and surface migration of contaminated soils. No contaminant reduction.	Implementable by standard construction techniques; would require specialized, but readily available, equipment and materials to install synthetic cap.	Capital: Moderate O & M: Low	Retained.

TABLE 2-13
DETAILED EVALUATION OF TECHNOLOGIES AND PROCESS OPTIONS FOR SITE 3 LANDFILL MATERIALS
OU-6 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	EFFECTIVENESS	IMPLEMENTABILITY	COST	CONCLUSION
Containment (continued)	Cap (continued)	Composite (Double) Barrier	Same as single barrier. Second impermeable barrier would provide greater assurance against cover failure. Level of protection offered by composite barrier cap not required at Site 3 since groundwater contamination is low and groundwater is not used.	Implementable by standard construction; would require specialized equipment and materials to install double barrier cap. More care required to install than soil cover or single barrier.	Capital: High O & M: Low	Eliminated.
Removal and Disposal	Excavation	Mechanical Excavation	Effective method for removing highly contaminated soils and hot spots, none were encountered at site 3.	Implementable with standard construction equipment. Equipment and resources are readily available from various contractors.	Capital: Low O & M: None	Eliminated.
	Disposal Offbase	RCRA Landfill (for hot spot removals only)	Effectively controls release of hot spot contaminants to environment. Landfill materials may require treatment prior to disposal to meet land disposal requirements. No hot spots were encountered at site 3.	Implementable. Commercial landfill facilities are available. Implementation becomes more difficult if excavated materials require segregation or treatment prior to disposal.	Capital: Moderate O & M: None	Eliminated.
	Disposal On Base	Consolidation	Allows small volumes of material from other isolated locations to be consolidated and addressed with the majority of landfill materials.	Readily implementable for small or moderate soil volumes. No implementability concerns.	Capital: Low O & M: Low	Retained.

TABLE 2-14
EVALUATION OF TECHNOLOGIES AND PROCESS OPTIONS FOR SITE 3 CONTAMINATED GROUNDWATER
OU-6 FEASIBILITY STUDY
NAVAL WEAPONS STATION EARLE, COLTS NECK, NEW JERSEY

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	EFFECTIVENESS	IMPLEMENTABILITY	COST	RETAIN/ ELIMINATE
No Action	No Action	No Action	Does not achieve remedial action objectives.	Implementable	Capital: None O&M: Low	Retained.
Natural Attenuation	Natural Attenuation	Natural Attenuation	Effectiveness dependent on subsurface biological, chemical, and physical conditions. Attenuation of metals is anticipated to be gradual.	Implementable. Would require monitoring to determine whether attenuation is ongoing.	Capital: None O&M: Low	Retained.
Limited Action	Institutional Controls	Land Use Restrictions	Effectiveness depends on future enforcement. Does not reduce contamination.	Can be added to property deeds (or Base Master Plan) and is implementable.	Capital: Low O&M: Low	Retained.
	Long-Term Monitoring	Groundwater Monitoring	Effective method for observing contaminant extent and potential migration and for assessing effectiveness of remedial action.	Readily implementable; numerous companies available with resources to perform monitoring.	Capital: Low O&M: Low	Retained.

Human Health Protection Considerations

Because Site 10 is an inactive military landfill with no known deposition of military specific wastes (e.g., chemical warfare agents), the presumptive remedy guidance for CERCLA municipal landfills was applied to the site. Landfill materials likely contain a variety of metals, consisting primarily of aluminum and steel containers, based on information obtained under previous investigations regarding materials that were disposed in the landfill. However, the majority of the landfill is currently covered by a layer of loose sand and is moderately treed.

The potential receptors considered for this site were future industrial and residential receptors. The RME cancer risk associated with the future residential (groundwater) exposure scenario was approximately 7E-05, within the conservative EPA guideline target acceptable risk range. The cancer risk associated with the future industrial (groundwater) exposure scenario was within the mid-range of the target acceptable risk range. The noncarcinogenic HIs associated with the future industrial and future residential (groundwater) exposure scenarios were below 1.0 the cutoff point below which adverse effects are not expected to occur. Lead groundwater concentrations at the site were below the EPA action level for public water supplies and are not expected to be associated with significant increases in blood-lead levels based on the results of the IEUBK Lead Model (v. 0.99).

The risk assessment procedure resulted in the elimination of all COPCs with associated risk above target guideline limits.

The underlying groundwater is not used as a potable water supply, and there are no plans for base closure or realignment that would result in Site 10 being considered for future residential land use.

Ecological Receptors Risk Considerations

Site 10 constitutes a relatively small area. Some upland habitat is present on the site, but much of the site is bare due to the roadway and vehicle turn-around area on the site and eroding topsoil with exposed debris. The area is surrounded by a forested wetland and some upland areas that contain no surface water. These areas are probably utilized by a variety of wildlife found on the base. Runoff from the site is to the east to a drainage ditch that connects with a branch of Hockhockson Brook northwest of the site. Groundwater flow at the site is generally northward, making groundwater to surface water discharge to the drainage ditch possible. Aquatic migration pathways and exposure routes are the main concern for Site 10.

No contaminants were detected in surface water that were not found at comparable concentrations in blanks. In sediments, only antimony exceed the most conservative ET, but its HQ value was indicative of low

potential risk. Aluminum and vanadium were conservatively retained as final COPCs in sediments since no ETs were available, but both were present at concentrations lower than in the upstream sample.

Some elevated levels of metals were found in 1993 RI/FS groundwater samples, including lead, chromium, arsenic, and cadmium. In 1995 RI groundwater samples, no organics were detected and most metals were within the range of background values. No metals detected in groundwater were present at elevated levels in drainage ditch sediments, suggesting the absence of groundwater discharge. In addition, the low levels of organics in drainage ditch sediments are more likely attributable to the railroad bed than the landfill.

For these reasons, potential risks to ecological receptors at Site 10 and contaminant contributions to the Hockhockson Brook Watershed appear insignificant, and further study or remediation at the site based on ecological concerns is considered unwarranted. However, since cover material has eroded heavily, an additional cover could be placed on the landfill to prevent any further erosion and runoff and may expedite ecological succession and increase vegetation cover on the landfill.

Environmental Media Protection Considerations

Previous VOC groundwater results were confirmed to be below the level of regulatory concern.

Metals results from monitoring well low-flow samples were generally lower than concentrations found in previous (SI and RI/FS) samples, probably due to reduced turbidity in the sample. Groundwater metals concentrations were generally in the range of background. Therefore, there does not appear to be a significant impact to groundwater from the site. The calculated cancer risk indicates that the site is generally in the target acceptable range.

Concentrations of metals found in site subsurface soils and sediments were generally in the range of background and below ARARs and TBCs. However, samples were not taken directly from exposed corroded metal wastes. Typical aluminum and steel scrap, potentially associated with other metals as anti-corrosion treatments or coatings, interred at the site, appear to have limited potential for effect on human health or the environment. Aluminum, iron, and manganese were found at concentrations above the corresponding GWQS but below the comparison to two times background.

Some sort of cover should be considered for source containment and to improve the appearance and/or utility of the site. For instance, the application of a gravel and pavement material may improve the site as a potential temporary open storage area.

RAOs Selection

For the reasons provided above, the following remedial action objectives have been selected for Site 10:

Protection of Human Health RAO

- Prevent potential human exposure to contaminated landfill materials since cover material has been eroded.

Protection of the Environment RAO

- Minimize exposure to exposed corroded metal wastes.

2.7.2 Site 10 Preliminary Remediation Goals

Data from the RI, the human health risk assessment and ARARs were reviewed to identify COCs for Site 10. The summary and basis for selecting the COCs are presented in Table 2-15.

Since it would be impractical to attempt groundwater remediation for the common metals found above GWQS (aluminum, iron, and manganese) and since these materials are generally in the range of background concentrations, no PRGs were developed for metals There were no organics or metal contaminants in groundwater that would contribute to excess human health carcinogenic risk (greater than the EPA guideline risk range) or HIs greater than 1.0.

Aluminum, iron, and manganese were found at concentrations above the corresponding GWQS but below the comparison to two times background. These contaminants were selected as COCs.

2.7.3 Site 10 General Response Actions

General response actions were selected based on the RAOs for Site 10 and the consideration that the site is an inactive military landfill, thus incorporating the application of a presumptive remedy. Treatment of landfill soils and materials is considered technically impracticable. The general response actions for Site 10 that address potential human exposures to contaminated landfill soils and materials include

- No action
- Institutional controls (limited action)

TABLE 2-15
SITE 10 GROUNDWATER CONTAMINANTS OF CONCERN
OU-6 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY

Contaminant of Concern	Exceeds NJ GWQS	Exceeds SDWA MCLs
Aluminum	X	(1)
Arsenic	--	--
Iron	X	(1)
Manganese	X	(1)

Notes:

- X indicates the basis for selection of the compound or element as a COC.
- The New Jersey state GWQS are ARARs.
- Safe Drinking Water Act (SDWA) MCLs regulate organic and inorganic constituents in public drinking water supplies.

(1) No SDWA MCL for this analyte.

- Containment
- Removal and disposal

Table 2-16 presents a summary of the Site 10 RAOs and corresponding general response actions.

2.7.4 Identification and Screening of Technologies and Process Options for Site 10

Table 2-17 presents a summary of potential remedial technologies and process options that apply to the Site 10 RAOs and general response actions. Screening of the remedial technologies considered their overall applicability to the media of concern (landfill materials), primary contaminants (metals), and current site conditions. During the screening step, process options and entire technology types were eliminated from further consideration on the basis of technical implementability.

Site conditions considered include fill materials consisting of heterogeneous metal military waste materials (demilitarized munitions and spent munitions cases) and a cover of sandy soils over the landfilled materials. The disposed material consisted primarily of aluminum and steel containers. The preliminary screening of soils and landfill material remedial technologies is presented and summarized in Table 2-17. Detailed evaluations of the remedial technologies and process options for contaminated soils/landfill materials and groundwater is presented in Table 2-18.

2.7.5 Site 10 Summary of Selected Remedial Technologies and Process Options

Table 2-18 identifies the remedial technologies that were retained after the detailed evaluation process. The technologies and process options that are not likely to be implementable or effective or that would result in higher implementation costs were eliminated from further consideration. Site-specific considerations were also factors in the elimination of candidate technologies and process options.

For the contaminated soils and landfill materials options, local ordinances were eliminated from further consideration because this action may be difficult to implement and would not offer any greater protection than other institutional controls. The composite cap was eliminated since it did not offer substantially greater protectiveness than the single barrier cap and the current leaching of landfill contaminants does not appear to constitute a major problem.

TABLE 2-16
SITE 10 REMEDIAL ACTION OBJECTIVES, GENERAL RESPONSE ACTIONS, TECHNOLOGY TYPES, AND PROCESS OPTIONS
OU-6 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY

Environmental Media	Remedial Action Objectives (from site characterization)	General Response Action (for all RAOs)	Remedial Technology Type (for general response actions)	Process Options
Landfill Materials	Protection of Human Health	No Action	No Action	Not Applicable
	Prevent human exposure to landfill materials.	Limited Action	Institutional Controls	- Deed restrictions - Local ordinances
			Access Restrictions	- Fencing
			Monitoring	- Monitoring of surface soil/sediment (to assess contaminant status)
	Protection of the Environment	Containment	Surface Controls	- Grading - Revegetation
	Minimize contaminant migration into groundwater.		Cap	- Soil cover - Single barrier - Double barrier
		Removal and Disposal	Excavation	- Mechanical excavation
			Disposal on base	- Consolidation (into existing landfill) - New landfill
			Disposal off base	- RCRA Landfill

TABLE 2-17
PRELIMINARY SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS FOR SITE 10 LANDFILL MATERIALS
OU-6 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	DESCRIPTION	SCREENING COMMENTS
No Action	No Action	No Action	No remedial actions taken.	Retained as baseline for comparison, in accordance with the NCP.
Limited Action	Institutional Controls	Land Use Restrictions	Administrative action used to restrict future site activities on NWS Earle within potentially contaminated area. Activities such as excavation or residential development could be restricted or prohibited.	Potentially viable. Retained.
		Local Ordinances	Administrative actions, such as zoning by-laws and Board of Health regulations, used to limit property use and activities such as well installation.	Not viable, local ordinances may not be applicable to military bases. Eliminated.
	Access Restrictions	Fencing	Security fence installed around contaminated areas to restrict access.	Potentially viable. Retained.
	Monitoring	Surface Soil/Sediment Monitoring	Periodic monitoring of surface, soil, and sediment to evaluate contaminant presence and migration from the landfill.	Potentially viable. Retained.
Containment	Surface Controls	Grading	Reshaping of topography to manage precipitation infiltration and surface runoff.	Grading of current cover material of varied thickness may not be effective in promoting precipitation infiltration management. Grading would be potentially viable if additional cover materials added. Retained.
		Revegetation	Seeding and maintaining site surface to establish vegetation to minimize erosion and to promote evapotranspiration of precipitation, thus reducing infiltration.	Potentially viable. Retained.

TABLE 2-17
PRELIMINARY SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS FOR SITE 10 LANDFILL MATERIALS
OU-6 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	DESCRIPTION	SCREENING COMMENTS
Containment (continued)	Cap	Soil (Permeable) Cover	Soil with a vegetative cover to prevent direct contact and minimize erosion and surface migration of contaminated soils.	Potentially viable if direct contact and erosion are the prime threats. Offers limited effectiveness for reducing infiltration. Retained.
		Single Barrier	Cap constructed with one low-permeability layer (clay or synthetic membrane) over the site to prevent direct contact, to minimize erosion, and to reduce leaching of contaminants from the landfill into groundwater. Additional layers would be required to protect the barrier.	Potentially viable to prevent direct contact and to reduce erosion and infiltration. Retained.
		Composite (Double) Barrier	Multi-media cap with two low-permeability layers (clay and/or synthetic membranes) constructed over the site to prevent direct contact and reduce leaching of landfill contaminants into groundwater. Provides greater reduction in infiltration and better protection against failure than a single-barrier cap.	Potentially viable to prevent direct contact and to reduce erosion and infiltration. Retained.
Removal and Disposal	Excavation	Mechanical Excavation	Mechanical removal of solid materials using common construction equipment such as bulldozers, excavators, and front-end loaders.	Potentially viable for hot spot areas if encountered. However, no hot spots were identified at Site 10. Retained.
	Disposal Off Base	RCRA Landfill	Transport and disposal of excavated materials in a RCRA-permitted landfill.	Technically impracticable to excavate and dispose of entire landfill, the bulk of which is metal debris. Eliminated.

TABLE 2-17
PRELIMINARY SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS FOR SITE 10 LANDFILL MATERIALS
OU-6 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY
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GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	DESCRIPTION	SCREENING COMMENTS
Removal and Disposal (continued)	Disposal On Site	New RCRA-Type Landfill	Disposal of untreated bulk landfill materials in a specially constructed on-base landfill.	Technically impracticable to excavate and dispose of entire landfill, the bulk of which is metal debris. Eliminated.
		Consolidation (into existing landfill)	Relocation of landfill materials into another on-base landfill. Or relocation of small, isolated quantities of contaminated materials into an existing on-base landfill so that one closure action can accommodate both.	Technically impracticable to excavate and relocate landfill. Eliminated. Retained for consolidating small quantities of contaminated materials into existing on-base landfill.

TABLE 2-18
DETAILED EVALUATION OF TECHNOLOGIES AND PROCESS OPTIONS FOR SITE 10 LANDFILL MATERIALS
OU-6 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	EFFECTIVENESS	IMPLEMENTABILITY	COST	CONCLUSION
No Action	No Action	No Action	Would not achieve remedial action objectives.	Implementable.	Capital: None O & M: Low	Retained.
Limited Action	Institutional Controls	Land Use Restrictions	Effectiveness dependent on continued future enforcement to prevent use of underlying groundwater or use of landfill for development. No contaminant reduction anticipated.	Can be added to property deed (or Base Master Plan) and is implementable.	Capital: Low O & M: Low	Retained.
	Access Restrictions	Fencing	Would limit access to landfill materials. No contamination reduction.	Readily implementable; numerous companies available to perform construction.	Capital: Low O & M: Low	Retained.
	Monitoring	Surface Soil/Sediment Monitoring	Would allow assessment of landfill contaminant status. Would enable action to be taken to reduce contaminant reduction. No contaminant reduction.	Readily implementable; numerous companies with personnel and equipment to perform sampling.	Capital: Low O & M: Low	Retained.

TABLE 2-18
DETAILED EVALUATION OF TECHNOLOGIES AND PROCESS OPTIONS FOR SITE 10 LANDFILL MATERIALS
OU-6 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	EFFECTIVENESS	IMPLEMENTABILITY	COST	CONCLUSION
Containment	Surface Controls	Grading	Would be effective in promoting precipitation runoff, thus decreasing infiltration and potential contaminant leaching. Would be applicable to top layer of cap system.	Implementable, numerous companies with personnel and heavy equipment to perform earth moving and grading.	Capital: Low O & M: None	Retained.
		Revegetation	Would be effective in reducing precipitation infiltration through promotion of evapotranspiration and reduction of surface erosion.	Implementable; numerous companies with personnel and equipment available to perform revegetation.	Capital: Low O & M: Low	Retained.
	Cap	Soil (Permeable) Cover	Would prevent direct exposure to landfill materials. Would reduce precipitation infiltration and would reduce erosion of landfill materials to adjacent wetlands. No contaminant reduction.	Implementable using standard methods and readily available equipment.	Capital: Low O & M: Low	Retained.
		Single Barrier	Would limit infiltration. Would prevent exposure to contaminated soils and surface migration of contaminated soils. No contaminant reduction.	Implementable by standard construction techniques; would require specialized, but readily available, equipment and materials to install synthetic cap.	Capital: Moderate O & M: Low	Retained.

TABLE 2-18
DETAILED EVALUATION OF TECHNOLOGIES AND PROCESS OPTIONS FOR SITE 10 LANDFILL MATERIALS
OU-6 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY
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GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	EFFECTIVENESS	IMPLEMENTABILITY	COST	CONCLUSION
		Composite (Double) Barrier	Same as single barrier. Second impermeable barrier would provide greater assurance against cover failure. Level of protection offered by composite barrier cap not required at Site 10 since groundwater contamination is low and groundwater is not used.	Implementable by standard construction; would require specialized equipment and materials to install double barrier cap. More care required to install than soil cover or single barrier.	Capital: High O & M: Low	Eliminated.
Removal and Disposal	Excavation	Mechanical Excavation	Effective method for removing highly contaminated soils and hot spots, none were encountered at site 10.	Implementable with standard construction equipment. Equipment and resources are readily available from various contractors.	Capital: Low O & M: None	Eliminated.
	Disposal Offbase	RCRA Landfill (for hot spot removals only)	Effectively controls release of hot spot contaminants to environment. Landfill materials may require treatment prior to disposal to meet land disposal requirements. No hot spots were encountered at site 10.	Implementable. Commercial landfill facilities are available. Implementation becomes more difficult if excavated materials require segregation or treatment prior to disposal.	Capital: Moderate O & M: None	Eliminated.

TABLE 2-18
DETAILED EVALUATION OF TECHNOLOGIES AND PROCESS OPTIONS FOR SITE 10 LANDFILL MATERIALS
OU-6 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	EFFECTIVENESS	IMPLEMENTABILITY	COST	CONCLUSION
	Disposal On Base	Consolidation	Allows small volumes of material from other isolated locations to be consolidated and addressed with the majority of landfill materials.	Readily implementable for small or moderate soil volumes. No implementability concerns.	Capital: Low O & M: Low	Retained.

3.0 DEVELOPMENT AND SCREENING OF REMEDIAL ACTION ALTERNATIVES

The purpose of the alternative development and screening process is to assemble an appropriate range of possible remedial options to achieve the RAOs identified for the site. In this process, technically feasible technologies retained for further evaluation in Section 2.0 are combined to form remedial alternatives that provide varying levels of risk reduction.

3.1 SITE 3 - DEVELOPMENT AND SCREENING OF ALTERNATIVES

This section will discuss the rationale for development of remedial action alternatives for Site 3, describe the assembled alternatives, and present the screening of alternatives. Detailed evaluations and costing of the retained alternatives are presented in Section 4.0.

3.1.1 Site 3 - Rationale for Development of Alternatives

Factors considered in formulating the remedial alternatives to achieve the RAOs for Site 3 are discussed below:

Statutory and Guidance Considerations - Navy/Marine Corps policy (as stated in the Installation Restoration Manual) dictates that the procedures outlined in the National Oil and Hazardous Substances Contingency Plan (NCP, 40 CFR 300.430) be followed for all IR sites. In accordance with this policy, alternatives were developed in compliance with statutory requirements of the NCP and in consideration of applicable EPA directives and guidance, including

- Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (Interim Final) (RI/FS Guidance), OSWER Directive No. 9355.3-01, EPA/540/G-89/004, October 1988.

- Presumptive Remedy for CERCLA Municipal Landfill Sites, OSWER Directive No. 9355.0-49FS, September 1993.

- Application of the CERCLA Municipal Landfill Presumptive Remedy to Military Landfills (Interim Guidance), OSWER Directive No. 9355.0-62FS, April 1996.

- Conducting Remedial Investigations/Feasibility Studies for CERCLA Municipal Landfill Sites, OSWER Directive No. 9355.3-11, EPA/540/P-91/001, February 1991.

The NCP and the EPA RI/FS guidance present a broad framework for the formulation, evaluation, and selection of remedial alternatives for uncontrolled hazardous waste sites. The NCP encourages development of a range of alternatives, including one or more engineering control alternatives (such as containment), one or more innovative treatment alternatives, and the baseline no-action alternative. Treatment technologies are favored to address principal threats, and engineering controls are favored to address relatively low long-term threats.

In an effort to streamline the RI/FS process dictated by the NCP and RI/FS guidance, EPA has undertaken the presumptive remedies initiative to speed up selection of remedial actions at certain categories of waste sites. Presumptive remedies are preferred technologies for common categories of sites, based on historical patterns of remedy selection and EPA's scientific and engineering evaluations of performance data on technology implementation.

EPA established containment as the presumptive remedy for municipal landfills based on the expectation that containment would generally be appropriate for municipal landfill waste because the volume and heterogeneity of the waste generally make treatment impracticable (OSWER Directive No. 9355.0-49FS). Further, EPA established that the municipal landfill presumptive remedy should also be applied to all appropriate military sites (OSWER Directive No. 9355.0-62FS). Based on the criteria presented in that directive, the Site 3 landfill is an appropriate site for the application of the presumptive remedy for CERCLA municipal landfills. As such, alternatives were developed and screened in accordance with the presumptive remedy directives noted above and the guidance Conducting Remedial Investigations Feasibility Studies for CERCLA Municipal Landfill Sites. The resulting alternatives development process was streamlined to focus on containment alternatives rather than treatment.

Protection of Human Health Considerations - The RAOs for protection of human health specify preventing human exposure to the contaminated landfill materials and preventing potential exposure to contaminants in site groundwater. The alternatives were formulated to meet these objectives.

Protection of the Environment Considerations - The RAO for protection of the environment specifies minimizing contaminant migration to groundwater and the adjacent wetlands (surface water and sediments). The alternatives for Site 3 contain measures to meet these objectives.

3.1.2 Site 3 - Remedial Alternatives Descriptions

This section presents detailed descriptions of the remedial alternatives for Site 3. As discussed in Section 2, no active groundwater response actions are anticipated because groundwater appears to be minimally impacted by landfill contents, if at all. Through establishment of institutional controls [land use restrictions

and Classification Exception Area (CEA) waiver], groundwater will not be used for potable purposes. Long-term groundwater monitoring is included in each Site 3 remedial alternative. The key components of Alternatives 1 through 3 are identified on Table 3-1.

3.1.2.1 Site 3 - Alternative 1: No Action

The no-action alternative is developed as a baseline case, as required by the NCP. The only activities conducted under this alternative are monitoring to evaluate contaminant migration and a review of site conditions and risks every 5 years. The purpose of the alternative is to evaluate the overall human health and environmental protection provided by the site in its present state. Under this alternative, no remedial actions would be taken to protect human health or the environment.

Under the no-action alternative, no measures would be implemented to prevent potential human or animal exposure to landfill materials or site groundwater or to mitigate contaminant migration to the environment. Key components of Alternative 1 are identified on Table 3-1 and described below.

Existing Features - Currently, site features offer limited protection of human health and the environment. The main protective feature is a sandy soil cover that reduces the potential for human and animal contact with landfill materials. The cover is moderately vegetated with grasses and scrub pines that serve to reduce infiltration of precipitation into landfill materials and limit surface runoff and erosion. Where present and in good condition, the vegetation may reduce precipitation infiltration and surface runoff. The cover is present over the majority of the landfill; however, erosion of the cover and exposed debris are evident in some areas.

Because no actions would be conducted under Alternative 1 to maintain or cover the landfill, the landfill surface may continue to erode, potentially exposing more contaminated materials and potentially increasing infiltration.

Long-Term Monitoring - Under Alternative 1, three new downgradient wells would be installed. The groundwater, surface water, and wetland sediment would be sampled periodically to monitor the migration of contaminants from the landfill and the potential impacts to downgradient areas. The collected data would be evaluated during the 5-year review period.

For the purpose of costing, it is assumed that groundwater samples would be collected from the three new monitoring wells, along with the eight existing monitoring wells, and the samples would be analyzed for site-specific contaminants (metals). Surface water and sediment would be collected from three locations within the adjacent wetlands and analyzed for metals. The sampling results would be evaluated to assess

TABLE 3-1
SITE 3- REMEDIAL ALTERNATIVE COMPONENTS
OU-6 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY

	ALTERNATIVE	KEY COMPONENTS OF ALTERNATIVE
1	Action	• Long-term periodic groundwater, surface water, and sediment monitoring • Five-year reviews
2	Limited Action	• Fencing/Signage • Institutional controls (land use restrictions, CEA*) • Long-term periodic groundwater, surface water, and sediment monitoring • Five-year reviews
3	Capping, Institutional Controls and Long-Term Monitoring	• Pre-design investigations • Site preparation • Site grading • Single-barrier cover system • Fencing/Signage • Institutional controls (land use restrictions, CEA*) • Long-term operation and maintenance • Long-term periodic groundwater, surface water, and sediment monitoring • Five-year reviews

Notes:

* Classification Exception Area pursuant to the New Jersey Groundwater Quality Standards (N.J. A.C 7:9-6) would be established for groundwater that does not meet state Groundwater Quality Standards.

whether there have been changes in contaminant status and to determine whether additional response actions are warranted.

Five-Year Reviews - Since contaminants remain on the site, a review of site conditions and risks would be conducted every 5 years, as required by CERCLA. The reviews would consist of evaluation of analytical and hydrogeologic data, assessing whether contaminant migration has increased, and determining whether human or ecological receptors or natural resources are at risk.

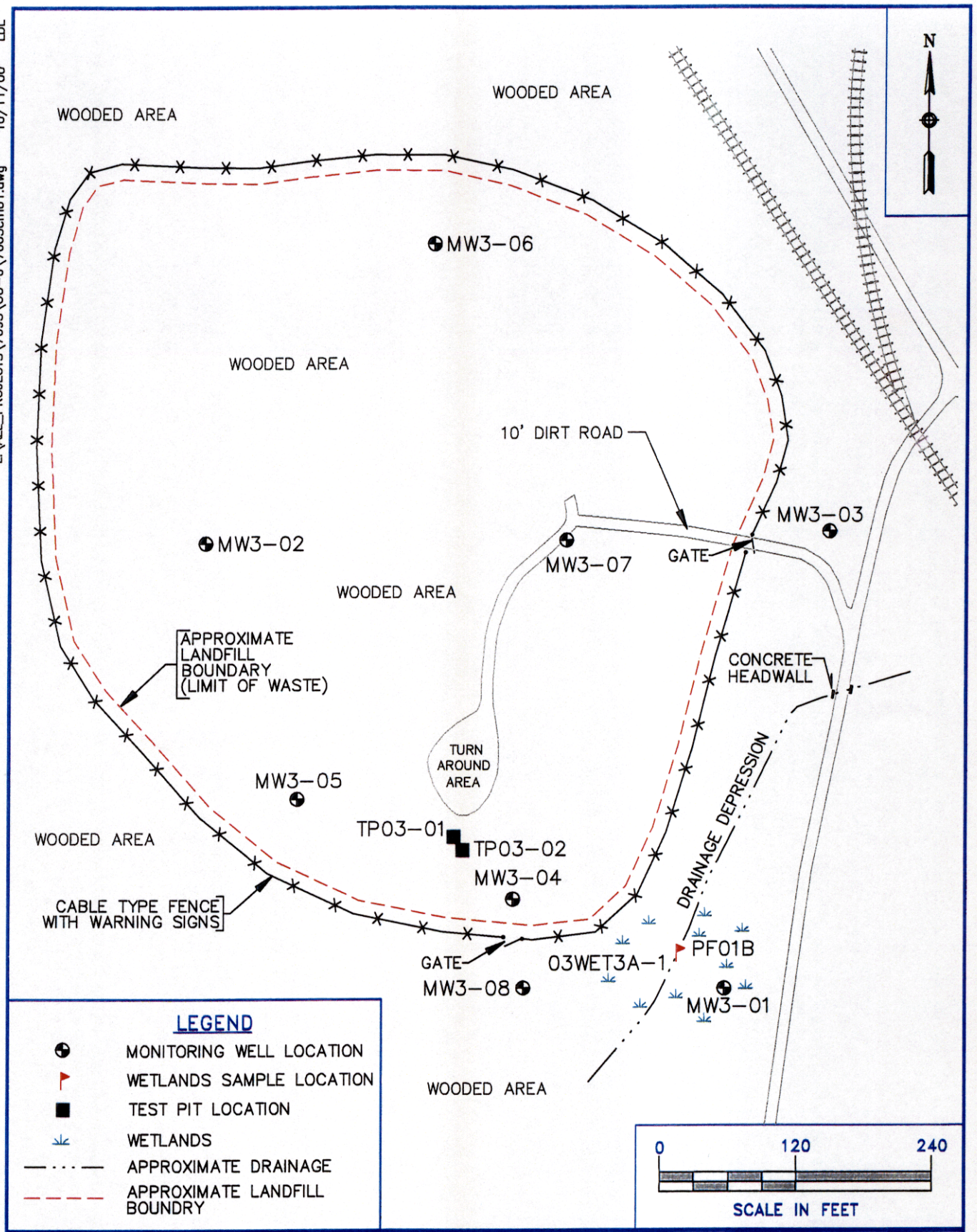
3.1.2.2 Site 3 - Alternative 2: Limited Action (Cover, Grading, Institutional Controls, Access Restrictions, and Long-Term Monitoring)

Alternative 2 was developed as an option that relies on containment, access restrictions, and institutional controls to limit exposures to site risks. This alternative does not employ treatment or containment to address site contamination.

Any exposed debris and the remnants of a former skeet range would be removed and additional cover material would be placed to grade the site to encourage runoff. Restrictions would be attached to the Station Master Plan (access restrictions) to limit future uses of the site to prevent disturbance of the soil cover or direct contact with contaminated media. A fence with appropriate warning signs would be erected around the landfill to limit access to the site, to restrict human contact with contaminated landfill materials, and to protect the integrity of the cover. Figure 3-1 presents a plan view of conceptual design of Alternative 2. Long-term periodic monitoring would be conducted to assess contaminant status and potential threats to human health and the environment. Since wastes would be left in place, site conditions and risks would be reviewed every 5 years. Key components of Alternative 2 are identified on Table 3-1 and described below.

In the event of full or partial transfer of property, through existing legislation or through future base closure authorization, a review would be conducted to determine the suitability of any parcel for transfer of ownership.

Existing Features - Existing site features offer limited protection of human health and the environment. The main protective feature is a sandy soil cover that reduces the potential for human and animal contact with landfill materials. The cover is moderately vegetated with grasses and scrub pines that serve to reduce infiltration of precipitation into landfill materials and limit surface runoff and erosion. Where present and in good condition, the vegetation may reduce precipitation infiltration and surface runoff. Actions to maintain the cover of the landfill would be conducted under Alternative 2.



DRAWN BY LDL	DATE 10/11/00	Tetra Tech NUS, Inc.	ALTERNATIVE 2 SITE 3 LANDFILL SOUTHWEST OF "F" GROUP NAVAL WEAPONS STATION EARLE COLTS NECK, NEW JERSEY	CONTRACT NO. 7695
CHECKED BY	DATE			OWNER NO. OU-6
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SCALE AS NOTED				DRAWING NO. FIGURE 3-1 / REV.

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Pre-Design Investigations and Activities - Pre-design investigations would be conducted to collect topographic, chemical, and geologic data needed for the cover system design. A topographic survey of the site would be performed to collect accurate elevation and contour data for use in the cover system design.

Site Preparation - The site has not been used for many years and is moderately vegetated with grasses and pine trees. Clearing and grubbing of the vegetative growth may be necessary in parts of the site to prepare for cover placement. However, where possible, the additional cover and grading will be placed around the existing trees. Silt fences or staked hay bales would be required to minimize erosion effects while the trees and vegetation are being removed. Silt barriers would be placed at the perimeter of the level portions of the landfill and at the toe of the landfill area to prevent silt and soil movement to downslope areas and properties.

Site Grading - Grading of the landfill area would be completed without removal of site vegetation, where possible. Compaction of the soils and landfill materials would be performed as needed. The appropriate slopes for the cover (to facilitate drainage) would be determined as part of the cover system design.

The final surface slope of landfill cover should have a slope of between three percent (3V:1OOH) and 5 percent (5V:1OOH) to ensure slope stability, control erosion, and allow compaction, seeding, and revegetation of the cover materials. The final slope would also promote precipitation runoff while inhibiting erosion or infiltration.

Institutional Controls - Under Alternative 2, access restrictions would be enacted to limit future use of the landfill property. Restrictions would be placed on future activities that could result in increased human exposure to contaminated landfill materials or increased erosion and contaminant migration. Restricted activities would include excavation, vehicular traffic (off-road vehicles and dirt bikes), and use of untreated groundwater for drinking water.

Because site groundwater does not meet New Jersey groundwater quality standards, a CEA pursuant to N.J.A.C 7:9-6 would be established to provide the state official notice that the constituent standards will not be met for a specified duration and to ensure that use of groundwater in the affected area is suspended until standards are achieved.

Fencing - The entire landfill area would be fenced to limit human access to contaminated soils and landfill materials. An estimated 2,500 linear feet of strung cable-type fence would be required to encircle the landfill area. Warning signs would be suspended from the strung cable at regular intervals. The fencing

would impede intrusion onto the landfill by humans and motorized vehicles. However, fencing would not restrict access to animals, birds or small, burrowing animals that may be at the greatest risk from exposure to contaminants within the landfill. Two chain link fence-type gates would provide access to the vegetative cap for maintenance purposes. The fencing would be inspected and repaired annually.

Long-Term Monitoring - Under Alternative 2, three new downgradient wells would be installed. The groundwater, surface water, and wetland sediment would be sampled periodically to monitor the migration of contaminants from the landfill and the potential impacts to downgradient areas. The collected data would be evaluated during the 5-year review period.

For the purpose of costing, it is assumed that groundwater samples would be collected from the three new monitoring wells, along with the eight existing monitoring wells, and the samples would be analyzed for site-specific contaminants (metals). Surface water and sediment would be collected from three locations within the adjacent wetlands and would be analyzed for metals. The sampling results would be evaluated to assess whether there have been changes in contaminant status and to determine whether additional response actions are warranted.

Five-Year Reviews - Since contaminants remain on the site, a review of site conditions and risks would be conducted every 5 years, as required by CERCLA. The reviews would consist of evaluating analytical and hydrogeologic data, assessing whether contaminant migration has increased, and determining whether human or ecological receptors or natural resources are at risk.

3.1.2.3 Site 3 - Alternative 3: Capping, Institutional Controls, and Long-Term Monitoring

Alternative 3 relies on containment and institutional controls to limit exposures to site-related contaminants and minimize migration of contaminants to groundwater and surface water. Active treatment is not employed to address site contamination. Over time, the minimal metal contaminants in groundwater will likely gradually decrease through adsorption, dispersion, and precipitation. Contaminant concentrations in groundwater will also decrease as a result of reduced infiltration of precipitation through contaminated landfill materials.

A low-permeability cover system that complies with federal and state regulatory requirements would be used to prevent potential human and animal contact with contaminants in landfill materials, limit contaminant leaching to groundwater, and minimize contaminant migration via surface runoff and erosion. The cover system would be installed over all former landfill areas of the site. Access restrictions would be enacted to limit future uses of the site that may result in disturbance of the cover or direct contact with contaminated media.

Long-term periodic monitoring would be conducted to assess contaminant status and potential threats to human health and the environment. Since wastes would be left in place, site conditions and risks would be reviewed every 5 years. Key components of Alternative 3 are identified on Table 3-1 and described below.

Pre-Design Investigations and Activities - Pre-design investigations would be conducted to collect topographic, chemical, and geologic data needed for the cover system design. A topographic survey of the site would be performed to collect accurate elevation and contour data for use in the cover system design.

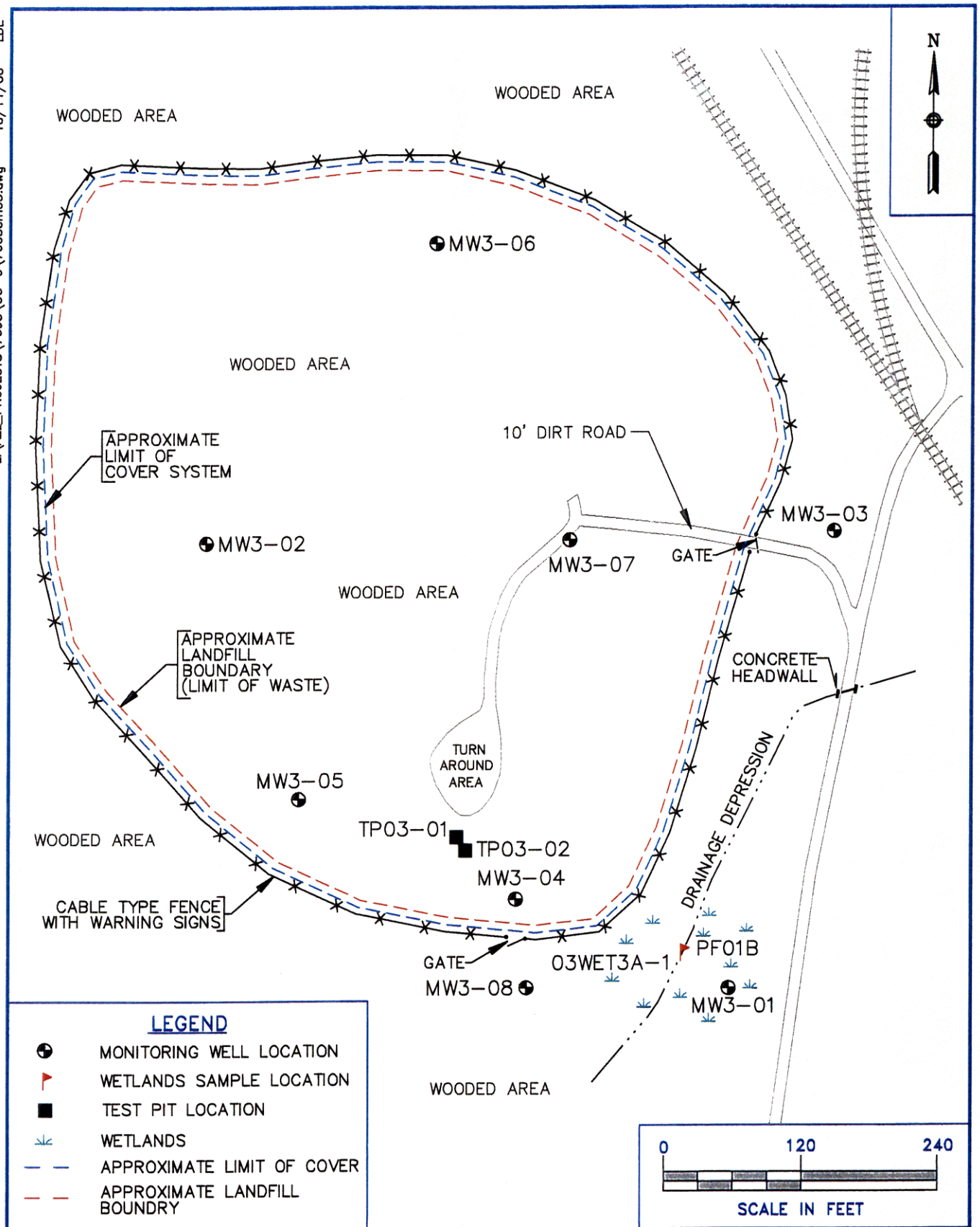
A geotechnical field evaluation of the landfill may be necessary to evaluate the stability and settling characteristics of the landfill to determine whether actions are required to minimize future differential settling of landfill contents that could damage the cover system. However, settling concerns are likely to be minimal because the landfill has been inactive since 1968.

Site Preparation - The site has not been used for many years and is moderately vegetated with grasses and pine trees. Clearing and grubbing of the vegetative growth would be necessary to prepare the site for capping. Silt fences or staked hay bales would be required to minimize erosion effects while the trees and vegetation are being removed. Silt barriers would be placed at the perimeter of the level portions of the landfill and at the toe of the landfill area to prevent silt and soil movement to downslope areas.

Site Grading - Grading of the landfill area would be required following removal of site vegetation. Compaction of the soils and landfill materials would be performed as needed. The appropriate slopes for the base of the cover (to facilitate drainage) would be determined as part of the cover system design.

Cover System Placement - A low-permeability cover system would be designed and installed to prevent human and animal exposures to landfill contaminants, to reduce infiltration and resulting metals leaching into groundwater, and to prevent migration of contaminants by wind and surface runoff. The cover design would include an impermeable layer (e.g., membrane or geocomposite clay) and generally meet RCRA Criteria for Municipal Solid Waste Landfills (40 CFR 258).

For the purpose of this focused FS, a single-barrier cover system was selected as the representative capping option. Figure 3-2 presents a plan view of conceptual design of the cover. A cross section of a conceptual cover system is presented on Figure 3-3. Descriptions of the individual cover layers are summarized as follows, from bottom to top:



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CHECKED BY DATE			OWNER NO. OU-6
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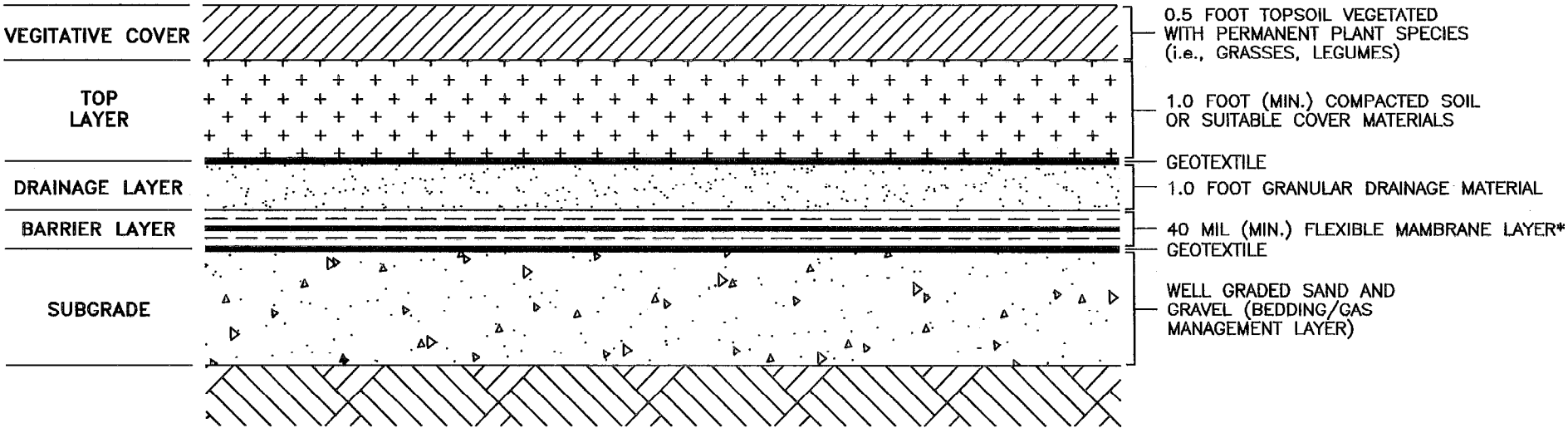

LANDFILL MATERIALS AND SOILS

* MAY SUBSTITUTE ONE FOOT OF CLAY OR EQUAL WITH MAX. PERMEABILITY OF 1.0E-07 CM/SEC

CROSS-SECTIONAL VIEW

NOTE:

NOT FOR DESIGN.

DRAWN BY LDL/EEH	DATE 10/12/00	Tetra Tech NUS, Inc.	CONCEPTUAL COVER SYSTEM DESIGN SITE 3 – ALTERNATIVE 3 FEASABILITY STUDY REPORT NAVAL WEAPONS STATION EARLE COLTS NECK, NEW JERSEY
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Subgrade - The base layer of the cover system should be a well-compacted and smooth surface of sufficient thickness to prevent puncture of the barrier layer by landfill materials. The subgrade may be a well-graded sand and gravel. A geotextile material may be used above the subgrade to separate the sand and gravel from the layers above.

Gas Vent System - A gas vent system would be installed only if a pre-design investigation concludes that one is necessary. Because the landfill has been out of use for nearly 30 years and was covered with permeable cover materials, the need for a gas venting system is not anticipated.

Barrier Layer - This layer would be designed to minimize precipitation infiltration into the landfill materials. In accordance with applicable regulations and guidance, a barrier with a maximum permeability of 1×10^{-7} cm/s, consisting of a minimum of 1 foot of compacted clay or a geomembrane at least 30 mil thick, or the equivalent, would be used.

For this FS, a geomembrane barrier would be selected as the representative barrier layer. Geomembranes can be installed more efficiently than a compacted clay layer and are less sensitive to extreme weather conditions. The geomembrane may be a flexible membrane liner (FML) composed of low-density synthetics for tolerating subsidence-induced strains. A 40-mil thick FML is proposed due to its improved survivability during construction over 30-mil FML.

Drainage Layer - A drainage layer would be installed to prevent the accumulation of water above the barrier layer that could damage the geomembrane or cause erosion of the top layer. The drainage layer would promote the removal of water to areas outside the cover. For the FS, it is assumed that a gravel drainage layer would be used to channel infiltration to toe drains located at the perimeter of the cover system. Precipitation infiltration that reaches this layer would ultimately be discharged to the wetlands north and west of the site.

Top Layer - The objective of this layer is to protect the cover from erosion by rain or wind and from burrowing animals. A minimum of 2 feet of uniform compacted soil would be placed over the drainage layer. The top layer would be vegetated with permanent plant species such as grasses and legumes to minimize erosion. Trees, woody shrubs, and other deep-rooted plants that might penetrate the low-permeability layer would be prevented from growing on the cover.

The final surface slope of the cover system should be between three percent (3V:100H) and 5 percent (5V:100H) to ensure slope stability, control erosion, and allow compaction, seeding, and revegetation of the cover materials. Side slope would not be greater than 33 percent. The final slope would also promote precipitation runoff while inhibiting erosion or infiltration. Surface run-on

and runoff controls would be required to channel run-on and runoff, via drainage swales or trenches, to surface drains located on the perimeter of the cover system for ultimate discharge to the adjacent wetlands.

The final slopes and materials to be used in the cover system would be determined during the engineering design. The capped area is expected to encompass all landfill materials.

Fencing - The entire landfill area would be fenced to limit human access to contaminated soils and landfill materials. An estimated 2,500 linear feet of strung cable-type fence would be required to encircle the landfill area. Warning signs would be suspended from the strung cable at regular intervals. The fencing would impede intrusion onto the landfill by humans and motorized vehicles. However, fencing would not restrict access to animals, birds or small, burrowing animals that may be at the greatest risk from exposure to contaminants within the landfill. Two chain link fence-type gates would provide access to the vegetative top layer for maintenance purposes. The fencing would be inspected and repaired annually.

Institutional Controls - After the construction of the cover, access restrictions would be used to significantly limit the future activities that could result in intrusion into and possible damage of the cover and accidental exposure to the landfill wastes. Restricted activities would include excavation, excessive vehicular traffic (off-road vehicles and dirt bikes), and use of untreated groundwater for drinking water.

Because site groundwater does not meet New Jersey groundwater quality standards, a CEA pursuant to N.J.A.C 7:9-6 would be established to provide the state official notice that the constituent standards will not be met for a specified duration and to ensure that use of groundwater in the affected area is suspended until standards are achieved.

Operation and Maintenance - To ensure the proper functioning and protectiveness of the cover system, routine mowing, maintenance, and repairs of the fencing, runoff and drainage systems, gas vent system (if needed), and the cover system would be required.

Long-Term Monitoring - Under Alternative 3, three new downgradient wells would be installed. The groundwater, surface water, and wetland sediment would be sampled periodically to monitor the migration of contaminants from the landfill and the potential impacts to downgradient areas. The collected data would be evaluated during the 5-year review period.

For the purpose of costing, it is assumed that groundwater samples would be collected from the three new monitoring wells, along with the eight existing monitoring wells, and the samples would be analyzed for site-specific contaminants (metals). Surface water and sediment collected from three locations within the

adjacent wetlands would be analyzed for metals. The sampling results would be evaluated to assess whether there have been changes in contaminant status and to determine whether additional response actions are warranted.

Five-Year Reviews - Because contaminants remain on the site, a review of site conditions and risks would be conducted every 5 years, as required by CERCLA. The reviews would consist of evaluation of analytical and hydrogeologic data and assessing whether contaminant migration has increased and whether human or biological receptors or groundwater resources are at risk.

3.1.3 Site 3 - Alternatives Screening

In this section, alternatives are evaluated generally with regard to effectiveness, implementability, and cost to further determine the most plausible array of remedial alternatives for Site 3. All three alternatives for Site 3 remediation have been retained for development and detailed analysis. The screening is presented in Table 3-2.

3.2 SITE 10 – DEVELOPMENT AND SCREENING OF ALTERNATIVES

This section will discuss the rationale for development of remedial action alternatives for Site 10, describe the assembled alternatives, and present the screening of alternatives. Detailed evaluations and costing of the retained alternatives are presented in Section 4.0.

3.2.1 Site 10 - Rationale for Development of Alternatives

Factors considered in formulating the remedial alternatives to achieve the RAOs for Site 10 are discussed below:

Statutory and Guidance Considerations - Navy/Marine Corps policy (as stated in the Installation Restoration Manual) dictates that the procedures outlined in the National Oil and Hazardous Substances Contingency Plan (NCP, 40 CFR 300.430) be followed for all IR sites. In accordance with this policy, alternatives were developed in compliance with statutory requirements of the NCP and in consideration of applicable EPA directives and guidance, including

- Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (Interim Final) (RI/FS Guidance), OSWER Directive No.9355.3-01, EPN/540/G-89/004, October 1988.

TABLE 3-2
SITE 3 - SCREENING OF REMEDIAL ALTERNATIVES
OU-6 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY

	ALTERNATIVE	EFFECTIVENESS	IMPLEMENTABILITY	COST	COMMENTS
1	No Action: (long-term monitoring, 5-year reviews)	Provides no additional protection of human health or the environment. Does not reduce potential for human exposure to landfill or groundwater contaminants. Does not reduce contaminant migration in the environment. No reduction in toxicity, mobility, or volume of contaminants.	Readily implementable. No technical or administrative difficulties.	Capital: none O&M: low	Retained as baseline alternative in accordance with NCP.
2	Limited Action (Cover, grading, institutional controls, access restrictions, long-term monitoring and 5-year reviews)	Provides some protection of human health through covering, fencing, and institutional controls. Restricted groundwater use. No reduction in toxicity, mobility, or volume of contaminants.	Readily implementable. No technical or administrative difficulties.	Capital: low O&M: low	Relative to Alt. 1, provides additional human health protectiveness. Retained.
3	Capping, Institutional Controls, and Long-Term Monitoring	Protects human health and the environment. Capping contaminated landfill materials prevents direct contact exposure and minimizes contaminant migration to the environment. Groundwater use would be restricted. No reduction of toxicity or volume of contaminants.	Readily implementable. No technical or administrative difficulties. Personnel and materials necessary to implement alternative are widely available.	Capital: moderate O&M: moderate	Groundwater contaminants would decrease gradually over time at a rate faster than Alternative 2. Retained.

- Presumptive Remedy for CERCLA Municipal Landfill Sites, OSWER Directive No.9355.0-49FS, September 1993.

- Application of the CERCLA Municipal Landfill Presumptive Remedy to Military Landfills (Interim Guidance), OSWER Directive No. 9355.0-62FS, April 1996.

- Conducting Remedial Investigations/Feasibility Studies for CERCLA Municipal Landfill Sites OSWER Directive No.9355.3-11, EPA/540/P-91/001, February 1991.

The NCP and the EPA RI/FS guidance present a broad framework for the formulation, evaluation, and selection of remedial alternatives for uncontrolled hazardous waste sites. The NCP encourages development of a range of alternatives, including one or more engineering control alternatives (such as containment), one or more innovative treatment alternatives, and the baseline no-action alternative. Treatment technologies are favored to address principal threats, and engineering controls are favored to address relatively low long-term threats.

In an effort to streamline the RI/FS process dictated by the NCP and RI/FS guidance, EPA has undertaken the presumptive remedies initiative to speed up selection of remedial actions at certain categories of waste sites. Presumptive remedies are preferred technologies for common categories of sites, based on historical patterns of remedy selection and EPA's scientific and engineering evaluations of performance data on technology implementation.

EPA established containment as the presumptive remedy for municipal landfills based on the expectation that containment would generally be appropriate for municipal landfill waste because the volume and heterogeneity of the waste generally make treatment impracticable (OSWER Directive No. 9355.0-9FS). Further, EPA established that the municipal landfill presumptive remedy should also be applied to all appropriate military sites (OSWER Directive No. 9355.0-62FS). Based on the criteria presented in that directive, the Site 10 landfill is an appropriate site for the application of the presumptive remedy for CERCLA municipal landfills. As such, alternatives were developed and screened in accordance with the presumptive remedy directives noted above and the guidance Conducting Remedial Investigations/Feasibility Studies for CERCLA Municipal Landfill Sites. The resulting alternatives development process was streamlined to focus on containment alternatives rather than treatment.

Protection of Human Health Considerations - The RAOs for protection of human health specify preventing potential human exposure to the contaminated landfill materials. The alternatives were formulated to meet this objective.

Protection of the Environment Considerations - The RAO for protection of the environment specifies minimizing exposure to exposed corroded metal wastes. The alternatives for Site 10 contain measures to meet this objective.

3.2.2 Site 10 - Remedial Alternatives Descriptions

This section presents detailed descriptions of the source control alternatives. As previously presented, no active groundwater response actions are anticipated based on the evaluation of current site conditions. The key components of Alternatives 1 through 3 are identified on Table 3-3.

3.2.2.1 Site 10 - Alternative 1: No Action

The no-action alternative is developed as a baseline case, as required by the NCP. The only activities conducted under this alternative are monitoring to evaluate contaminant migration and a review of site conditions and risks every 5 years. The purpose of the alternative is to evaluate the overall human health and environmental protection provided by the site in its present state. Under this alternative, no remedial actions would be taken to protect human health or the environment.

Under the no-action alternative, no measures would be implemented to prevent potential human or animal exposure to landfill materials or site groundwater or to mitigate contaminant migration to the environment. Key components of Alternative 1 are identified on Table 3-3 and described below.

Existing Features - Currently, site features offer limited protection of human health and the environment. The main protective feature is a sandy soil cover that reduces the potential for human and animal contact with landfill materials. The cover is moderately vegetated with grasses and scrub pines that serve to reduce infiltration of precipitation into landfill materials and limit surface runoff and erosion. Where present and in good condition, the vegetation may reduce precipitation infiltration and surface runoff. The cover is present over the majority of the landfill; however, erosion of the cover and exposed debris are evident on some areas of the landfill. Because no actions would be conducted under Alternative 1 to maintain or cover the landfill, the landfill surface would continue to erode, potentially exposing more landfilled materials.

3.2.2.2 Site 10 - Alternative 2: Limited Action (Institutional Controls and Access Restrictions)

Alternative 2 was developed as an option that relies on access restrictions and institutional controls to

TABLE 3-3
SITE 10 - REMEDIAL ALTERNATIVE COMPONENTS
OU-6 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY

	ALTERNATIVE	KEY COMPONENTS OF ALTERNATIVE
1	No Action	• No actions would be performed
2	Limited Action	• Fencing • Institutional Controls (land use restrictions)
3	Covering and Institutional Controls	• Pre-design investigations • Site preparation • Site grading • Pavement cover system • Fencing • Institutional controls (land use restrictions) • Long-term operation and maintenance

limit exposures to landfilled metals. This alternative does not employ treatment or containment to address site contamination.

Restrictions would be attached to the property title and/or the Base Master Plan (access restrictions) to limit future uses of the site that may result in disturbance of the existing soil cover or direct contact with landfilled materials. A fence with appropriate warning signs would be erected around the landfill to limit access to the site, to restrict human contact with landfill materials, and to protect the integrity of the existing cover. Figure 3-4 presents a plan view of conceptual design of Alternative 2. Long-term periodic inspections would be conducted to assess contaminant status and potential threats to human health and the environment. Since wasteswould be left in place, site conditions and risks would be reviewed every 5 years. Key components of Alternative 2 are identified on Table 3-3 and described below.

In the event of full or partial transfer of property, through existing legislation or through future base closure authorization, a review would be conducted to determine the suitability of any parcel for transfer of ownership.

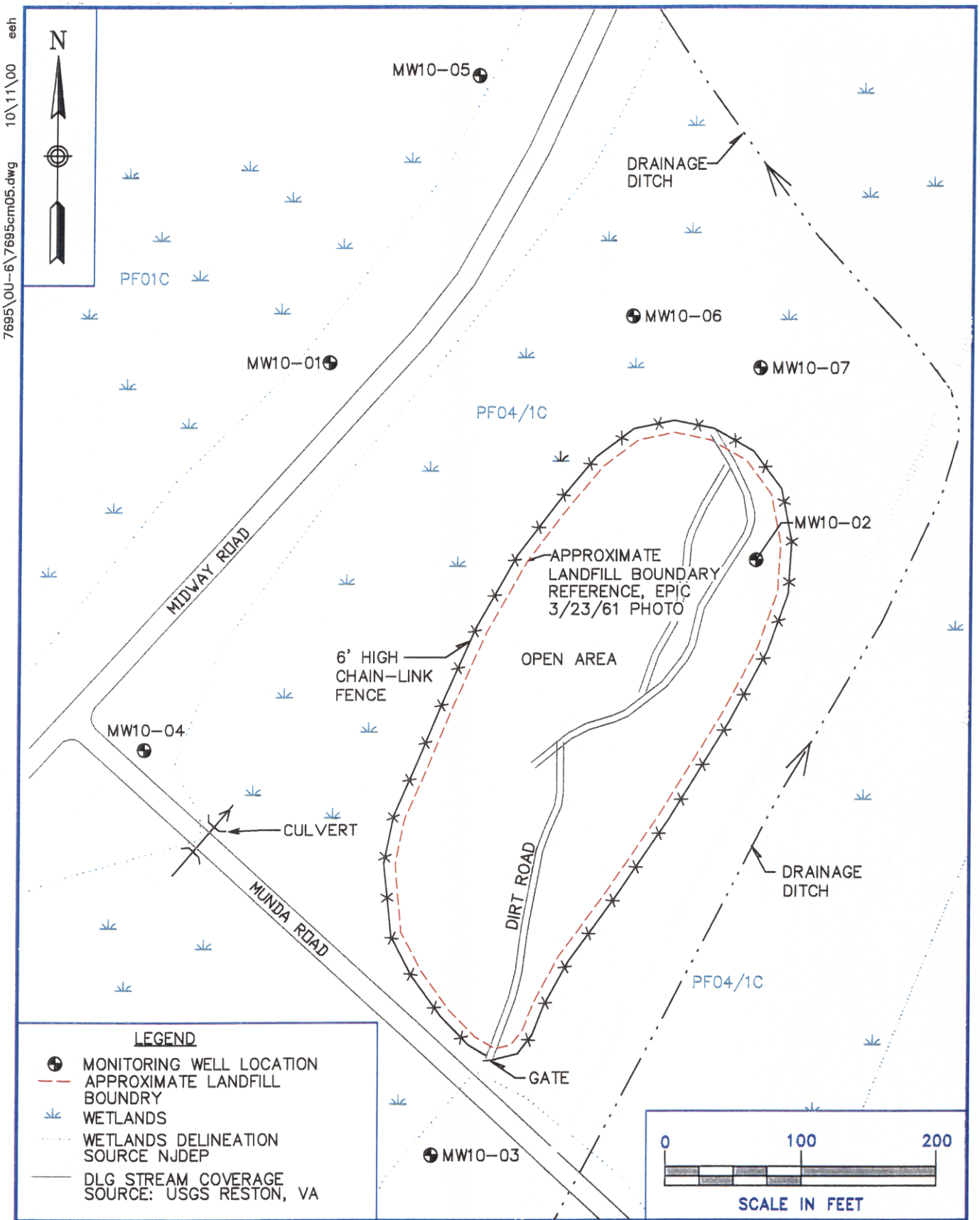
Existing Features - Because no actions would be conducted to maintain or further cover the landfill, the landfill surface would continue to erode, potentially exposing more landfill materials.

Institutional Controls - Under Alternative 2, access restrictions would be enacted to limit future use of the landfill property. Restrictions would be placed on future activities that could result in increased human exposure to contaminated landfill materials or increased erosion and contaminant migration. Restricted activities would include excavation and vehicular traffic (off-road vehicles and dirt bikes).

Fencing - The entire landfill area would be fenced to limit human access to contaminated soils and landfill materials. An estimated 1,500 linear feet of 6-foot-high chain link-type fence would be required to encircle the landfill area. The fencing would also limit animal intrusion into the landfill area, thus reducing exposure of biota to contaminated materials. However, fencing would not restrict access to birds or small, burrowing animals that may be at the greatest risk from exposure to contaminants within the landfill. One gate would provide access to the existing cover for maintenance purposes. The fencing would be inspected and repaired annually.

3.2.2.3 Site 10 - Alternative 3: Cover and Institutional Controls

Alternative 3 relies on containment and institutional controls to limit exposures to landfilled materials. Active treatment is not employed to address site contamination.



DRAWN BY EEH	DATE 10/11/00	Tetra Tech NUS, Inc.	ALTERNATIVE 2 SITE 10 SCRAP METAL LANDFILL NAVAL WEAPONS STATION EARLE COLTS NECK, NEW JERSEY	CONTRACT NO. 7695
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A pavement cover system would be used to prevent potential human and animal contact with landfill materials. The cover system would be installed over all former landfill areas of the site. Access restrictions would be enacted to limit future uses of the site that may result in disturbance of the cover or direct contact with landfill materials. Key components of Alternative 3 are identified on Table 3-3 and described below.

Pre-Design Investigations and Activities - Pre-design investigations would be conducted to collect topographic, chemical, and geologic data needed for the cover system design. A topographic survey of the site would be performed to collect accurate elevation and contour data for use in the cover system design. A limited test pit investigation would be performed to confirm the boundaries of the landfill.

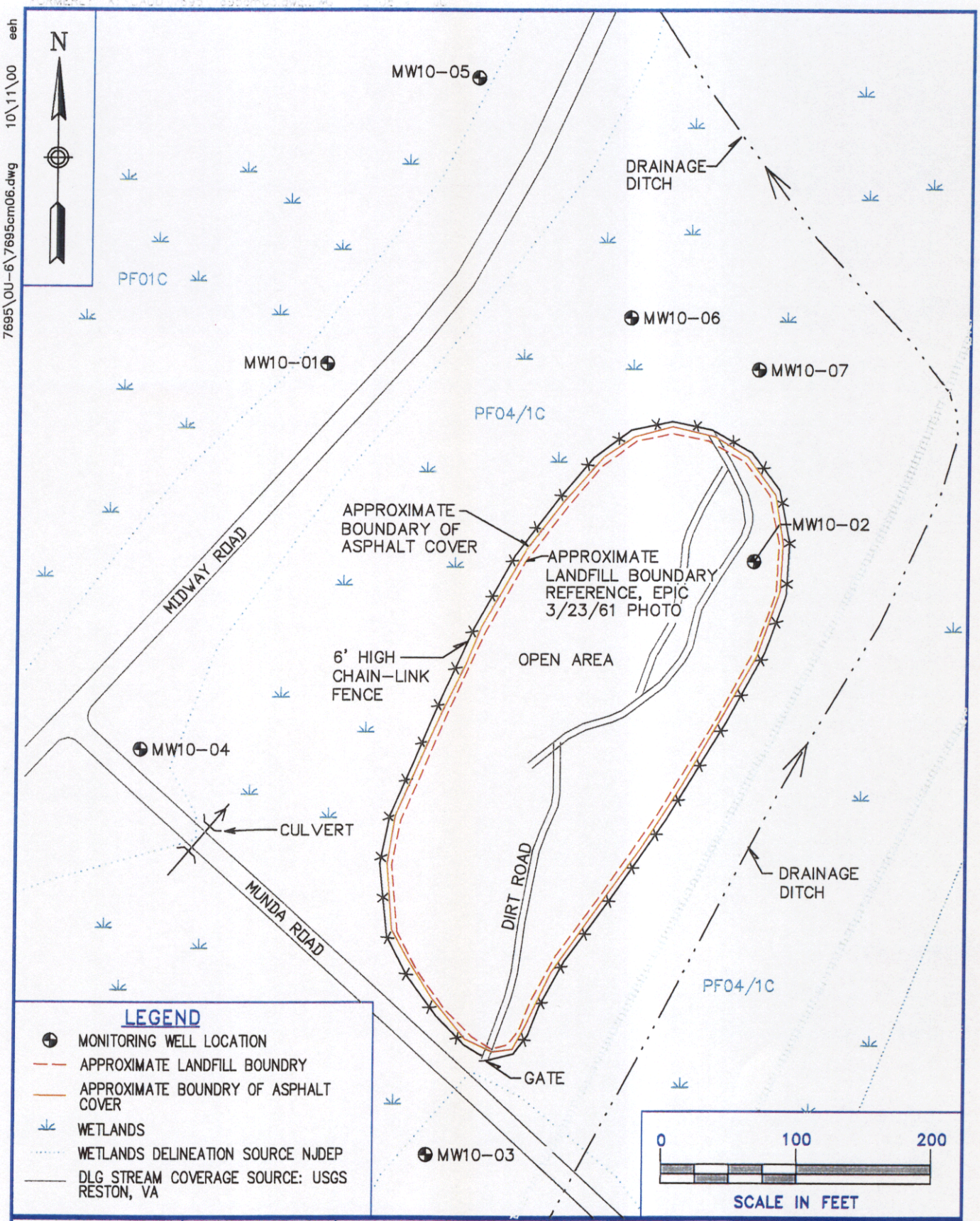
A geotechnical field evaluation of the landfill may be necessary to evaluate the stability and settling characteristics of the landfill to determine whether actions are required to minimize future differential settling of landfill contents that could damage the cover system. However, settling concerns are likely to be minimal because the landfill has been inactive since 1965.

Site Preparation - The site has not been used for many years and is moderately vegetated with grasses and pine trees. Clearing and grubbing of the vegetative growth would be necessary to prepare the site for covering. Silt fences or staked hay bales would be required to minimize erosion effects while the trees and vegetation are being removed. Silt barriers would be placed at the perimeter of the level portions of the landfill and at the toe of the landfill area to prevent silt and soil movement to downslope areas.

Site Grading - Grading of the landfill area would be required following removal of site vegetation. Compaction of the soils and landfill materials would be performed as needed. The appropriate slopes for the base of the cover (to facilitate drainage) would be determined as part of the cover system design.

Cover System Placement - A pavement cover system would be designed and installed to prevent human and animal exposures to landfill material contaminants and to prevent migration of contaminants by wind and surface runoff.

Since the waste materials disposed at Site 10 are similar to construction/demolition debris (predominantly metals and other inert materials), a pavement cover system was selected as the covering option. The landfill received primarily steel and aluminum containers. Figure 3-5 presents a plan view of conceptual design of the cover. A cross section of a conceptual cover system is presented on Figure 3-6. Descriptions of the individual cover layers are summarized as follows, from bottom to top:



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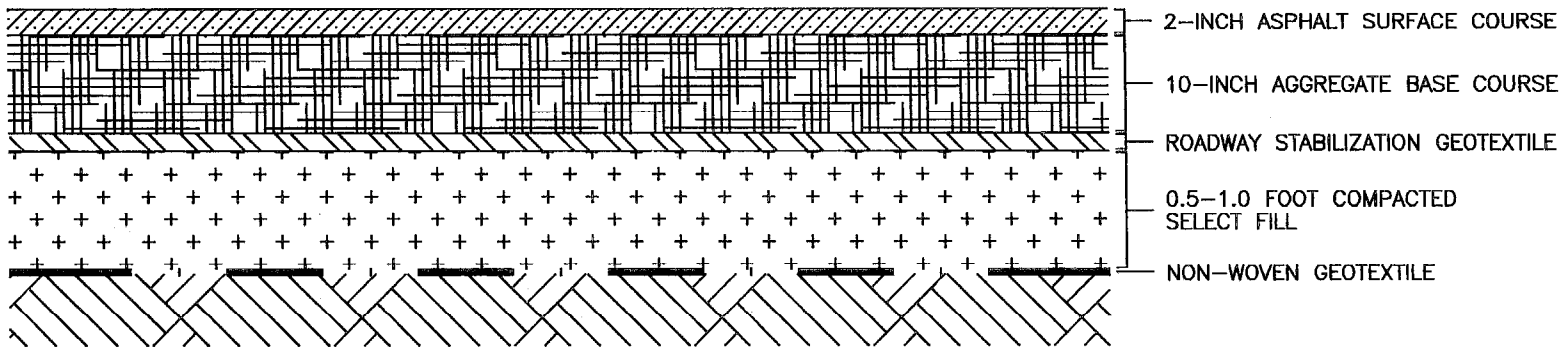

LANDFILL MATERIALS AND SOILS

CROSS-SECTIONAL VIEW

NOTE:

NOT FOR DESIGN.

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Subbase - The subbase layer of the cover system should be a well-compacted and smooth surface to provide a stabilized layer for the base layer. The subbase layer would be existing subgrade soil and/or borrow material.

Base - The base layer of the cover system should be well compacted in one or more layers and provide a smooth surface for the barrier/top layer (pavement). The base layer would be graded crushed rock, gravel, and soil cement.

Barrier/Top Layer - This surface layer would be designed to reduce precipitation infiltration into the landfill materials. The layer would be 2 inches of asphalt or the equivalent to protect the landfill from erosion by rain or wind and from burrowing animals. This cover would allow the use of the site as a storage yard while reducing the infiltration through the landfill.

The final surface slope of the cover system in the landfill area would slope gently to a series of perimeter stormwater drains. Stormwater from the paved area would be discharged to the adjacent drainageways. The final slopes and materials to be used in the cover system would be determined during the engineering design. The capped area is expected to encompass all landfill materials.

Security Fencing - Security fencing would be installed to deter human and animal entry into the landfill area. The fence is expected to be 6-foot-high chain-link fence, with galvanized steel posts installed at 8-foot intervals. A locking gate would be installed.

Institutional Controls - After the construction of the cover, access restrictions would be used to significantly limit the future activities that could result in intrusion into and possible damage of the cover and accidental exposure to the landfill materials. Restricted activities would include excavation.

Operation and Maintenance - To ensure the proper functioning and protectiveness of the cover system, routine maintenance and repairs of the fencing, runoff and drainage systems, and the cover system would be required.

3.2.3 Site 10 - Alternatives Screening

In this section, alternatives are evaluated generally with regard to effectiveness, implementability, and cost to further determine the most plausible array of remedial alternatives for Site 10. The screening is presented in Table 3-4. Alternative 1 - No action was retained in accordance with requirements of the NCP. Alternative 2 - Limited Action was eliminated because it does not meet the minimum objective to eliminate direct contact with exposed landfill contents. Alternative 3 - Covering and Institutional Controls was retained.

TABLE 3-4
SITE 10 - SCREENING OF REMEDIAL ALTERNATIVES
OU-6 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY

	ALTERNATIVE	EFFECTIVENESS	IMPLEMENTABILITY	COST	COMMENTS
1	No Action	Provides no additional protection of human health or the environment. Does not reduce potential for human exposure to landfill materials. Does not reduce contaminant migration in the environment. No reduction in toxicity, mobility, or volume of contaminants.	Readily implementable. No technical or administrative difficulties.	Capital: none O&M: none	Retained as baseline alternative in accordance with NCP. Retained.
2	Limited Action (Institutional controls and access restrictions)	Provides little added protection of human health through fencing and institutional controls. Does not reduce contaminant migration to the environment. No reduction in toxicity, mobility, or volume of contaminants.	Readily implementable. No technical or administrative difficulties.	Capital: low O&M: low	Relative to Alt. 1, provides minimal additional protectiveness for additional cost. Eliminated.
3	Covering and Institutional Controls	Protects human health and the environment Covering landfill materials prevents direct contact exposure. No reduction of toxicity or volume of contaminants.	Readily implementable. No technical or administrative difficulties. Personnel and materials necessary to implement alternative are widely available.	Capital: moderate O&M: moderate	Retained.

4.0 DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES

This section contains the detailed evaluation of the remedial alternatives that were retained after the screening of alternatives in Section 3.0. In accordance with the EPA RI/FS guidance, each alternative is evaluated with respect to seven criteria: overall protection of human health and the environment; compliance with ARARs; long-term effectiveness and permanence; reduction of toxicity, mobility, and volume through treatment; short-term effectiveness; implementability; and cost. Site 3 alternatives are evaluated in Section 4.1; Site 10 alternatives are evaluated in Section 4.2.

4.1 INDIVIDUAL ANALYSIS OF SITE 3 ALTERNATIVES

Detailed evaluations of the three Site 3 remedial alternatives retained for further evaluation are presented in this section. Detailed cost estimates and assumptions for each alternative are presented in Appendix A.

4.1.1 Site 3 - Alternative 1: No Action

The no-action alternative was developed as a baseline case, as required by the NCP. The only activities conducted under this alternative are periodic monitoring and evaluation of contaminant migration and a review of site conditions and risks every 5 years.

Overall Protection of Human Health and the Environment

The no-action alternative would not provide protection of human health or the environment. Contaminants within the landfill materials would not be remediated or isolated and would continue to pose risk and adversely impact the environment

Because precipitation would continue to infiltrate the landfill, the contaminants remaining in the landfill mass would continue to leach into the groundwater, causing continued exceedence of state GWQS and potentially affecting downgradient portions of the aquifer. Under a future residential land use scenario, exposure to contaminated groundwater beneath the site would pose potential non-carcinogenic risks at or above EPA's conservative target risk range. Alternative 1 does not include implementation of institutional controls to restrict use of contaminated groundwater in the event of future change in land or groundwater use.

The potential health risks from direct exposure to landfill contaminants were not quantified in the RI; however, it is conservatively assumed that direct exposure to landfilled materials may pose health risks to humans and animals. Presently, most of the surface is covered with soil and vegetation, but exposed debris

and scarred areas are evident on parts of the landfill. Over time, as the landfill surface erodes, more contaminated subsurface materials may be exposed and become available for direct contact, resulting in increased human health and ecological risks. Additionally, increased migration of contaminated soils to the adjacent surface water and wetlands may result from surface runoff and wind erosion.

Long-term periodic monitoring of groundwater, surface water, and sediment would make it possible to evaluate site conditions and risks. Frequency of monitoring can be set so that impacts on downgradient receptors may be identified early enough to provide additional protection of human health or the environment.

Compliance with ARARs

Alternative 1 would not comply with federal and state municipal landfill post-closure requirements [40 CFR 258.61 and N.J.A.C. 7:26-2A.9] for routine maintenance and repair of the existing cover, but it would comply with long-term monitoring requirements through the annual monitoring and evaluation of groundwater, surface water, and sediment monitoring requirements.

Because groundwater beneath Site 3 exceeds groundwater quality criteria (GWQC) specified in the New Jersey GWQS (N.J.A.C. 7:9-6] and no actions would be taken to reduce contaminant concentrations or establish a CEA, Alternative 1 would not comply with these standards.

Long-Term Effectiveness and Permanence

Since no remedial actions would occur under Alternative 1, the current and future threats to human health and the environment would remain.

The Site 3 human health risk assessment concluded that, under a future residential land use scenario, exposure to contaminated groundwater beneath the site would result in a potential non-carcinogenic risk HI greater than 1. This estimated risk exceeds the conservative EPA target risk guideline for non-carcinogenic exposure. Because no actions would be taken to reduce contaminant leaching to groundwater and no institutional controls would be implemented to prohibit use of untreated contaminated groundwater, the risk to potential future residential users of the groundwater would remain. The groundwater underlying Site 3 is not currently used as a potable water supply and there are no existing plans for its use; however, public non-community wells and domestic wells are situated elsewhere on or near NWS Earle. If site land and groundwater usage changes in the future, potential residential users of groundwater would not be protected.

The potential health risks from direct exposure to landfill contaminants were not quantified in the RI;

however, it is conservatively assumed that landfilled materials may pose health risks to humans and ecological receptors. Because this alternative includes no controls to prevent deterioration of the landfill surface, over time, surface soils would likely erode, exposing landfill materials and potentially increasing the human health and ecological risks posed by direct contact with landfill materials. Erosion of the landfill surface would also result in increased migration of contaminants to the adjacent surface water and wetlands through wind and surface runoff.

Under ambient conditions, a gradual reduction and degradation of some of the contaminants in landfill materials and site groundwater may occur; however, the process is likely to take many years. Five-year reviews would be required to assess whether threats or risks are increasing or abating with time in light of future land use or changes in the conditions at the site.

No controls would be used to manage the landfill mass under the no-action alternative; therefore, the evaluation of the adequacy and reliability of controls is not applicable.

Reduction of Toxicity Mobility, or Volume through Treatment

The no-action alternative would not reduce the toxicity, mobility, or volume of contamination through treatment, since no treatment is used to address the contaminated landfill materials.

Short-Term Effectiveness

Since no response actions would occur, implementation of the no-action alternative would not pose additional short-term risks to station personnel or the local community. Short-term risks to workers conducting long-term monitoring would be mitigated by use of appropriate procedures and personal protective equipment (PPE). Current risks would remain unabated. None of the RAOs would be achieved.

Implementability

Since no response activities would occur, the no-action alternative is readily implementable. The technical feasibility criteria, including constructibility, operability, and reliability, are not relevant to this alternative. Monitoring to assess contaminant status would pose no implementability concerns. Additional actions can be easily implemented in the future, if warranted.

Permits would not be required under Alternative 1. Coordination with other agencies may be required as part of the long-term monitoring and 5-year review processes.

Regulatory personnel and environmental specialists are readily available to perform the environmental monitoring and 5-year reviews effectively.

Cost

Capital costs for the no-action alternative total $41,400. The average annual O&M cost for long-term monitoring is $17,500 and 5-year reviews are $15,500 per event. Over a 30-year period, the net present-worth cost is $291,000 (at a 7 percent discount rate).

4.1.2 Site 3 - Alternative 2: Limited Action, Covering, Grading, Institutional Controls, and Long-Term Monitoring

Alternative 2 relies on containment and institutional controls to achieve RAOs. After limited removal of protruding landfill materials, scarred or bare areas would receive additional cover and revegetation 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. The perimeter of the landfill would be fenced and warning signs would be posted to limit access to the covered area. Access restrictions would be placed to limit future uses of the site that may result in disturbance of the soil cover or direct contact with contaminated media and to prohibit the use of untreated groundwater as drinking water. Over time, as a result of reduced leaching of contaminants from the landfill, groundwater contamination is expected to gradually decrease by chemical and physical mechanisms. Long-term, periodic monitoring and 5-year reviews would assess contaminant status and potential threats to human health and the environment. The key components of Alternative 2 are identified on Table 3-1.

Overall Protection of Human Health and the Environment

Alternative 2 would provide protection of human health and the environment by preventing direct exposure to contaminated landfill materials, reducing contaminant migration from the landfill into the environment, and instituting restrictions on use of site groundwater.

Although the potential health risks from direct exposure to landfill contaminants were not quantified in the RI, it is conservatively assumed that direct exposure to landfilled materials may pose health risks to humans and animals. These risks would be reduced by installation of additional cover over the landfill. Because the additional cover would effectively eliminate the direct exposure pathway, the direct contact risks would be eliminated, provided that the cover was properly maintained. The additional cover would also prevent contaminant migration to the environment by surface runoff and wind erosion.

Alternative 2 would also reduce the risks posed by future use of site groundwater. The human health risk assessment concluded that site groundwater poses non-carcinogenic risks exceeding EPA's target risk range under a future residential exposure scenario. Covering, grading, and revegetating bare areas of the landfill would reduce infiltration of precipitation into the landfill, thereby reducing contaminant leaching from the landfill materials to the underlying groundwater. Reducing leaching of contaminants from the landfill into the underlying groundwater would eventually result in a decrease of groundwater contaminant concentrations to acceptable levels (GWQSs), reducing the long-term risk posed by future use of site groundwater. Implementing access restrictions and establishing the site as a groundwater CEA would provide interim protection by prohibiting use of the aquifer until GWQSs are achieved.

Fencing with warning signs and access restrictions would provide additional long-term protection by limiting access to the capped area and restricting activities that could damage or intrude into the cover system and contaminated media.

The long-term periodic monitoring program would allow the responsible agency to monitor the quality of groundwater leaving the site, assess potential impacts to downgradient receptors, and determine whether additional remedial actions are necessary.

Use of engineering controls to minimize generation of fugitive dusts and vapors and proper use of PPE by site workers would effectively minimize short-term risks to the local community and workers posed by implementation of this alternative.

Compliance with ARARs

Implementation of Alternative 2 would comply with most ARARs identified in Tables 2-1 through 2-6. Alternative 2 does not include active treatment of groundwater. Initially, the groundwater beneath Site 3 would not meet the constituent concentrations specified in the New Jersey GWQS [N.J.A.C. 7:9-6]. However, covering and grading the landfill as proposed under Alternative 2 would reduce migration of contaminants into groundwater, facilitating the gradual decrease of contaminants and ultimately resulting in attainment of GWQS. Alternative 2 includes a provision to seek a temporary exemption (CEA) from these requirements until the GWQSs are achieved. The CEA would be established to provide the state official notice that the constituent standards would not be met for a specified duration and to ensure that consumption of the untreated groundwater is prohibited.

The long-term monitoring and maintenance plan proposed under this alternative would comply with federal and state municipal landfill closure and post-closure regulations [40 CFR 258.60 & 258.61 and N.J.A.C. 7:26-2A.9].

The potential effects of the proposed remediation on wetlands, floodplains, water bodies, and other sensitive receptors would be identified during the design of Alternative 2 and all necessary measures would be taken to comply with the location-specific federal and state ARARs identified in Tables 2-3 and 2-4. It is expected that Alternative 2 would easily comply with these ARARs.

Brief descriptions of the cited requirements are provided in Section 2.2 of this report.

Long-Term Effectiveness and Permanence

The risk assessment concluded that, under a future residential land use scenario, exposure to contaminated groundwater beneath the site would result in a potential HI greater than 1 for non-carcinogenic exposures. The non-carcinogenic risk estimates exceed EPA's target risk range. The covering and grading of the landfill, maintaining the cover, and implementing institutional controls to prohibit use of untreated groundwater would reduce these risks and provide long-term protection of human health.

Adding additional fill and grading/revegetating the landfill would reduce infiltration of precipitation into the landfill, thereby reducing contaminant leaching from the landfill materials to the underlying groundwater. This would ultimately result in reduced risk as groundwater contaminant concentrations decrease to acceptable levels (GWQSs) through physical and chemical mechanisms.

The groundwater underlying Site 3 is not currently used as a potable water supply and there are no existing plans for its use; however, public non-community wells and domestic wells are situated elsewhere on the station, indicating that future use of groundwater is conceivable. If site land and groundwater usage changes in the future, potential residential users of groundwater would be protected by institutional controls (access restrictions and CEA) until GWQSs are achieved.

The potential health risks from direct exposure to landfill contaminants were not quantified in the RI; however, it is conservatively assumed that direct exposure to landfilled materials may pose health risks to human and ecological receptors. This alternative would reduce the human health risk posed by direct exposure to contaminated landfill materials. Because contaminated soils and landfill materials would remain in place beneath the cover, long-term routine maintenance of the cover system and perimeter fencing would be required to ensure the long-term protectiveness of the cover. With proper maintenance, the soil cover would provide long-term protection.

Periodic monitoring and evaluation of groundwater, surface water, and sediment would allow the responsible agency to monitor the quality of groundwater beneath and leaving the site, assess potential impacts to the adjacent wetlands and downgradient receptors, and determine whether additional remedial actions are necessary. The monitoring program, in combination with the cover grading, should be effective in minimizing the risks to downgradient receptors and the environment.

Five-year reviews would be required to assess whether the cover grading is effective in preventing direct exposures and reducing contaminant leaching and whether groundwater contaminants are decreasing. These reviews would be based in large part on analytical data collected during monitoring events. The effectiveness of access restrictions and the CEA in preventing damage to the cover system and exposure to site contaminants would be reviewed.

No difficulties or uncertainties are anticipated in performing the long-term maintenance or monitoring. All materials used in placement and grading of the cover and installation of the fencing are readily available and can be replaced. In the event of damage to the soil cover, repairs would likely be performed without many difficulties. Groundwater monitoring wells may require replacement if sedimentation or damage occur; the wells would be readily replaceable.

In the event of failure or damage of the cover, existing access restrictions, institutional controls, and monitoring would provide adequate short-term protection of human health until the cover could be repaired.

Reduction of Toxicity, Mobility, or Volume through Treatment

Alternative 2 would not reduce the toxicity, mobility, or volume of contamination through treatment since no treatment is used to address the contaminated landfill materials or groundwater. However, mobility of contaminants in the landfill materials would be reduced by the removal of protruding landfill contents and placement of additional cover and revegetation of scarred or bare areas.

Short-Term Effectiveness

Implementation of Alternative 2 is not expected to pose any significant risks to station personnel or the local community. Increased truck and heavy equipment traffic would occur as the result of site preparation and the placement and grading of cover materials. Coordination and scheduling of truck and heavy equipment traffic on public roads would be required to manage increased vehicular activity.

During removal of protruding landfill contents and placement of the cover, risks posed to station personnel by fugitive dust (bearing adsorbed contaminants) would be minimized by appropriate engineering control measures such as dust suppressants. Workers who implement Alternative 2 would be adequately safeguarded by using appropriate PPE to prevent exposure to contaminated landfill materials, contaminant-laden dusts, and airborne VOCs. OSHA standards would be followed and proper PPE would be used during all remedial activities.

No permanent adverse impacts to the environment are anticipated to result from placement and grading of the additional cover. Erosion control measures such as hay bales and silt fences would be used to prevent damage to the environment from sediment runoff during cover construction.

The limited removal, cover placement, grading, revegetation, access restrictions, and establishment of the groundwater CEA would require approximately 18 months to implement, including limited pre-design and design activities. Upon completion of the cover grading, Alternative 2 would achieve the RAO for protection of human health by preventing exposure to contaminated soils and the RAO for reducing migration of contaminants to groundwater.

Implementability

Alternative 2 is implementable. No anticipated difficulties or uncertainties exist in cover placement and grading since common construction techniques are required and cover materials are available from several vendors. Long-term monitoring (sampling and analyses) only requires readily available resources. Access restrictions should not be difficult to implement and enforce, since the site is part of an active Navy base and coordination with other agencies and property owners is not necessary.

Since long-term monitoring is included under Alternative 2, contaminant presence and migration can be assessed. Monitoring of groundwater, surface water, and sediment would be effective for detecting changes in media quality that may indicate potential impacts to downgradient receptors.

Permits would not be required under Alternative 2 since all activities would be conducted on the site; however, the substantive requirements of most ARARs would be met as described previously.

The criterion of availability of treatment technologies, treatment and disposal (TAD) facilities, and capacity is not applicable.

There is ample availability of companies with the trained personnel, equipment, and materials to perform limited removal and disposal of protruding landfill contents, cover placement, and grading, install fencing,

and perform maintenance and long-term monitoring. Regulatory personnel and environmental specialists are readily available to perform 5-year reviews.

Cost

The capital costs for Alternative 3 total $627,600. The average annual O&M costs are $17,500, and 5-year reviews cost $15,500 per event. Over a 30-year period, the net present-worth cost is $878,000 (at a 7 percent discount rate).

4.1.3 Site 3 - Alternative 3: Capping, Institutional Controls, and Long-Term Monitoring

Alternative 3 relies on containment and institutional controls to achieve RAOs. A low-permeability cover system would be used 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. The perimeter of the landfill would be fenced and warning signs would be posted to limit access to the covered area. Access restrictions would be placed to limit future uses of the site that may result in disturbance of the soil cover or direct contact with contaminated media and to prohibit the use of untreated groundwater as drinking water. Over time, as a result of reduced leaching of contaminants from the landfill, groundwater contamination is expected to gradually decrease by chemical and physical mechanisms. Long-term, periodic monitoring and 5-year reviews would assess contaminant status and potential threats to human health and the environment. The key components of Alternative 3 are identified on Table 3-1.

Overall Protection of Human Health and the Environment

Alternative 3 would provide overall protection of human health and the environment by preventing direct exposure to contaminated landfill materials, reducing contaminant migration from the landfill into the environment, and instituting restrictions on use of site groundwater.

Although the potential health risks from direct exposure to landfill contaminants were not quantified in the RI, it is conservatively assumed that direct exposure to landfilled materials may pose health risks to humans and animals. These risks would be reduced by installation of a cover system over the landfill. Because the cover would effectively eliminate the direct exposure pathway, the direct contact risks would be eliminated, provided that the cover was properly maintained. The cover system would also prevent contaminant migration to the environment by surface runoff and wind erosion.

Alternative 3 would also reduce the risks posed by future use of site groundwater. The human health risk

assessment concluded that site groundwater poses non-carcinogenic risks exceeding EPA's target risk range under a future residential exposure scenario. Capping the landfill with a low-permeability cover system would significantly reduce infiltration of precipitation into the landfill, thereby reducing contaminant leaching from the landfill materials to the underlying groundwater. Reducing leaching of contaminants from the landfill into the underlying groundwater would eventually result in a decrease of groundwater contaminant concentrations to acceptable levels (GWQSs), reducing the long-term risk posed by future use of site groundwater. Implementing access restrictions and establishing the site as a groundwater CEA would provide interim protection by prohibiting use of the aquifer until GWQSs are achieved.

Fencing with warning signs and access restrictions would provide additional long-term protection by limiting access to the capped area and restricting activities that could damage or intrude into the cover system and contaminated media.

The long-term periodic monitoring program would allow the responsible agency to monitor the quality of groundwater leaving the site, assess potential impacts to downgradient receptors, and determine whether additional remedial actions are necessary.

Use of engineering controls to minimize generation of fugitive dusts and vapors and proper use of PPE by site workers would effectively minimize short-term risks to the local community and workers posed by implementation of this alternative.

Compliance with ARARs

Implementation of Alternative 3 would comply with all ARARs identified in Tables 2-1 through 2-6. Because Alternative 3 does not include active treatment of groundwater, initially, the groundwater beneath Site 3 would not meet the constituent concentrations specified in the New Jersey GWQS (N.J.A.C. 7:9-6]. However, capping the landfill as proposed under Alternative 3 would reduce migration of contaminants into groundwater, ultimately resulting in attainment of GWQS. Alternative 3 includes a provision to seek a temporary exemption (CEA) from these requirements until the GWQS are achieved. The CEA would be established to provide the state official notice that the constituent standards would not be met for a specified duration and to ensure that consumption of the untreated groundwater is prohibited.

The single-barrier cover system and long-term monitoring and maintenance plan proposed under this alternative would comply with federal and state municipal landfill closure and post-closure regulations [40 CFR 258.60 & 258.61 and N.J.A.C. 7:26-2A.9].

The potential effects of the proposed remediation on wetlands, floodplains, water bodies, and other sensitive receptors would be identified during the design of Alternative 3 and all necessary measures would be taken to comply with the location-specific federal and state ARARs identified in Tables 2-3 and 2-4. It is expected that Alternative 3 would easily comply with these ARARs.

Brief descriptions of the cited requirements are provided in Section 2.2 of this report.

Long-Term Effectiveness and Permanence

The risk assessment concluded that, under a future residential land use scenario, exposure to contaminated groundwater beneath the site would result in a potential carcinogenic risk of 3.4 E-04 and an HI of 3.2 for non-carcinogenic exposures. These non-carcinogenic risk estimates exceed EPA's target risk range. Capping the landfill, maintaining the cap, and implementing institutional controls to prohibit use of untreated contaminated groundwater would reduce these risks and provide long-term protection of human health.

Capping the landfill with a low-permeability cover system would significantly reduce infiltration of precipitation into the landfill, thereby reducing contaminant leaching from the landfill materials to the underlying groundwater. Containing the source of groundwater contamination would ultimately result in reduced risk as groundwater contaminant concentrations decrease to acceptable levels (GWQSs) through physical and chemical mechanisms.

The groundwater underlying Site 3 is not currently used as a potable water supply and there are no existing plans for its use; however, public non-community wells and domestic wells are situated elsewhere on or near NWS Earle, indicating that future use of groundwater is conceivable. If site land and groundwater usage changes in the future, potential residential users of groundwater would be protected by institutional controls (access restrictions and CEA) until GWQSs are achieved.

The potential health risks from direct exposure to landfill contaminants were not quantified in the RI; however, it is conservatively assumed that direct exposure to landfilled materials may pose health risks to human and ecological receptors. Alternative 3 would reduce the human health risk posed by direct exposure to contaminated landfill materials. Because contaminated soils and landfill materials would remain in place beneath the cover, long-term routine maintenance of the cover system and perimeter fencing would be required to ensure the long-term protectiveness of the cover. With proper maintenance, the cover system would provide long-term protection.

Periodic monitoring and evaluation of groundwater, surface water, and sediment would allow the responsible agency to monitor the quality of groundwater beneath and leaving the site, assess potential impacts to the adjacent wetlands and downgradient receptors, and determine whether additional remedial actions are necessary. The monitoring program, in combination with the cover system, should be effective in minimizing the risks to downgradient receptors and the environment.

Five-year reviews would be required to assess whether the cover system is effective in preventing direct exposures and reducing contaminant leaching. These reviews would be based in large part on analytical data collected during monitoring events. Review of the effectiveness of access restrictions and the CEA in preventing damage to the cover system and exposure to site contaminants would also be required.

No difficulties or uncertainties are anticipated in performing the long-term maintenance or monitoring. All materials used in construction of the enhanced cover system and fencing are readily available and can be replaced. In the event of damage to the cap system, repairs would likely be performed without many difficulties. Groundwater monitoring wells may require replacement if sedimentation or vandalism occur; the wells would be readily replaceable.

Because maintenance of the cover system would be continual, catastrophic failure is unlikely. In the event of failure or damage of the cover, existing access restrictions, institutional controls, and monitoring would provide adequate short-term protection of human health until the cover system could be repaired.

Reduction of Toxicity, Mobility, or Volume through Treatment

Alternative 3 would not reduce the toxicity, mobility, or volume of contamination through treatment since no treatment is used to address the contaminated landfill materials or groundwater. However, mobility of contaminants in the landfill materials would be reduced by the cover system.

Short-Term Effectiveness

Implementation of Alternative 3 is not expected to pose any significant risks to station personnel or the local community. Increased truck and heavy equipment traffic would occur as the result of site preparation and the import and placement of capping materials. Coordination and scheduling of truck and heavy equipment traffic on public roads would be required.

During site preparation and placement of the cap system, risks posed to station personnel by fugitive dust (bearing adsorbed contaminants) would be minimized by appropriate engineering control measures such as dust suppressants. Workers who implement Alternative 3 would be adequately safeguarded by using

appropriate PPE to prevent exposure to contaminated landfill materials, contaminant-laden dusts, and airborne VOCs. OSHA standards would be followed and proper PPE would be used during all remedial activities.

No permanent adverse impacts to the environment are anticipated to result from construction of the enhanced cap system. Erosion control measures such as hay bales and silt fences would be used to prevent damage to the environment from sediment runoff during cap construction.

The cap system placement would require approximately 18 months to implement, including pre-design and design activities. Upon completion of the cap, Alternative 3 would achieve the RAO for protection of human health by preventing exposure to contaminated soils and the RAO for reducing migration of contaminants to groundwater. Implementing access restrictions and establishing the groundwater CEA may take a year or longer.

Implementability

Alternative 3 is implementable. No anticipated difficulties or uncertainties exist in constructing the enhanced cover system since common construction techniques are required and cover materials are available from several vendors. Long-term monitoring (sampling and analyses) only requires readily available resources. Access restrictions should not be difficult to implement and enforce, since the site is part of an active Navy base and coordination with other agencies and property owners is not necessary.

Since long-term monitoring is included under Alternative 3, contaminant presence and migration can be assessed. Monitoring of groundwater, surface water, and sediment would be effective for detecting changes in media quality that may indicate cap failure and for identifying potential impacts to downgradient receptors.

Permits would not be required under Alternative 3 since all activities would be conducted on the site; however, the substantive requirements of all ARARs would be met as described previously.

The criterion of availability of treatment technologies, TSD facilities, and capacity is not applicable.

There is ample availability of companies with the trained personnel, equipment, and materials to perform site preparation, construct the cover system, install fencing, and perform maintenance and long-term monitoring. Regulatory personnel and environmental specialists are readily available to perform 5-year reviews.

Cost

The capital costs for Alternative 3 total $4,962,100. The average annual O&M costs are $20,400, and 5-year reviews cost $15,500 per event. Over a 30-year period, the net present-worth cost is $5,249,000 (at a 7 percent discount rate).

4.1.4 Comparative Analysis of Site 3 Alternatives

As part of the detailed analysis, comparisons of the remedial alternatives are made to identify differences among the alternatives and how site contaminant threats are addressed. The three alternatives are compared with respect to each of the evaluation criteria and differences are identified. Table 4-1 presents summaries of the evaluations for each alternative.

Overall Protection of Human Health and the Environment

Alternatives 2 and 3 would be protective of human health and the environment. Because no actions are conducted, Alternative 1 would not reduce human health or ecological risk and would not reduce contaminant migration to the environment. Because no actions would be taken under Alternative 1 to contain contaminants or prevent deterioration of the landfill surface, health risks and adverse impacts to the environment are expected to remain the same or increase over time.

Alternative 2 is protective of human health and the environment. The institutional controls would reduce human health risks posed by contact with landfilled materials and would provide assurance that untreated contaminated groundwater is not used as a potable water source in the future.

Alternative 3 is most protective of human health and the environment. The enhanced cover system would reduce human health and ecological risks posed by contact with landfilled materials and would significantly reduce infiltration through landfill materials and leaching of contaminants to groundwater, thereby reducing contaminant migration into the environment. Routine maintenance of the landfill cover system would ensure its long-term protectiveness. Institutional controls would provide assurance that untreated contaminated groundwater is not used as a potable water source in the future.

Compliance with ARARs

Because Alternative 1 does not include any remedial actions, it would not comply with state and federal ARARs pertaining to post-closure of municipal landfills [40 CFR 258.60 & 258.61 and N.J.A.C. 7:26-2A.9]. Alternative 2 would comply with some of these requirements. Alternative 3 would comply with these

TABLE 4-1
SITE 3 - COMPARATIVE ANALYSIS OF REMEDIAL ACTION ALTERNATIVES
0U-6 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY

CRITERION:	ALTERNATIVE 1: NO ACTION	ALTERNATIVE 2: LIMITED ACTION, COVER, GRADING, INSTITUTIONAL CONTROLS, AND LONG-TERM MONITORING	ALTERNATIVE 3: CAPPING, INSTITUTIONAL CONTROLS, AND LONG-TERM MONITORING
OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT			
Prevent Human Exposure to Contaminated Soils and Landfilled Materials	No action would be taken to prevent human exposure to contaminated soils and landfilled materials. Existing risks would remain. Continued deterioration of the landfill surface would expose more contaminated soils and landfilled materials and result in increased direct exposure risks.	Fencing with warning signs would reduce the potential for direct contact with contaminated soils and landfilled materials. Limited removal of protruding landfill contents, additional soil cover, and revegetation of scarred areas would inhibit contact with landfill contents.	Cover system would prevent direct contact with contaminated soils and landfilled materials.
Prevent Human Exposure to Metal Contaminants in Groundwater	No action would be taken to prevent human exposure to contaminated groundwater. Non-carcinogenic risks exceeding EPA's target risk range would remain. No actions would be taken to reduce contaminant leaching to groundwater. No institutional controls would be implemented to prohibit use of untreated groundwater.	Institutional controls would minimize potential exposure to site groundwater by prohibiting its use. In time, a gradual reduction of contaminants in groundwater due to decreased infiltration and continued dissipation/dilution would occur.	Institutional controls would minimize potential exposure to site groundwater by prohibiting its use. The cover system would reduce leaching of contaminants to groundwater. In time, contaminant concentrations would decrease due to dissipation and dilution.
Minimize Contaminant Migration	No actions would be taken to reduce contaminant leaching to groundwater. Contaminants would continue to leach into groundwater and migrate.	Additional soil cover, grading and revegetation would help to reduce migration of contaminants by surface water and wind erosion and would reduce contaminant leaching to groundwater. However, contaminants may continue to leach into groundwater and migrate.	A cover system would reduce leaching of contaminants to groundwater and would reduce migration of contaminants to the environment by surface water and wind erosion.

TABLE 4-1
SITE 3 - COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES
0U-6 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY

CRITERION:	ALTERNATIVE 1: NO ACTION	ALTERNATIVE 2: LIMITED ACTION, COVER, GRADING, INSTITUTIONAL CONTROLS, AND LONG-TERM MONITORING	ALTERNATIVE 3:CAPPING, INSTITUTIONAL CONTROLS, AND LONG-TERM MONITORING
COMPLIANCE WITH ARARs			
Chemical-Specific ARARs	Would not comply with state groundwater quality standards.	Groundwater contaminant concentrations would initially exceed state GWQS; over time, GWQS would be achieved by dissipation/dilution. A CEA would be established to provide the state official notification that standards would not be met for a specified duration.	Groundwater contaminant concentrations would initially exceed state GWQS; over time, GWQS would be achieved by dissipation/dilution. A CEA would be established to provide the state official notification that standards would not be met for a specified duration.
Location-Specific ARARs	Not applicable	Would comply with federal and state ARARs for wetlands, floodplains, and other sensitive receptors.	Would comply with federal and state ARARs for wetlands, floodplains, and other sensitive receptors.
Action-Specific ARARs	Would not comply with federal or state ARARs for post-closure maintenance of municipal landfills.	Would not comply with federal or state ARARs for post-closure maintenance of municipal landfills.	Would comply with federal and state ARARs for closure and post-closure of municipal landfills.
LONG-TERM EFFECTIVENESS AND PERMANENCE			
Magnitude of Residual Risk	Existing (HI greater than 1) non-carcinogenic risk from exposure to site groundwater would remain. Increased direct contact risk would be anticipated over time as landfill surface deteriorates.	Existing risks would remain. Institutional controls would preclude use of groundwater. Over time, assuming reduced infiltration and no new waste disposal in the former landfill, concentrations of metals in groundwater downgradient of the site would be expected to decrease.	Existing risks would remain. Institutional controls would preclude use of groundwater in the vicinity. Over time, assuming reduced infiltration and no new waste disposal in the former landfill, concentrations of metals downgradient of the site would be expected to decrease.

TABLE 4-1
SITE 3 - COMPARATIVE ANALYSES OF REMEDIAL ALTERNATIVES
OU-6 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY

CRITERION:	ALTERNATIVE 1: NO ACTION	ALTERNATIVE 2: LIMITED ACTION, COVER, GRADING, INSTITUTIONAL CONTROLS, AND LONG-TERM MONITORING	ALTERNATIVE 3: CAPPING, INSTITUTIONAL CONTROLS, AND LONG-TERM MONITORING
Adequacy and Reliability of Controls	No new controls would be implemented. Existing site features provide limited controls.	If implemented and enforced, institutional controls could prevent damage to the cover, intrusion into contaminated materials, and use of contaminated groundwater.	If properly maintained, the cap system would be reliable for preventing exposure and reducing contaminant migration to the environment. If implemented and enforced, institutional controls could prevent damage to the cap, intrusion into contaminated materials, and use of contaminated groundwater.
Need for 5-Year Review	Review would be required since soil and groundwater contaminants would be left in place.	Same as Alternative 1	Same as Alternative 1
REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT			
Reduction of Toxicity, Mobility, or Volume Through Treatment	No reduction, since no treatment would be employed.	No reduction, since no treatment would be employed.	No reduction, since no treatment would be employed.
SHORT-TERM EFFECTIVENESS			
Community Protection	No risk to community is anticipated.	No significant risk to community anticipated. Engineering controls would be used during implementation to mitigate risks.	No significant risk to community is anticipated. Engineering controls would be used during implementation to mitigate risks.
Worker Protection	No risk to workers is anticipated if proper PPE is used during long-term monitoring.	No risk to workers is anticipated if proper PPE is used during fence installation and long-term monitoring.	No significant risk to workers is anticipated if proper PPE is used during remediation and long-term monitoring.
Environmental Impacts	No adverse impacts to the environment are anticipated.	No adverse impacts to the environment are anticipated.	No significant impacts to the environment are anticipated. Engineering controls would be used during implementation to mitigate risks.
Time Until Action is Complete	Not applicable	Approximately 1 year to cover and grade the landfill and to institute CEA.	Approximately 1.5 years to install the cap and institute CEA.

TABLE 4-1
SITE 3 - COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES
0U-6 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY

CRITERION:	ALTERNATIVE 1: NO ACTION	ALTERNATIVE 2: LIMITED ACTION, COVER, GRADING, INSTITUTIONAL CONTROLS, AND LONG-TERM MONITORING	ALTERNATIVE 3: CAPPING, INSTITUTIONAL CONTROLS, AND LONG-TERM MONITORING
IMPLEMENTABILITY			
Ability to Construct and Operate	No construction or operation would be involved.	No difficulties are anticipated. Fencing, limited removal/off-station disposal, soil cover placement, grading, and revegetation are readily implementable technologies.	No difficulties are anticipated. Capping is a readily implementable technology.
Ease of Doing More Action if Needed	Additional actions would be easily implemented if required.	Additional actions would be easily implemented if required.	If additional actions are warranted, the cover system may need to be opened to access contaminated materials.
Ability to Monitor Effectiveness	Monitoring would provide assessment of potential exposures, contaminant presence, migration, or changes in site conditions.	Same as Alternative 1	Same as Alternative 1
Ability to Obtain Approvals and Coordinate with Other Agencies	Coordination for 5-year reviews may be required and would be obtainable.	Coordination for 5-year reviews may be required and would be obtainable. Coordination with the state would be required to establish a CEA and would be obtainable.	Coordination for 5-year reviews may be required and would be obtainable. Coordination with the state would be required to establish a CEA and would be obtainable.
Availability of Treatment, Storage Capacities, and Disposal Services	None required	Same as Alternative 1	Same as Alternative 1
Availability of Equipment, Specialists, and Materials	Personnel and equipment would be available for implementation of long-term monitoring and 5- year reviews.	Equipment and personnel are available to install fencing and perform long-term maintenance, monitoring, and 5-year reviews.	Equipment and personnel are available to construct cap and perform long-term maintenance, monitoring, and 5-year reviews.
Availability of Technology	Not required	Common construction techniques and materials would be required for construction.	Common construction techniques and materials would be required for cap construction.

TABLE 4-1
SITE 3 - COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES
OU-6 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY
PAGE 5 OF 5

CRITERION:	ALTERNATIVE 1: NO ACTION	ALTERNATIVE 2: LIMITED ACTION, COVER, GRADING, INSTITUTIONAL CONTROLS, AND LONG-TERM MONITORING	ALTERNATIVE 3: CAPPING, INSTITUTIONAL CONTROLS AND LONG-TERM MONITORING
COST			
Capital Cost	$41,400	$627,600	$4,962,100
First-Year Annual O&M Cost	$17,500	$17,500	$20,400
Five-Year Reviews	$15,500	$15,500	$15,500
Present Worth Cost*	$291,000	$878,000	$5,249,000

* Present-worth cost is based on discount rate of 7 %.

requirements since an enhanced cover system would be installed and a long-term maintenance and repair program would be implemented.

All three alternatives would comply with federal and state long-term monitoring requirements through periodic monitoring and evaluation of groundwater, surface water, and sediments.

Alternative 1 would not comply with state ARARs for attainment of groundwater quality standards (N.J.A.C. 7:9-61). Alternatives 2 and 3 would comply by seeking a temporary exemption (CEA) from these requirements until the GWQS are achieved.

Long-Term Effectiveness and Permanence

Alternatives 2 and 3 offer substantial long-term protection of human health and the environment. Under Alternative 1, risks would remain the same or increase over time as the landfill surface erodes because no additional actions would be taken to contain wastes and limit deterioration of the landfill surface. Potential future users of site groundwater may be at risk under Alternative 1 because it lacks institutional controls that would prohibit use of untreated contaminated groundwater.

Alternative 2 would reduce human risks due to ingestion of site groundwater by reducing the potential for exposure. Long-term risks due to ingestion of site groundwater would be reduced by implementing institutional controls to prohibit use of untreated, contaminated groundwater.

Alternative 3 would reduce human and ecological risks due to direct exposure to landfilled materials by eliminating the potential for exposure. Long-term risks due to ingestion of site groundwater would be mitigated by significantly reducing contaminant leaching into groundwater and by implementing institutional controls to prohibit use of untreated contaminated groundwater.

Reduction of Toxicity, Mobility, or Volume through Treatment

Because none of the alternatives includes treatment, they would not reduce the toxicity, mobility, or volume through treatment. Alternative 3 would reduce the mobility of landfill contaminants by significantly reducing precipitation infiltration.

Short-Term Effectiveness

The short-term effectiveness of the three alternatives would be similar since the use of appropriate engineering controls and PPE is expected to minimize adverse impacts to station residents and

personnel, the local community, and workers during implementation.

Long-term monitoring, which would provide little opportunity for short-term impact, is the only on-site action proposed under Alternative 1. Alternatives 2 and 3 would present a greater opportunity for short-term impact due to site preparation and grading and construction of the enhanced cover system (Alternative 3 only).

Impacts to the environment are not anticipated under Alternative 1 since minimal activities would be conducted. Impacts to the environment would be minimized under Alternative 2 and 3 by use of erosion and stormwater control measures during site work.

Alternative 1 would not achieve any of the RAOs. Alternative 2 would achieve some of the RAOs within approximately 1 year, which would be the time to perform limited removal of protruding landfill contents, place, grade, and revegetate additional soil cover, install the fencing, and implement the CEA. Alternative 3 would achieve all RAOs within approximately 1.5 years, which would be the time to design and install the proposed cover and to implement the CEA.

Implementability

Alternative 1 is the most easily implemented since the only activities proposed are long-term monitoring and 5-year reviews. Alternative 2 would be more difficult to implement since it would involve removal of protruding landfill contents, placement, grading, and revegetating additional soil cover, the installation of fencing, and implementation of the CEA; however, no difficulties are anticipated, since common installation techniques are required and materials are available from several vendors. Alternative 3 would be most difficult to implement since it involves the construction of an enhanced cover system over several acres of land; however, no difficulties are anticipated, since common construction techniques are required and cover materials are available from several vendors.

If additional actions are warranted, they could be easily implemented under Alternatives 1 and 2. Additional actions could be implemented under Alternative 3; however, opening the cover system to access contaminated materials may be required.

Cost

The costs associated with each alternative are provided in Table 4-1. Alternative 1, no action, would cost the least and Alternative 2, limited action would cost more than Alternative 1 but less to implement than Alternative 3.

4.2 INDIVIDUAL ANALYSIS OF SITE 10 ALTERNATIVES

Detailed evaluations of the two Site 10 remedial alternatives (1 and 3) retained for further evaluation are presented in this section. Detailed cost estimates and assumptions for each alternative are presented in Appendix A.

4.2.1 Site 10 - Alternative 1: No - Action

The no-action alternative was developed as a baseline case, as required by the NCP. There will be no activities conducted under this alternative.

Overall Protection of Human Health and the Environment

The no-action alternative would not provide protection of human health or the environment. Contaminants within the landfill materials would not be remediated or isolated and would continue to pose risk and adversely impact the environment.

The potential health risks from direct exposure to landfill contaminants were not quantified in the RI; however, it is conservatively assumed that direct contaminated landfill materials may pose health risks to humans and animals. Currently, the landfill surface is a wooded area, moderately vegetated with scrub pines and grasses; cover materials are reported to be thin in some areas with landfilled materials exposed at the edge of the landfill. Because Alternative 1 does not include measures to prevent deterioration of the landfill surface, over time, surface soils would erode, particularly in the sparsely vegetated areas, exposing additional subsurface materials and potentially increasing the human health and ecological risks posed by direct contact with landfilled materials.

Compliance with ARARs

Alternative 1 would not comply with federal and state municipal landfill post-closure requirements (40 CFR 258.61 and N.J.A.C. 7:26-2A9] for routine maintenance and repair of the existing cover.

Long-Term Effectiveness and Permanence

Since no remedial actions would occur under Alternative 1, the current and future threats to human health and the environment would remain.

The Site 10 human health risk assessment concluded that, under a future residential land use scenario, exposure to contaminated groundwater beneath the site would result in a potential carcinogenic risk of 6.7E-05 and an HI of 0.65 for non-carcinogenic exposures. These risk estimates are within EPA's target risk range.

The potential health risks from direct exposure to landfill contaminants were not quantified in the RI; however, it is conservatively assumed that landfilled materials may pose health risks to humans and ecological receptors. Because this alternative includes no controls to prevent deterioration of the landfill surface, over time, surface soils could erode, exposing landfilled materials and potentially increasing the human health and ecological risks posed by direct contact with landfilled materials.

Reduction of Toxicity, Mobility, or Volume through Treatment

The no-action alternative would not reduce the toxicity, mobility, or volume of contamination through treatment, since no treatment is used to address the contaminated landfill materials.

Short-Term Effectiveness

Since no response actions would occur, implementation of the no-action alternative would not pose additional short-term risks to station personnel or the local community. Current risks would remain unabated. None of the RAOs would be achieved.

Implementability

Since no response activities would occur, the no-action alternative is readily implementable. The technical feasibility criteria, including constructibility, operability, and reliability, are not relevant to this alternative. Additional actions can be easily implemented in the future, if warranted. Permits would not be required under Alternative 1.

Cost

There are no costs are associated with the no-action alternative.

4.2.2 Site 10 - Alternative 3: Covering, Institutional Controls

Alternative 3 relies on containment and institutional controls to achieve RAOs. A cover system would be installed over the area of former active landfill operations to prevent potential human and animal contact

with contaminants in the landfilled materials, reduce contaminant leaching to groundwater, and minimize contaminant migration via surface runoff and erosion. Access restrictions would be employed to limit future uses of the site that may result in direct contact with contaminated media and to prohibit the use of untreated groundwater as drinking water.

Routine inspection and maintenance of the entire landfill surface would be conducted to ensure the integrity of the existing and new cover systems. The key components of Alternative 3 are identified on Table 3-3.

Overall Protection of Human Health and the Environment

Alternative 3 would provide overall protection of human health and the environment by preventing direct exposure to landfill materials and reducing contaminant migration from the landfill into the environment.

Although the potential health risks from direct exposure to landfill materials were not quantified in the RI, it is conservatively assumed that direct exposure to landfilled materials may pose health risks to humans and animals. Direct exposure risks would be reduced by installation of a pavement cover system over the landfill and long-term inspection and maintenance of the landfill surface. Because the properly maintained cover system would effectively eliminate the direct exposure pathway, the direct contact risks would be eliminated by implementation of Alternative 3. The cover system would also prevent further erosion of the landfill surface and reduce contaminant migration to the environment by surface runoff and wind erosion.

Access restrictions would also provide additional long-term protection by limiting access to the capped area and restricting activities that could intrude into the cover system and contaminated media.

Use of engineering controls to minimize generation of fugitive dusts and vapors and proper use of PPE by site workers would effectively minimize short-term risks to the local community and workers posed by implementation of this alternative.

Compliance with ARARs

Implementation of Alternative 3 would comply with all ARARs identified in Tables 2-1 through 2-6.

The cover system and maintenance plan proposed under Alternative 3 would comply with federal and state construction/demolition debris landfill closure and post-closure regulations (40 CFR 258.60 & 258.61 and N.J.A.C. 7:26-2A.9].

The potential effects of the proposed remediation on wetlands, floodplains, water bodies, and other sensitive receptors would be identified during the design of Alternative 3 and all necessary measures would be taken to comply with the location-specific federal and state ARARs identified in Tables 2-3 and 2-4. It is expected that Alternative 3 would easily comply with these ARARs.

Brief descriptions of the cited requirements are provided in Section 2.2 of this report.

Long-Term Effectiveness and Permanence

The potential health risks from direct exposure to landfill contaminants were not quantified in the RI; however, it is conservatively assumed that direct exposure to landfilled materials may pose health risks to human and ecological receptors. Covering the Site 10 landfill would reduce the human health risk posed by direct exposure to contaminated landfill materials. Because landfill materials would remain in place beneath the cover, long-term routine maintenance of the new pavement cover system would be required to ensure its long-term protectiveness. With proper maintenance, the cover system would effectively provide long-term protection of human health and the environment

No difficulties or uncertainties are anticipated in performing the long-term maintenance. All materials used in construction of the pavement cover system are readily available and can be replaced. In the event of damage to the cap system, repairs would likely be performed without many difficulties.

Because maintenance of the cover system would be continual, catastrophic failure is unlikely. In the event of failure or damage of the cover, institutional controls would provide adequate short-term protection of human health until the cover system can be repaired.

Reduction of Toxicity, Mobility, or Volume through Treatment

Alternative 3 would not reduce the toxicity, mobility, or volume of contamination through treatment since no treatment is used to address the contaminated landfill materials or groundwater. However, mobility of contaminants in the landfill materials would be further reduced by placement of the pavement cover over the landfill.

Short-Term Effectiveness

Implementation of Alternative 3 is not expected to pose any significant risks to station personnel or the local community. Increased truck and heavy equipment traffic would occur as the result of site preparation and the import and placement of covering materials. Coordination and scheduling of truck

and heavy equipment traffic on public roads would be required.

During site preparation and placement of the cover system, risks posed to station personnel by fugitive dust would be minimized by appropriate engineering control measures such as dust suppressants. Workers who implement Alternative 3 would be adequately safeguarded by using appropriate PPE to prevent exposure to contaminated landfill materials and contaminant-laden dusts. OSHA standards would be followed and proper PPE would be used during all remedial activities.

No permanent adverse impacts to the environment are anticipated to result from construction of the pavement cover system. Erosion control measures such as hay bales and silt fences would be used to prevent damage to the environment from sediment runoff during cover construction.

The pavement cover placement would require approximately 18 months to implement, including pre-design and design activities. Upon completion of the cover, Alternative 3 would achieve the RAO for protection of human health by preventing exposure to landfilled materials.

Implementability

Alternative 3 is implementable. No anticipated difficulties or uncertainties exist in constructing the pavement cover since common construction techniques are required and cover materials are available from several vendors. Access restrictions should not be difficult to implement and enforce, since the site is part of an active Navy base and coordination with other agencies and property owners is not necessary.

Permits would not be required under Alternative 3 since all activities would be conducted on the site; however, the substantive requirements of all ARARs would be met, as described previously.

The criterion of availability of treatment technologies, TSD facilities, and capacity is not applicable.

There is ample availability of companies with the trained personnel, equipment, and materials to perform site preparation, construct the pavement cover, and perform maintenance.

Cost

The capital costs for Alternative 3 total $676,000. Repaving the cap every 10 years would cost $35,400. Over a 30-year period, the net present-worth cost is $703,000 (at a 7 percent discount rate).

4.2.3 Comparative Analysis of Site 10 Alternatives

As part of the detailed analysis, comparisons of the remedial alternatives are made to identify differences between the alternatives and how site contaminant threats are addressed. The two alternatives are compared with respect to each of the evaluation criteria and differences are identified. Table 4-2 presents summaries of the evaluations for each alternative.

Overall Protection of Human Health and the Environment

Only Alternative 3 would be protective of human health and the environment. Because no actions are conducted, Alternative 1 would not reduce human health or ecological risk and would not reduce contaminant migration to the environment. Health risks and adverse impacts to the environment are expected to remain the same or increase over time.

Alternative 3 is protective of human health and the environment. The pavement cover would reduce human health and ecological risks posed by contact with landfilled materials. Routine maintenance of the landfill cover would ensure its long-term protectiveness.

Compliance with ARARs

Because Alternative 1 does not include any remedial actions, it would not comply with state and federal ARARs pertaining to post-closure of municipal or demolition debris landfills (40 CFR 258.60 & 258.61andN.J.A.C. 7:26-2A.9].

Alternative 3 would comply with these requirements since a pavement cover would be installed and a long-term maintenance and repair program would be implemented, consistent with what would typically be required for a demolition debris landfill.

Long-Term Effectiveness and Permanence

Alternative 3 is the only alternative that offers long-term protection of human health and the environment. Because no additional actions would be taken under Alternative 1 to contain wastes and limit deterioration of the landfill surface, risks would increase over time as the landfill surface erodes. Potential future users of the site may be at risk under Alternative 1 because it lacks features to limit contact with landfill contents. Alternative 3 would reduce human and ecological risks due to direct exposure to landfilled materials by eliminating the potential for exposure. Long-term risks due to ingestion of site groundwater would decrease by reducing contaminant leaching into groundwater.

TABLE 4-2
SITE 10- COMPARATIVE ANALYSIS OF REMEDIAL ACTION ALTERNATIVES
0U-6 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY

CRITERION:	ALTERNATIVE 1: NO ACTION	ALTERNATIVE 3: CAPPING, INSTITUTIONAL CONTROLS, AND NATURAL ATTENUATION
OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT		
Prevent Human Exposure to Landfill Materials	No action would be taken to prevent human exposure to landfilled materials. Existing risks would remain. Continued deterioration of the landfill surface, particularly the edge of the landfill, would expose more landfilled materials and result in increased direct exposure risks.	New cover system over the landfill would prevent direct contact with contaminated materials. Risks would be reduced by installing the new pavement cover and maintaining the new cover.
COMPLIANCE WITH ARARs		
Chemical-Specific ARARs	Not applicable	Not applicable
Location-Specific ARARs	Not applicable	This alternative would comply with federal and state ARARs for wetlands, floodplains, and other sensitive receptors.
Action-Specific ARARs	This alternative would not comply with federal or state ARARs for post-closure maintenance of municipal landfills.	This alternative would comply with federal and state ARARs for closure and post-closure of construction/demolition debris landfills.
LONG-TERM EFFECTIVENESS AND PERMANENCE		
Magnitude of Residual Risk	Increased risk would be anticipated over time as landfill surface deteriorates, especially along edge of landfill.	Installation of the new cover, maintenance of the new cover, and implementation of access restrictions to prevent intrusion into landfilled materials would reduce direct exposure risks.
Adequacy and Reliability of Controls	No new controls would be implemented. Existing site features provide limited controls.	If properly maintained, the cover system would be reliable for preventing exposure and reducing contaminant migration to the environment. If implemented and enforced, institutional controls could prevent damage to the cover, and intrusion into landfilled materials.
Need for 5-Year Review	Review would be required since soil and groundwater contaminants would be left in place.	Same as Alternative 1.
REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT		
Reduction of Toxicity, Mobility, or Volume Through Treatment	No reduction, since no treatment would be employed.	Leaching of landfill contents to groundwater would be reduced.

TABLE 4-2
SITE 10 COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES
OU-6 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY
PAGE 2 OF 2

CRITERION:	ALTERNATIVE 1: NO ACTION	ALTERNATIVE 3: CAPPING, INSTITUTIONAL CONTROLS, AND NATURAL ATTENUATION
SHORT-TERM EFFECTIVENESS		
Community Protection	No risk to community is anticipated.	No significant risk to community is anticipated. Engineering controls would be used during implementation to mitigate risks.
Worker Protection	No risk to workers is anticipated.	No significant risk to workers is anticipated if proper PPE is used during cover construction.
Environmental Impacts	No adverse impacts to the environment are anticipated.	No significant impacts to the environment are anticipated. Engineering controls would be used during implementation to mitigate risks.
Time Until Action is Complete	Not applicable	18 months until new paved cover is in place.
IMPLEMENTABILITY		
Ability to Construct and Operate	No construction or operation is involved.	No difficulties are anticipated. Paving is a readily implementable technology.
Ease of Doing More Action if Needed	Additional actions would be easily implemented if required.	If additional actions are warranted in the landfill, the pavement cover system may need to be opened to access landfilled materials within.
Ability to Monitor Effectiveness	No monitoring is involved.	Same as Alternative 1
Ability to Obtain Approvals and Coordinate with Other Agencies	Not applicable	Coordination with the state would be required to establish a CEA and would be obtainable.
Availability of Treatment, Storage Capacities, and Disposal Services	None required	Same as Alternative 1
Availability of Equipment, Specialists, and Materials	Not applicable	Ample availability of equipment and personnel to construct paved cover and perform long-term maintenance.
Availability of Technology	Not required	Common construction techniques and materials required for pavement construction.
COST		
Capital Cost	$0	$676,000
First-Year Annual O&M Cost	$0	$0
Repaving every 10 years	$0	$35,400
Present Worth Cost*	$0	$703,000

* Present-worth cost is based on discount rate of 7 %.

Reduction of Toxicity, Mobility, or Volume through Treatment

Because neither of the alternatives includes treatment, neither would reduce the toxicity, mobility, or volume through treatment. Alternative 3 would reduce the mobility of landfill contaminants by reducing precipitation infiltration into the landfill.

Short-Term Effectiveness

The short-term effectiveness of the two alternatives would be similar since the use of appropriate engineering controls and PPE is expected to minimize adverse impacts to station residents and personnel, the local community, and workers during implementation. There is no on-site action proposed under Alternative 1. Alternative 3 would present a greater opportunity for short-term impact due to site preparation, grading, and constructing the cover system.

Impacts to the environment are not anticipated under Alternative 1 since no activities would be implemented. Impacts to the environment would be minimized by implementing erosion and storm water control measures during pavement cover construction under Alternative 3.

Alternative 1 would not achieve any of the RAOs. Alternative 3 would achieve all RAOs within approximately 1 year, including design and installation of the pavement cover and implementation of the CEA.

Implementability

Each of the alternatives would be implementable. Alternative 1 is easily implemented since no activities are proposed. Alternative 3 would be more difficult to implement since it involves the construction of a pavement cover over several acres of land; however, no difficulties are anticipated, because pavement covers are a commonly applied technology involving conventional construction methods and cover materials are available from several vendors.

If additional actions are warranted, they could be easily implemented under Alternative 1. Under Alternative 3, additional actions could be easily implemented; however, opening the cover system to access contaminated materials may be required.

Cost

The costs associated with each alternative are provided in Table 4-2. Alternative 1, no action, would cost less to implement than Alternative 3.

APPENDIX A

COSTS

ASSUMPTIONS
ESTIMATED COSTS FOR REMEDIAL ALTERNATIVES
OU-6 (SITE 3)

The following major assumptions were made in estimating the cost of the alternatives for Site 3.

- Installation of the monitoring wells will be difficult due to the presence of wetlands, which are located immediately adjacent to the site. The cost of well installation was adjusted accordingly.

- The landfill boundaries that the cost estimate are based on, have not been field verified, therefore they should be viewed as uncertain.

- No detailed topography exists for this site. In order to estimate the amount of regrading required to achieve minimum grades for cost estimation purposes, relative topography was assumed based on field observations. The regrading volumes based on the assumed topography are very uncertain and can have a significant effect the cost estimate.

- It is assumed that the landfill cap can be designed to not permanently encroach on the wetland area, although a wetland borders a portion of the landfill. It is assumed that construction of a replacement wetland will not required.

- Perimeter ditches are assumed to surround the site to control surface water runon and runoff from the cap surface.

- Time to construct Alternative 2 was assumed to be 1 month.

- Time to construct Alternative 3 was assumed to be 6 months.

- All construction cost at normal safety levels. No additional cost included for safety upgrade.

- Access to site not heavily restricted due to station security.

CALCULATION WORKSHEET Order No. 19116 (01-91)

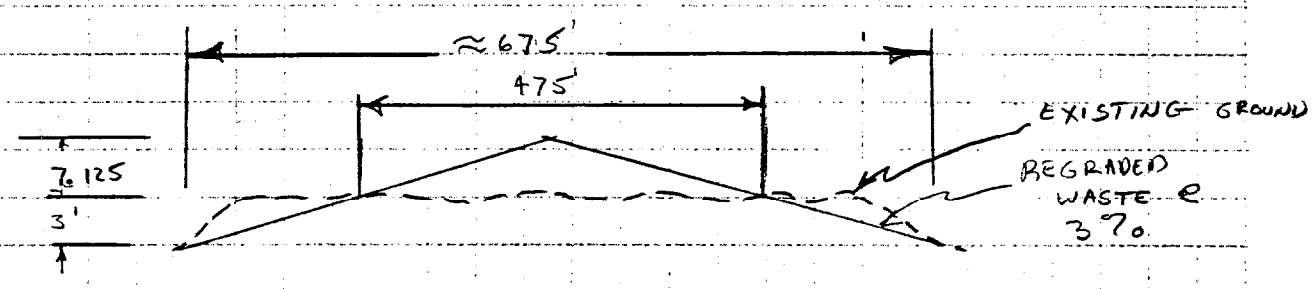
CLIENT NWS EARLE	JOB NUMBER 7695
SUBJECT SITE 3 FS COST ESTIMATE	
BASED ON	DRAWING NUMBER

BY	CHECKED BY	APPROVED BY	DATE
DCW 11/24/97	MJW 12/3/97		

PURPOSE: ESTIMATE QUANTITIES FOR COST ESTIMATE FOR ALTERNATIVE 3 CAPPING

1. AREA OF LANDFILL CAP – USE A PLANIMETER TO ESTIMATE THE AREA OF THE LANDFILL CAP BASED ON FIGURE 6-1 IN THE RI. THE AREA IS APPROXIMATELY 8.0 ACRES.

2. VOLUME OF REGRADED WASTE CONTOURS AND ELEVATIONS ARE NOT AVAILABLE FOR THIS SITE. TO ESTIMATE THE AMOUNT OF REGRADING AND IMPORTED FILL MATERIAL, THE EXISTING GROUND ELEVATIONS WILL BE ASSUMED BASED ON DISCUSSIONS WITH PERSONNEL WHO HAVE SEEN THE SITE.



VOLUME OF WASTE CUT

– ASSUME SITE IS CIRCULAR

AVERAGE VOLUME IS EXCAVATION AREA X AVERAGE DEPTH

ASSUME AVG DEPTH $3'/2 = 1.5'$

AREA $= \pi(328)^2 - \pi(238)^2 = 180956$ SF

VOLUME $= 180956 \cdot 1.5 = 271433$ CF $= 10{,}053$ C.Y.

VOLUME OF WASTE FILL VOLUME OF CONE $= \frac{1}{3} h r^2 \pi$

$\frac{1}{3}(7.125)(238)^2\pi/27 = 15653$ C.Y.

CLIENT		JOB NUMBER	
SUBJECT SITE 3			
BASED ON		DRAWING NUMBER	
BY DCW 11/24/97	CHECKED BY MJW 12/3/97	APPROVED BY	DATE

ASSUME 10,000 C.Y WASTE CUT
ASSUME 6,000 C.Y. IMPORT FILL
16,000 C.Y PLACE AND COMPACT

ONCE THE ACTUAL TOPOGRAPHY IS KNOWN, THE ACTUAL GRADES MAY ALLOW A CUT/FILL BALANCE. IMPORTING FILL WILL BE A CONSERVATIVE ASSUMPTION FOR COSTING PURPOSES.

3. CLEAR AND GRUBB

ASSUME CLEARED AND GRUBBED AREA IS APPROXIMATELY 25% LARGER THAN THE SIZE OF THE LANDFILL.
1.25 X 8.0 = 10 AC

4. STORM DRAINAGE SYSTEM

ASSUME A PERIMETER DITCH WILL BE EXCAVATED AROUND THE LANDFILL. THE DITCHES WILL BE 2200 FT LONG AND BE APPROXIMATELY 2' DEEP WITH A CROSS SECTIONAL AREA OF 16 ft^2

- ASSUME CHANNELS ARE LINED WITH 6" OF TOPSOIL
  (6/12 X 12' WIDE X 2200') 1/27 = 490 C.Y. TOPSOIL
- ASSUME PERMANENT DETENTION STRUCTURES ARE NOT REQUIRED

5. CAP COMPONENTS

- 12" GAS MANAGEMENT LAYER
  1' X 8.0 X 43560/27 = 12,907 C.Y.

- 40 MIL VFPE (SMOOTH)
  8.0 X 43560 = 348,480 SF

CLIENT		JOB NUMBER	
SUBJECT SITE 3			
BASED ON		DRAWING NUMBER	
BY	CHECKED BY MJW 12/3/97	APPROVED BY	DATE

— CUSHION FABRIC (12 oz)
8.0 X 43560/9 = 38720 S.Y.

— 12" DRAINAGE LAYER = 12,907 C.Y.

— NON-WOVEN GEOTEXTILE = 38720 S.Y.

— 12" SELECT FILL = 12,907 C.Y.

— 6" TOP SOIL = 6453 C.Y.
0.5 x 8 x 43560/27

— GAS VENTS ASSUME ≈ 1/ACRE = 8 USE 10 TO BE CONSERVATIVE

— SEEDING 10 AC · 43560/1000 =

6. FENCE

ASSUME 6' HIGH CHAIN LINK FENCE 2500 LF

7. SEDIMENT CONTROL MEASURES

ASSUME THAT SEDIMENT BASINS AND SILT FENCE WILL BE REQUIRED

ASSUME 2500 LF OF SILT FENCE

VOLUME OF SEDIMENT BASIN SHOULD BE THE RUNOFF VOLUME OF THE 2-YEAR, 24-HR STORM (DURING CONSTRUCTION CONDITIONS) PLUS THE SEDIMENT STORAGE CAPACITY.

THE RUNOFF VOLUME FROM THE 2-YEAR STORM IS GIVEN BY THE FOLLOWING CALCULATION:

CURVE NUMBER FOR BARE SOIL, TYPE B SOIL IS 86
(TR-55 MANUAL)

CLIENT	JOB NUMBER		
SUBJECT SITE 3			
BASED ON	DRAWING NUMBER		
BY DCW 11/24/97	CHECKED BY MJW 12/3/97	APPROVED BY	DATE

THE 2-YEAR STORM, 24-HOUR TYPE III STORM HAS 3.4 INCHES OF RAINFALL

FROM FIGURE 2-1 OF THE TR-55 MANUAL THE RUNOFF DEPTH IS 2.0 INCHES

THE RUNOFF VOLUME IS $2''/12 \cdot 8 \cdot 43560 = 58{,}000$ CF

- SEDIMENT STORAGE VOLUME IS GIVEN BY 0.07 AC-FT PER ACRE PER YEAR OF CONSTRUCTION. (ASSUME 1 YEAR TO CONSTRUCT)
(STANDARD SPEC FOR E/S CONTROL IN N.J.)

$8 \times 0.07 = 0.56$ AC-FT OR 24,400 CF

TOTAL VOLUME OF SEDIMENT BASINS 82,400 CF
OR 3,051 C.Y.

ASSUME THAT 3,051 C.Y. ARE EXCAVATED WITH THE EXCAVATED MATERIAL USED TO CONSTRUCT EARTH BERMS WHICH WILL GIVE THE SEDIMENT BASINS THE REQUIRED FREEBOARD ABOVE THE MINIMUM VOLUME.

THEREFORE EXCAVATE 3050 C.Y
PLACE AND COMPACT 3050 C.Y.

OUTLET STRUCTURE(S) BASED ON PREVIOUS WORK ASSUME $5000

CLIENT	JOB NUMBER		
SUBJECT SITE 3			
BASED ON	DRAWING NUMBER		
BY DCW 11/24/97	CHECKED BY MJW 12/3/97	APPROVED BY	DATE

8. PRE-DESIGN STUDIES

a) TOPOGRAPHIC MAPPING — ASSUME 12 ACRES OF COVERAGE, MOSTLY WITH LIGHT TO MEDIUM BRUSH/TREES

$ 15,000

b) GEOTECHNICAL INVESTIGATION

$ 6000

c) WETLAND DELINEATION $ 5000

d) TEST PIT EXCAVATION $15,000

9. ALTERNATIVE 2 LIMITED ACTION SPOT REGRADING

ASSUME THAT FILL WILL BE IMPORTED TO FILL LOW SPOTS WITHIN THE LIMIT OF THE LANDFILL AT SITE 3 TO IMPROVE DRAINAGE. ASSUME THAT THE SITE WILL NOT BE CLEARED AND GRUBBED BUT FILL PLACED AROUND TREES.

ASSUME 6" OF FILL ARE REQUIRED TO BE IMPORTED OVER THE WHOLE LANDFILL.

IMPORT FILL = 8.0 AC × 93560 × $\frac{6''}{12}$ /27 = 6453 C.Y.
PLACE COMPACT = 6453 C.Y.

ASSUME SEEDING OF 3/4 OF LANDFILL
3/4 × 8.0 × 93560 /1000 = 261.3 MSF

NAVAL WEAPONS STATION EARLE
Colts Neck, New Jersey
Operable Unit 6 (Site 3)
Alternative 1 - No Action
Capital Cost Summary

Prepared by JSR

Checked by DCW

	ITEM	SUBCONTRACTED	MATERIAL	LABOR	EQUIPMENT	TOTAL
1	MONITORING WELL INSTALLATION	$16,000	$0	$0	$0	$16,000
2	OVERSIGHT	$0	$0	$3,700	$0	$3,700
		$16,000	$0	$3,700	$0	$19,700
	Overhead on Labor Cost @ 30%			$1,110		$1,110
	G & A on Labor @ 10%			$370		$370
	G & A on Material Cost @ 10%		$0			$0
	G & A on Subcontract Cost @ 10%	$1,600				$1,600
	Total Direct Cost	$17,600	$0	$5,180	$0	$22,780
	Indirects on Total Direct Labor Cost @ 75%			$3,885		$3,885
	Profit on Total Direct Cost @ 10%					$2,278
						$28,943
	Health and Safety Monitoring @ 10%					$2,894
	Total Field Cost					$31,837
	Contingency on Total Field Cost @ 20%					$6,367
	Engineering on Total Field Cost @ 10%					$3,184
	TOTAL COST					$41,388

NAVAL WEAPONS STATION EARLE
Colts Neck, New Jersey
Operable Unit 6 (Site 3)
Alternative 1 - No Action
Capital Cost

Prepared by DK
Checked by NCW

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Total Cost Subcontract	Total Cost Material	Total Cost Labor	Total Cost Equipment	Total Direct Cost	Comments
1 MONITORING WELL INSTALLATION												
1.1 Well Installation	1	ls	$15,000.00				$15,000	$0	$0	$0	$15,000	3 wells/25' deep
1.2 Well Survey	1	ls	$1,000.00				$1,000	$0	$0	$0	$1,000	
							$16,000	$0	$0	$0	$16,000	
2 OVERSIGHT												
2.1 Engineering Oversight	1	ls			$3,700.00		$0	$0	$3,700	$0	$3,700	for one week
							$0	$0	$3,700	$0	$3,700	

NAVAL WEAPONS STATION EARLE
Colts Neck, New Jersey
Operable Unit 6 (Site 3)
Alternative 1 - No Action
Annual Cost

Prepared by TSR

Checked by DCW

Item	Item Cost Annually	Item Cost per 5 Years	Notes
Sampling	$9,300		Collect three surface water samples, three sediment samples and eleven groundwater samples, per sampling period, plus travel, living and shipping cost
Analysis/Water	$3,200		Twenty water samples, per sampling period, (including blanks & duplicates for each medium) metals
Analysis/Sediment	$960		Six sediment samples, per sampling period, (including blanks & duplicates for each medium) metals
Annual Report	$4,000		Ten hours per sampling report plus other direct cost
Site Review		$15,500	Review of Site Conditions by 3 Engineers for Years 5, 10, 15, 20, 25, 30
TOTALS	$17,460	$15,500	

NAVAL WEAPONS STATION EARLE
Colts Neck, New Jersey
Operable Unit 6 (Site 3)
Alternative 1 - No Action
Present Worth Analysis

Prepared by

Checked by

Year	Capital Cost	Annual Cost	Total Year Cost	Annual Discount Rate at 7%	Present Worth
0	$41,388		$41,388	1.000	$41,388
1		$17,460	$17,460	0.935	$16,325
2		$17,460	$17,460	0.873	$15,243
3		$17,460	$17,460	0.816	$14,247
4		$17,460	$17,460	0.763	$13,322
5		$32,960	$32,960	0.713	$23,500
6		$17,460	$17,460	0.666	$11,628
7		$17,460	$17,460	0.623	$10,878
8		$17,460	$17,460	0.582	$10,162
9		$17,460	$17,460	0.544	$9,498
10		$32,960	$32,960	0.508	$16,744
11		$17,460	$17,460	0.475	$8,294
12		$17,460	$17,460	0.444	$7,752
13		$17,460	$17,460	0.415	$7,246
14		$17,460	$17,460	0.388	$6,774
15		$32,960	$32,960	0.362	$11,932
16		$17,460	$17,460	0.339	$5,919
17		$17,460	$17,460	0.317	$5,535
18		$17,460	$17,460	0.296	$5,168
19		$17,460	$17,460	0.277	$4,836
20		$32,960	$32,960	0.258	$8,504
21		$17,460	$17,460	0.242	$4,225
22		$17,460	$17,460	0.226	$3,946
23		$17,460	$17,460	0.211	$3,684
24		$17,460	$17,460	0.197	$3,440
25		$32,960	$32,960	0.184	$6,065
26		$17,460	$17,460	0.172	$3,003
27		$17,460	$17,460	0.161	$2,811
28		$17,460	$17,460	0.150	$2,619
29		$17,460	$17,460	0.141	$2,462
30		$32,960	$32,960	0.131	$4,318
				TOTAL PRESENT WORTH	**$291,468**

NAVAL WEAPONS STATION EARLE
Colts Neck, New Jersey
Operable Unit 6 (Site 3)
Alternative 2 - Limited Action
Capital Cost Summary

Prepared by TJR

Checked by DCW

	ITEM	SUBCONTRACTED	MATERIAL	LABOR	EQUIPMENT	TOTAL
1	PRE-DESIGN INVESTIGATION	$3,000	$0	$0	$0	$3,000
2	MOBILIZATION/SITE SUPPORT/DEMOBILIZATION	$9,456	$4,000	$1,548	$1,500	$16,504
3	DECONTAMINATION FACILITIES & SERVICES	$3,200	$10,361	$1,086	$90	$14,738
4	SITE MANAGEMENT STAFFING	$0	$0	$17,257	$0	$17,257
5	LANDFILL REGRADING	$0	$27,349	$43,203	$99,639	$170,191
6	SITE RESTORATION	$56,925	$6,998	$1,970	$1,881	$67,774
7	POST CONSTRUCTION SUBMITTALS	$15,000	$0	$5,000	$0	$20,000
		$87,581	$48,707	$70,064	$103,111	$309,464
	Overhead on Labor Cost @ 30%			$21,019		$21,019
	G & A on Labor @ 10%			$7,006		$7,006
	G & A on Material Cost @ 10%		$4,871			$4,871
	G & A on Subcontract Cost @ 10%	$8,758				$8,758
	Total Direct Cost	$96,339	$53,578	$98,090	$103,111	$351,118
	Indirects on Total Direct Labor Cost @ 75%			$73,568		$73,568
	Profit on Total Direct Cost @ 10%					$35,112
						$459,798
	Health and Safety Monitoring @ 5%					$22,990
	Total Field Cost					$482,787
	Contingency on Total Field Cost @ 20%					$96,557
	Engineering on Total Field Cost @ 10%					$48,279
	TOTAL COST					$627,624

NAVAL WEAPONS STATION EARLE
Colts Neck, New Jersey
Operable Unit 6 (Site 3)
Alternative 2 - Limited Action
Capital Cost

Prepared by TJR
Checked by DCW

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Total Cost Subcontract	Total Cost Material	Total Cost Labor	Total Cost Equipment	Total Direct Cost	Comments
1 PRE-DESIGN INVESTIGATION												
1.1 Topographic Survey (includes new well locations)	1	ls	$3,000.00				$3,000	$0	$0	$0	$3,000	
							$3,000	$0	$0	$0	$3,000	
2 MOBILIZATION/SITE SUPPORT/DEMOBILIZATION												
2.1 Office Trailer	1	mo	$181.00				$181	$0	$0	$0	$181	
2.2 Storage Trailer	1	mo	$95.00				$95	$0	$0	$0	$95	
2.3 Portable Communication Equipment	1	sets	$1,500.00				$1,500	$0	$0	$0	$1,500	
2.4 Equipment Mob/Demob	2	ea			$54.00	$250.00	$0	$0	$108	$500	$608	
2.5 Site Utilities Hook-up	1	ls	$3,000.00				$3,000	$0	$0	$0	$3,000	
2.6 Site Utilities	1	mo	$4,000.00				$4,000	$0	$0	$0	$4,000	
2.7 Portable Toilet (2)	2	mo	$90.00				$180	$0	$0	$0	$180	
2.8 Pick-up Truck	1	mo	$500.00	$100.00			$500	$100	$0	$0	$600	
2.9 Access Road	1	ls		$3,000.00	$1,000.00	$1,000.00	$0	$3,000	$1,000	$1,000	$5,000	
2.10 Silt Fence	2000	lf		$0.45	$0.22		$0	$900	$440	$0	$1,340	
							$9,456	$4,000	$1,548	$1,500	$16,504	
3 DECONTAMINATION FACILITIES & SERVICES												
3.1 Decon Pad												
a) 4" sand	12.4	cy		$25.00			$0	$310	$0	$0	$310	10 mile haul
b) 6' stone	18.5	cy		$15.00			$0	$278	$0	$0	$278	
c) Railroad Ties (6'*8'*8')	20	ea		$27.83	$12.60	$2.40	$0	$557	$252	$48	$857	pressure treated
d) Geotextile 170 mil nonwoven	123	sy		$2.77	$0.46	$0.03	$0	$341	$57	$4	$401	
3.2 Laundry Service	4	wk	$250.00				$1,000	$0	$0	$0	$1,000	
3.3 Decontamination Service	1	mo	$1,200.00				$1,200	$0	$0	$0	$1,200	
3.4 Purchase Decon Water	5000	gal	$0.20				$1,000	$0	$0	$0	$1,000	
3.5 Clean Water Storage Tank	1	ea		$3,000.00	$300.00		$0	$3,000	$300	$0	$3,300	
3.6 Spent Water Storage	1	ea		$5,000.00	$400.00		$0	$5,000	$400	$0	$5,400	
3.7 Rock Construction Entrance												
a) Grade (dozer)	19	cy			$0.20	$0.67	$0	$0	$4	$13	$17	
b) Stone (import) 3/4" to 1 1/2"	19	cy		$23.05			$0	$438	$0	$0	$438	10 mile haul
c) Install Stone 8" thick	19	cy			$1.85	$0.35	$0	$0	$35	$7	$42	
d) Maintain Entrance	1	ls		$437.90	$38.87	$19.38	$0	$438	$39	$19	$496	100% of installation cost
							$3,200	$10,361	$1,086	$90	$14,738	
4 SITE MANAGEMENT STAFFING												
4.1 Site Manager	4	wk			$1,506.53		$0	$0	$6,026	$0	$6,026	
4.2 Site Supervisor/Foremen	4	wk			$1,438.05		$0	$0	$5,752	$0	$5,752	
4.3 Site Engineer	4	wk			$1,369.58		$0	$0	$5,478	$0	$5,478	
							$0	$0	$17,257	$0	$17,257	
5 LANDFILL REGRADING												
5.1 Grade Landfill Materials	3000	cy			$0.37	$1.39	$0	$0	$1,110	$4,170	$5,280	300 hp dozer
5.2 Compact Landfill Materials	3000	cy			$0.11	$0.12	$0	$0	$330	$360	$690	12" lifts/4 passes
5.3 Import Common Fill	6435	cy		$4.25	$6.04	$13.72	$0	$27,349	$38,867	$88,288	$154,504	
5.4 Place/Grade/Compact Common Fill	6435	cy			$0.45	$1.06	$0	$0	$2,896	$6,821	$9,717	
							$0	$27,349	$43,203	$99,639	$170,191	

NAVAL WEAPONS STATION EARLE
Colts Neck, New Jersey
Operable Unit 6 (Site 3)
Alternative 2 - Limited Action
Capital Cost

Prepared by TJR
Checked by DCW

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Total Cost Subcontract	Total Cost Material	Total Cost Labor	Total Cost Equipment	Total Direct Cost	Comments
6 SITE RESTORATION												
6.1 Hydroseed w/ mulch & fertilizer	261.3	msf		$26.78	$7.54	$7.20	$0	$6,998	$1,970	$1,881	$10,849	#7 utility mix
6.2 Well Installation	1	ls	$15,000.00				$15,000	$0	$0	$0	$15,000	3 wells/25' deep
6.3 Install New 6' High Chain Link Fence	2500	lf	$16.40				$41,000	$0	$0	$0	$41,000	
6.4 Double Swing Gate (12' opening)	1	ea	$925.00				$925	$0	$0	$0	$925	
							$56,925	$6,998	$1,970	$1,881	$67,774	
7 POST CONSTRUCTION SUBMITTALS												
7.1 Construction As-Builts	1	ls			$5,000.00		$0	$0	$5,000	$0	$5,000	
7.2 CEA & Modify Base Master Plan	1	ls	$15,000.00				$15,000	$0	$0	$0	$15,000	
							$15,000	$0	$5,000	$0	$20,000	

NAVAL WEAPONS STATION EARLE
Colts Neck, New Jersey
Operable Unit 6 (Site 3)
Alternative 2 - Limited Action
Annual Cost

Prepared by KSL

Checked by DCW

Item	Item Cost Annually	Item Cost per 5 Years	Notes
Sampling	$9,300		Collect three surface water samples, three sediment samples and eleven groundwater samples, per sampling period, plus travel, living and shipping cost
Analysis/Water	$3,200		Twenty water samples, per sampling period, (including blanks & duplicates for each medium) metals
Analysis/Sediment	$960		Six sediment samples, per sampling period, (including blanks & duplicates for each medium) metals
Annual Report	$4,000		Ten hours per sampling report plus other direct cost
Site Review		$15,500	Review of Site Conditions by 3 Engineers for Years 5, 10, 15, 20, 25, 30
TOTALS	$17,460	$15,500	

NAVAL WEAPONS STATION EARLE
Colts Neck, New Jersey
Operable Unit 6 (Site 3)
Alternative 2 - Limited Action
Present Worth Analysis

Prepared by

Checked by

Year	Capital Cost	Annual Cost	Total Year Cost	Annual Discount Rate at 7%	Present Worth
0	$627,624		$627,624	1.000	$627,624
1		$17,460	$17,460	0.935	$16,325
2		$17,460	$17,460	0.873	$15,243
3		$17,460	$17,460	0.816	$14,247
4		$17,460	$17,460	0.763	$13,322
5		$32,960	$32,960	0.713	$23,500
6		$17,460	$17,460	0.666	$11,628
7		$17,460	$17,460	0.623	$10,878
8		$17,460	$17,460	0.582	$10,162
9		$17,460	$17,460	0.544	$9,498
10		$32,960	$32,960	0.508	$16,744
11		$17,460	$17,460	0.475	$8,294
12		$17,460	$17,460	0.444	$7,752
13		$17,460	$17,460	0.415	$7,246
14		$17,460	$17,460	0.388	$6,774
15		$32,960	$32,960	0.362	$11,932
16		$17,460	$17,460	0.339	$5,919
17		$17,460	$17,460	0.317	$5,535
18		$17,460	$17,460	0.296	$5,168
19		$17,460	$17,460	0.277	$4,836
20		$32,960	$32,960	0.258	$8,504
21		$17,460	$17,460	0.242	$4,225
22		$17,460	$17,460	0.226	$3,946
23		$17,460	$17,460	0.211	$3,684
24		$17,460	$17,460	0.197	$3,440
25		$32,960	$32,960	0.184	$6,065
26		$17,460	$17,460	0.172	$3,003
27		$17,460	$17,460	0.161	$2,811
28		$17,460	$17,460	0.150	$2,619
29		$17,460	$17,460	0.141	$2,462
30		$32,960	$32,960	0.131	$4,318
				TOTAL PRESENT WORTH	**$877,703**

NAVAL WEAPONS STATION EARLE
Colts Neck, New Jersey
Operable Unit 6 (Site 3)
Alternative 3 - Capping
Capital Cost Summary

Prepared by JJK

Checked by DCW

	ITEM	SUBCONTRACTED	MATERIAL	LABOR	EQUIPMENT	TOTAL
1	PRE-DESIGN INVESTIGATION	$51,000	$0	$0	$0	$51,000
2	MOBILIZATION/SITE SUPPORT/DEMOBILIZATION	$35,736	$41,033	$49,491	$78,122	$204,382
3	DECONTAMINATION FACILITIES & SERVICES	$19,700	$10,361	$1,086	$90	$31,238
4	SITE MANAGEMENT STAFFING	$0	$0	$112,168	$0	$112,168
5	LANDFILL CAP	$8,700	$1,250,062	$305,667	$450,776	$2,015,205
6	SITE RESTORATION	$56,925	$11,665	$3,284	$3,136	$75,011
7	POST CONSTRUCTION SUBMITTALS	$15,000	$0	$5,000	$0	$20,000
		$187,061	$1,313,121	$476,697	$532,126	$2,509,004
	Overhead on Labor Cost @ 30%			$143,009		$143,009
	G & A on Labor @ 10%			$47,670		$47,670
	G & A on Material Cost @ 10%		$131,312			$131,312
	G & A on Subcontract Cost @ 10%	$18,706				$18,706
	Total Direct Cost	$205,767	$1,444,433	$667,375	$532,126	$2,849,701
	Indirects on Total Direct Labor Cost @ 75%			$500,531		$500,531
	Profit on Total Direct Cost @ 10%					$284,970
						$3,635,203
	Health and Safety Monitoring @ 5%					$181,760
	Total Field Cost					$3,816,963
	Contingency on Total Field Cost @ 20%					$763,393
	Engineering on Total Field Cost @ 10%					$381,696
	TOTAL COST					$4,962,052

NAVAL WEAPONS STATION EARLE
Colts Neck, New Jersey
Operable Unit 6 (Site 3)
Alternative 3 - Capping
Capital Cost

Prepared by JR
Checked by DCW

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Total Cost Subcontract	Total Cost Material	Total Cost Labor	Total Cost Equipment	Total Direct Cost	Comments
1 PRE-DESIGN INVESTIGATION												
1.1 Topographic Survey (includes new well locations)	1	ls	$15,000.00				$15,000	$0	$0	$0	$15,000	
1.2 Geotechnical Investigation	1	ls	$6,000.00				$6,000	$0	$0	$0	$6,000	
1.3 Wetland Delineation	1	ls	$5,000.00				$5,000	$0	$0	$0	$5,000	
1.4 Test Pit Investigation	1	ls	$15,000.00				$15,000	$0	$0	$0	$15,000	
1.5 Soil/Gas Survey	1	ls	$10,000.00				$10,000	$0	$0	$0	$10,000	
							$51,000	$0	$0	$0	$51,000	
2 MOBILIZATION/SITE SUPPORT/DEMOBILIZATION												
2.1 Office Trailer	6	mo	$181.00				$1,086	$0	$0	$0	$1,086	
2.2 Storage Trailer	6	mo	$95.00				$570	$0	$0	$0	$570	
2.3 Portable Communication Equipment	2	sets	$1,500.00				$3,000	$0	$0	$0	$3,000	
2.4 Equipment Mob/Demob	6	ea			$54.00	$250.00	$0	$0	$324	$1,500	$1,824	
2.5 Site Utilities Hook-up	1	ls	$3,000.00				$3,000	$0	$0	$0	$3,000	
2.6 Site Utilities	6	mo	$4,000.00				$24,000	$0	$0	$0	$24,000	
2.7 Portable Toilet (2)	12	mo	$90.00				$1,080	$0	$0	$0	$1,080	
2.8 Pick-up Truck	6	mo	$500.00	$100.00			$3,000	$600	$0	$0	$3,600	
2.9 Access Road	1	ls		$3,000.00	$1,000.00	$1,000.00	$0	$3,000	$1,000	$1,000	$5,000	
2.10 Silt Fence	2500	lf		$0.45	$0.22		$0	$1,125	$550	$0	$1,675	
2.11 Sediment/Detention Basin												
a) Excavate/Grade	3050	cy			$0.20	$0.67	$0	$0	$610	$2,044	$2,654	
b) Compaction	3050	cy			$0.11	$0.12	$0	$0	$336	$366	$702	12" lifts/4 passes
c) Outlet Structures & Misc. Items	1	ls		$2,500.00	$2,000.00	$500.00	$0	$2,500	$2,000	$500	$5,000	
d) Topsoil for Ditch	490	cy		$16.33	$6.04	$13.72	$0	$8,002	$2,960	$6,723	$17,684	
e) Runoff Ditch	2200	lf		$11.73	$6.81	$10.45	$0	$25,806	$14,982	$22,990	$63,778	
2.12 Clear and Grub Site	10	ac			$2,673.00	$4,300.00	$0	$0	$26,730	$43,000	$69,730	brush, stumps, trees
							$35,736	$41,033	$49,491	$78,122	$204,382	
3 DECONTAMINATION FACILITIES & SERVICES												
3.1 Decon Pad												
a) 4" sand	12.4	cy		$25.00			$0	$310	$0	$0	$310	10 mile haul
b) 6' stone	18.5	cy		$15.00			$0	$278	$0	$0	$278	
c) Railroad Ties (6'*8'*8')	20	ea		$27.83	$12.60	$2.40	$0	$557	$252	$48	$857	pressure treated
d) Geotextile 170 mil nonwoven	123	sy		$2.77	$0.46	$0.03	$0	$341	$57	$4	$401	
3.2 Laundry Service	26	wk	$250.00				$6,500	$0	$0	$0	$6,500	
3.3 Decontamination Service	6	mo	$1,200.00				$7,200	$0	$0	$0	$7,200	
3.4 Purchase Decon Water	30000	gal	$0.20				$6,000	$0	$0	$0	$6,000	
3.5 Clean Water Storage Tank	1	ea		$3,000.00	$300.00		$0	$3,000	$300	$0	$3,300	
3.6 Spent Water Storage	1	ea		$5,000.00	$400.00		$0	$5,000	$400	$0	$5,400	
3.7 Rock Construction Entrance												
a) Grade (dozer)	19	cy			$0.20	$0.67	$0	$0	$4	$13	$17	
b) Stone (import) 3/4" to 1 1/2"	19	cy		$23.05			$0	$438	$0	$0	$438	10 mile haul
c) Install Stone 8" thick	19	cy			$1.85	$0.35	$0	$0	$35	$7	$42	
d) Maintain Entrance	1	ls		$437.90	$38.87	$19.38	$0	$438	$39	$19	$496	100% of installation cost
							$19,700	$10,361	$1,086	$90	$31,238	
4 SITE MANAGEMENT STAFFING												
4.1 Site Manager	26	wk			$1,506.53		$0	$0	$39,170	$0	$39,170	
4.2 Site Supervisor/Foreman	26	wk			$1,438.05		$0	$0	$37,389	$0	$37,389	
4.3 Site Engineer	26	wk			$1,369.58		$0	$0	$35,609	$0	$35,609	
							$0	$0	$112,168	$0	$112,168	

NAVAL WEAPONS STATION EARLE
Colts Neck, New Jersey
Operable Unit 6 (Site 3)
Alternative 3 - Capping
Capital Cost

Prepared by TJR
Checked by DCW

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Total Cost Subcontract	Total Cost Material	Total Cost Labor	Total Cost Equipment	Total Direct Cost	Comments
5 LANDFILL CAP												
5.1 Grade Landfill Materials	10000	cy			$0.37	$1.39	$0	$0	$3,700	$13,900	$17,600	300 hp dozer
5.2 Compact Landfill Materials	10000	cy			$0.11	$0.12	$0	$0	$1,100	$1,200	$2,300	12" lifts/4 passes
5.3 Import Common Fill	6000	cy		$4.25	$6.04	$13.72	$0	$25,500	$36,240	$82,320	$144,060	
5.4 Place/Grade/Compact Common Fill	6000	cy			$0.45	$1.06	$0	$0	$2,700	$6,360	$9,060	
5.5 Import Sand for Gas Mgmt Layer	12907	cy		$25.20			$0	$325,256	$0	$0	$325,256	10 mile haul
5.6 Install Gas Mgmt Layer	12907	cy			$0.58	$1.11	$0	$0	$7,486	$14,327	$21,813	
5.7 Install 40 mil VFPE or GCL	348480	sf		$0.31	$0.09	$0.10	$0	$108,029	$31,363	$34,848	$174,240	
5.8 Third Party Testing of VFPE/GCL	1	ls	$8,700.00				$8,700	$0	$0	$0	$8,700	assume 5% of liner cost
5.9 Install Cushion Fabric	38720	sy		$2.77	$0.48	$0.03	$0	$107,254	$18,586	$1,162	$127,002	12 oz. = 170 mil
5.10 Import Drainage Layer Stone	12907	cy		$37.28			$0	$481,173	$0	$0	$481,173	AASHTO #57
5.11 Install Drainage Layer	12907	cy			$5.16	$0.65	$0	$0	$66,600	$8,390	$74,990	
5.12 Install Non-woven Geotextile	38720	sy		$1.08	$0.28	$0.02	$0	$41,818	$10,842	$774	$53,434	60 mil
5.13 Import Select Fill	12907	cy		$4.25	$6.04	$13.72	$0	$54,855	$77,958	$177,084	$309,897	10 mile haul
5.14 Place/Grade/ Compact Select Fill	12907	cy			$0.58	$1.27	$0	$0	$7,486	$16,392	$23,878	
5.15 Import Topsoil	6453	cy		$16.33	$6.04	$13.72	$0	$105,377	$38,976	$88,535	$232,889	
5.16 Place & Grade Topsoil	6453	cy			$0.33	$0.85	$0	$0	$2,129	$5,485	$7,615	
5.17 Install 4" PVC Gas Vents	10	ea		$80.00	$50.00		$0	$800	$500	$0	$1,300	
							$8,700	$1,250,062	$305,667	$450,776	$2,015,205	
6 SITE RESTORATION												
6.1 Hydroseed w/ mulch & fertilizer	435.6	msf		$26.78	$7.54	$7.20	$0	$11,665	$3,284	$3,136	$18,086	#7 utility mix
6.2 Well Installation	1	ls	$15,000.00				$15,000	$0	$0	$0	$15,000	3 wells/25' deep
6.3 Install New 6' High Chain Link Fence	2500	lf	$16.40				$41,000	$0	$0	$0	$41,000	
6.4 Double Swing Gate (12' opening)	1	ea	$925.00				$925	$0	$0	$0	$925	
							$56,925	$11,665	$3,284	$3,136	$75,011	
7 POST CONSTRUCTION SUBMITTALS												
7.1 Construction As-Builts	1	ls			$5,000.00		$0	$0	$5,000	$0	$5,000	
7.2 CEA & Modify Base Master Plan	1	ls	$15,000.00				$15,000	$0	$0	$0	$15,000	
							$15,000	$0	$5,000	$0	$20,000	

NAVAL WEAPONS STATION EARLE
Colts Neck, New Jersey
Operable Unit 6 (Site 3)
Alternative 3 - Capping
Annual Cost

Prepared by TJR
Checked by DCW

Item	Item Cost Annually	Item Cost per 5 Years	Notes
Site Maintenance	$1,428		1 Laborer / 1 Day per Month for 12 Months
	$720		Mobilization & Demobilization (pickup truck)
	$500		Misc. Materials (seed, rock, soil)
	$300		Misc. Equipment (mowers, hand tools)
Sampling	$9,300		Collect three surface water samples, three sediment samples and eleven groundwater samples, per sampling period, plus travel, living and shipping cost
Analysis/Water	$3,200		Twenty water samples, per sampling period, (including blanks & duplicates for each medium) metals
Analysis/Sediment	$960		Six sediment samples, per sampling period, (including blanks & duplicates for each medium) metals
Annual Report	$4,000		Ten hours per sampling report plus other direct cost
Site Review		$15,500	Review of Site Conditions by 3 Engineers for Years 5, 10, 15, 20, 25, 30
TOTALS	$20,408	$15,500	

NAVAL WEAPONS STATION EARLE
Colts Neck, New Jersey
Operable Unit 6 (Site 3)
Alternative 3 - Capping
Present Worth Analysis

Prepared by JJR

Checked by DCW

Year	Capital Cost	Annual Cost	Total Year Cost	Annual Discount Rate at 7%	Present Worth
0	$4,962,052		$4,962,052	1.000	$4,962,052
1		$20,408	$20,408	0.935	$19,081
2		$20,408	$20,408	0.873	$17,816
3		$20,408	$20,408	0.816	$16,653
4		$20,408	$20,408	0.763	$15,571
5		$35,908	$35,908	0.713	$25,602
6		$20,408	$20,408	0.666	$13,592
7		$20,408	$20,408	0.623	$12,714
8		$20,408	$20,408	0.582	$11,877
9		$20,408	$20,408	0.544	$11,102
10		$35,908	$35,908	0.508	$18,241
11		$20,408	$20,408	0.475	$9,694
12		$20,408	$20,408	0.444	$9,061
13		$20,408	$20,408	0.415	$8,469
14		$20,408	$20,408	0.388	$7,918
15		$35,908	$35,908	0.362	$12,999
16		$20,408	$20,408	0.339	$6,918
17		$20,408	$20,408	0.317	$6,469
18		$20,408	$20,408	0.296	$6,041
19		$20,408	$20,408	0.277	$5,653
20		$35,908	$35,908	0.258	$9,264
21		$20,408	$20,408	0.242	$4,939
22		$20,408	$20,408	0.226	$4,612
23		$20,408	$20,408	0.211	$4,306
24		$20,408	$20,408	0.197	$4,020
25		$35,908	$35,908	0.184	$6,607
26		$20,408	$20,408	0.172	$3,510
27		$20,408	$20,408	0.161	$3,286
28		$20,408	$20,408	0.150	$3,061
29		$20,408	$20,408	0.141	$2,878
30		$35,908	$35,908	0.131	$4,704
				TOTAL PRESENT WORTH	**$5,248,713**

ASSUMPTIONS
ESTIMATED COSTS FOR REMEDIAL ALTERNATIVES
OU-6 (SITE 10)

The following major assumptions were made in estimating the cost of the alternatives for Site 10.

- For Alternative 2 it is assumed that limited survey will be required to locate the proposed location of the security fence.
- The landfill boundaries that the cost estimate are based on, have not been field verified, therefore they should be viewed as uncertain.
- No detailed topography exists for this site. In order to estimate the amount of regrading required to achieve minimum grades for cost estimation purposes, relative topography was assumed based on field observations. The regrading volumes based on the assumed topography are very uncertain and can have a significant effect the cost estimate.
- It is assumed that the landfill cap can be designed to not permanently encroach on the wetland area, although a wetland borders a large portion of the landfill. It is assumed that construction of a replacement wetland will not required.
- Perimeter ditches are assumed to surround the site to control surface water runon and runoff from the cap surface. The runoff from the site would be directed to a detention basin located directly north of the landfill.
- Time to construct Alternative 3 is assumed to be 2 months since it is assumed that minimal regrading will be required and an impermeable liner is not required.
- All construction cost at normal safety levels. No additional cost included for safety upgrade.
- Access to site not heavily restricted due to station security.

CALCULATION WORKSHEET Order No. 19116 (01-91)

CLIENT	JOB NUMBER
SUBJECT SITE 10 FS COST ESTIMATE	
BASED ON	DRAWING NUMBER
BY DCW 11/24/97 / CHECKED BY MJW 12/3/97	APPROVED BY / DATE

PURPOSE: TO ESTIMATE QUANTITIES FOR ALTERNATIVE 3 (CAPPING) FOR THE FS COST ESTIMATE.

1. AREA OF LANDFILL CAP USE A PLANIMETER TO ESTIMATE THE AREA OF THE LANDFILL CAP BASED ON FIGURE 12-1 IN THE RI. THE AREA IS APPROXIMATELY 1.7 ACRES.

2. VOLUME OF REGRADED WASTE SINCE THIS CAP WILL NOT ENTAIL A STANDARD N.J. SOLID WASTE CAP ASSUME MINIMUM SLOPES ARE ALSO NOT REQUIRED. ASSUME THAT THE REQUIRED MINIMUM SLOPE FOR A PARKING AREA IS 1% AND THAT THE CUT AND FILL BALANCE CAN BE ACHIEVED WITH MINIMAL GRADING.

ASSUME 1000 C.Y. WASTE CUT.
1000 C.Y. WASTE PLACEMENT AND COMPACTION

3. CLEAR AND GRUBB
ASSUME CLEARED AND GRUBBED AREA IS APPROXIMATELY 25% LARGER THAN THE SIZE OF THE LANDFILL

$$1.25 \times 1.7 = 2.1 \text{ AC}$$

4. STORM DRAINAGE SYSTEM THE LANDFILL IS THE HIGHEST GROUND IN THE VICINITY OF THIS SITE. ASSUME THAT A SWALE IS REQUIRED ON 3 SIDES OF THE SITE TO DIRECT RUNOFF FROM THE CAP AWAY FROM THE RAILROAD TRACKS. RUNOFF FROM THE CAP ALONG THE WETLAND WILL DIRECTLY DISCHARGE TO THE WETLAND.

CLIENT		JOB NUMBER	
SUBJECT			
BASED ON		DRAWING NUMBER	
BY DCW 11/25/97	CHECKED BY MJW 12/3/97	APPROVED BY	DATE

4. CON'T

ASSUME RUNOFF IS DIRECTED TO A DETENTION BASIN ON THE NORTH END OF THE SITE. ASSUME DETENTION BASIN IS AS LARGE AS A SEDIMENT BASIN. COST OF DETENTION BASIN IS UNDER THE E/S CONTROLS. THIS ASSUMES THE SEDIMENT BASIN WILL BE CONVERTED TO A DETENTION BASIN.

ASSUME 750' OF DITCHES ARE REQ'D FOR 3 SIDES OF THE LANDFILL.
EXCAVATION FOR DITCHES = (750 x 16)/27) + 167 = 611 C.Y.
ASSUME CHANNELS ARE LINED WITH 6" TOPSOIL
(12' WIDE x 750' LONG x 6"/12) /27 = 167 CY

5. CAP COMPONENTS

ROADWAY STABILIZATION FABRIC
1.7 x 43560 /9 = 8228 S.Y.
10" AGGREGATE BASE COURSE = 2285 C.Y.
10/12 x 1.7 x 43560 /27
2" ASPHALT SURFACE = 8228 S.Y.
SEEDING (2.1 − 1.7 ACRES) · 43560/1000 =

6. FENCE

ASSUME 6' HIGH CHAIN LINK FENCE 1500 LF

7. SEDIMENT CONTROL MEASURES

ASSUME SILT FENCE AND SEDIMENT BASINS ARE REQUIRED.

ASSUME 1500 LF OF SILT FENCE

CLIENT	JOB NUMBER
SUBJECT SITE 10	
BASED ON	DRAWING NUMBER

BY	CHECKED BY	APPROVED BY	DATE
DCW 11/25/97	MJW 12/3/97		

7. CON'T

VOLUME OF SEDIMENT BASIN SHOULD BE THE VOLUME OF THE 2-YEAR, 24-HR STORM, PLUS THE SEDIMENT STORAGE CAPACITY

THE VOLUME FOR THE 2-YEAR STORM IS GIVEN BY THE FOLLOWING:

- CURVE NUMBER FOR BARE SOIL, TYPE B IS 86 (TR-55 MANUAL)
- THE 2-YR RAINFALL DEPTH IS 3.4 INCHES
- FROM FIGURE 2-1 IN THE TR-55 MANUAL THE RUNOFF DEPTH IS 2.0 INCHES

THE RUNOFF VOLUME IS $1.7 \times 2''/12 \cdot 43560 = 12342$ CF

- SEDIMENT STORAGE VOLUME GIVEN IS GIVEN BY 0.07 AC-FT PER ACRE PER YEAR OF CONSTRUCTION (ASSUME 1 YEAR CONSTRUCTION LENGTH) (BASED ON STANDARDS FOR EROSION CONTROL IN NEW JERSEY)

$1.7 \times 0.07 = 0.119$ AC-FT OR 5184 CF

TOTAL VOLUME = 17526 CF OR 650 C.Y.

ASSUME THAT 650 C.Y ARE EXCAVATED, WITH THE EXCAVATED MATERIAL USED TO CONSTRUCT BERMS TO GIVE THE REQUIRED FREEBOARD

THEREFORE EXCAVATE 650 C.Y.
PLACE/COMPACT 650 C.Y.

ADD $5000 OUTLET STRUCTURES/MISC ITEMS.

CALCULATION WORKSHEET Order No. 19116 (01-91)

CLIENT	JOB NUMBER		
SUBJECT SITE 10			
BASED ON	DRAWING NUMBER		
BY 11/25/97	CHECKED BY MJW 12/3/97	APPROVED BY	DATE

8. PRE - DESIGN STUDIES

a) TOPOGRAPHIC MAPPING ASSUME 6 ACRES COVERAGE, HEAVILY WOODED $10,000

b) GEOTECHNICAL INVESTIGATION $6000

c) WETLAND DELINEATION $5000

d) TEST PIT EXCAVATION, ASSUME TEST PITTING IS MORE DIFFICULT THAN SITE 13 BUT EASIER THAN SITE 3

ASSUME $12,500

NAVAL WEAPONS STATION EARLE
Colts Neck, New Jersey
Operable Unit 6 (Site 10)
Alternative 2 - Limited Action
Capital Cost Summary

Prepared by JB

Checked by NCW

	ITEM	SUBCONTRACTED	MATERIAL	LABOR	EQUIPMENT	TOTAL
1	PRE-DESIGN INVESTIGATION	$1,000	$0	$0	$0	$1,000
2	SITE FENCING	$25,525	$0	$0	$0	$25,525
		$26,525	$0	$0	$0	$26,525
	Overhead on Labor Cost @ 30%			$0		$0
	G & A on Labor @ 10%			$0		$0
	G & A on Material Cost @ 10%		$0			$0
	G & A on Subcontract Cost @ 10%	$2,653				$2,653
	Total Direct Cost	$29,178	$0	$0	$0	$29,178
	Indirects on Total Direct Labor Cost @ 75%			$0		$0
	Profit on Total Direct Cost @ 10%					$2,918
						$32,095
	Health and Safety Monitoring @ 5%					$1,605
	Total Field Cost					$33,700
	Contingency on Total Field Cost @ 20%					$6,740
	Engineering on Total Field Cost @ 10%					$3,370
	TOTAL COST					$43,810

NAVAL WEAPONS STATION EARLE
Colts Neck, New Jersey
Operable Unit 6 (Site 10)
Alternative 2 - Limited Action
Capital Cost

Prepared by JR
Checked by DCW

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Total Cost Subcontract	Total Cost Material	Total Cost Labor	Total Cost Equipment	Total Direct Cost	Comments
1 PRE-DESIGN INVESTIGATION												
1.1 Topographic Survey	1	ls	$1,000.00				$1,000	$0	$0	$0	$1,000	
							$1,000	$0	$0	$0	$1,000	
2 SITE FENCING												
6.1 Install New 6' High Chain Link Fence	1500	lf	$16.40				$24,600	$0	$0	$0	$24,600	
6.2 Double Swing Gate (12' opening)	1	ea	$925.00				$925	$0	$0	$0	$925	
							$25,525	$0	$0	$0	$25,525	

NAVAL WEAPONS STATION EARLE
Colts Neck, New Jersey
Operable Unit 6 (Site 10)
Alternative 3 - Landfill Cover System
Capatial Cost Summary

Prepared by JJR

Checked by DCW

	ITEM	SUBCONTRACTED	MATERIAL	LABOR	EQUIPMENT	TOTAL
1	PRE-DESIGN INVESTIGATION	$43,500	$0	$0	$0	$43,500
2	MOBILIZATION/SITE SUPPORT/DEMOBILIZATION	$15,912	$17,900	$15,531	$22,422	$71,765
3	DECONTAMINATION FACILITIES & SERVICES	$6,400	$10,361	$1,086	$90	$17,938
4	SITE MANAGEMENT STAFFING	$0	$0	$34,513	$0	$34,513
5	LANDFILL COVER	$0	$111,890	$6,737	$7,502	$126,129
6	SITE RESTORATION	$25,525	$466	$131	$125	$26,247
7	POST CONSTRUCTION SUBMITTALS	$15,000	$0	$5,000	$0	$20,000
		$106,337	$140,616	$62,999	$30,140	$340,092
	Overhead on Labor Cost @ 30%			$18,900		$18,900
	G & A on Labor @ 10%			$6,300		$6,300
	G & A on Material Cost @ 10%		$14,062			$14,062
	G & A on Subcontract Cost @ 10%	$10,634				$10,634
	Total Direct Cost	$116,971	$154,678	$88,199	$30,140	$389,987
	Indirects on Total Direct Labor Cost @ 75%			$66,149		$66,149
	Profit on Total Direct Cost @ 10%					$38,999
						$495,135
	Health and Safety Monitoring @ 5%					$24,757
	Total Field Cost					$519,892
	Contingency on Total Field Cost @ 20%					$103,978
	Engineering on Total Field Cost @ 10%					$51,989
	TOTAL COST					$675,859

NAVAL WEAPONS STATION EARLE
Colts Neck, New Jersey
Operable Unit 6 (Site 10)
Alternative 3 - Landfill Cover System
Capital Cost

Prepared by TJR
Checked by PCW

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Total Cost Subcontract	Total Cost Material	Total Cost Labor	Total Cost Equipment	Total Direct Cost	Comments
1 PRE-DESIGN INVESTIGATION												
1.1 Topographic Survey	1	ls	$10,000.00				$10,000	$0	$0	$0	$10,000	
1.2 Geotechnical Investigation	1	ls	$6,000.00				$6,000	$0	$0	$0	$6,000	
1.3 Wetland Delineation	1	ls	$5,000.00				$5,000	$0	$0	$0	$5,000	
1.4 Test Pit Investigation	1	ls	$12,500.00				$12,500	$0	$0	$0	$12,500	
1.5 Soil/Gas Survey	1	ls	$10,000.00				$10,000	$0	$0	$0	$10,000	
							$43,500	$0	$0	$0	$43,500	
2 MOBILIZATION/SITE SUPPORT/DEMOBILIZATION												
2.1 Office Trailer	2	mo	$181.00				$362	$0	$0	$0	$362	
2.2 Storage Trailer	2	mo	$95.00				$190	$0	$0	$0	$190	
2.3 Portable Communication Equipment	2	sets	$1,500.00				$3,000	$0	$0	$0	$3,000	
2.4 Equipment Mob/Demob	5	ea			$54.00	$250.00	$0	$0	$270	$1,250	$1,520	
2.5 Site Utilities Hook-up	1	ls	$3,000.00				$3,000	$0	$0	$0	$3,000	
2.6 Site Utilities	2	mo	$4,000.00				$8,000	$0	$0	$0	$8,000	
2.7 Portable Toilet (2)	4	mo	$90.00				$360	$0	$0	$0	$360	
2.8 Pick-up Truck	2	mo	$500.00	$100.00			$1,000	$200	$0	$0	$1,200	
2.9 Access Road	1	ls		$3,000.00	$1,000.00	$1,000.00	$0	$3,000	$1,000	$1,000	$5,000	
2.10 Silt Fence	1500	lf		$0.45	$0.22		$0	$675	$330	$0	$1,005	
2.11 Sediment/Detention Basin												
a) Excavate/Grade	650	cy			$0.20	$0.67	$0	$0	$130	$436	$566	
b) Compaction	650	cy			$0.11	$0.12	$0	$0	$72	$78	$150	12" lifts/4 passes
c) Outlet Structures & Misc. Items	1	ls		$2,500.00	$2,000.00	$500.00	$0	$2,500	$2,000	$500	$5,000	
d) Runoff Ditch	750	lf		$11.73	$6.81	$10.45	$0	$8,798	$5,108	$7,838	$21,743	
e) Topsoil for Ditch	167	cy		$16.33	$6.04	$13.72	$0	$2,727	$1,009	$2,291	$6,027	
2.12 Clear and Grub Site	2.1	ac			$2,673.00	$4,300.00	$0	$0	$5,613	$9,030	$14,643	brush, stumps, trees
							$15,912	$17,900	$15,531	$22,422	$71,765	
3 DECONTAMINATION FACILITIES & SERVICES												
3.1 Decon Pad												
a) 4" sand	12.4	cy		$25.00			$0	$310	$0	$0	$310	10 mile haul
b) 6' stone	18.5	cy		$15.00			$0	$278	$0	$0	$278	
c) Railroad Ties (6"8'*8')	20	ea		$27.83	$12.60	$2.40	$0	$557	$252	$48	$857	pressure treated
d) Geotextile 170 mil nonwoven	123	sy		$2.77	$0.46	$0.03	$0	$341	$57	$4	$401	
3.2 Laundry Service	8	wk	$250.00				$2,000	$0	$0	$0	$2,000	
3.3 Decontamination Service	2	mo	$1,200.00				$2,400	$0	$0	$0	$2,400	
3.4 Purchase Decon Water	10000	gal	$0.20				$2,000	$0	$0	$0	$2,000	
3.5 Clean Water Storage Tank	1	ea		$3,000.00	$300.00		$0	$3,000	$300	$0	$3,300	
3.6 Spent Water Storage	1	ea		$5,000.00	$400.00		$0	$5,000	$400	$0	$5,400	
3.7 Rock Construction Entrance												
a) Grade (dozer)	19	cy			$0.20	$0.67	$0	$0	$4	$13	$17	
b) Stone (import) 3/4" to 1 1/2"	19	cy		$23.05			$0	$438	$0	$0	$438	10 mile haul
c) Install Stone 8" thick	19	cy			$1.85	$0.35	$0	$0	$35	$7	$42	
d) Maintain Entrance	1	ls		$437.90	$38.87	$19.38	$0	$438	$39	$19	$496	100% of installation cost
							$6,400	$10,361	$1,086	$90	$17,938	
4 SITE MANAGEMENT STAFFING												
4.1 Site Manager	8	wk			$1,506.53		$0	$0	$12,052	$0	$12,052	
4.2 Site Supervisor/Foreman	8	wk			$1,438.05		$0	$0	$11,504	$0	$11,504	
4.3 Site Engineer	8	wk			$1,369.58		$0	$0	$10,957	$0	$10,957	
							$0	$0	$34,513	$0	$34,513	

NAVAL WEAPONS STATION EARLE
Colts Neck, New Jersey
Operable Unit 6 (Site 10)
Alternative 3 - Landfill Cover System
Capital Cost

Prepared by TJR
Checked by DCW

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Total Cost Subcontract	Total Cost Material	Total Cost Labor	Total Cost Equipment	Total Direct Cost	Comments
5 LANDFILL COVER												
5.1 Grade Landfill Materials	1000	cy			$0.37	$1.39	$0	$0	$370	$1,390	$1,760	300 hp dozer
5.2 Compact Landfill Materials	1000	cy			$0.11	$0.12	$0	$0	$110	$120	$230	12" lifts/4 passes
5.3 Install Roadway Geotextile	8228	sy		$0.45	$0.06	$0.02	$0	$3,703	$494	$165	$4,361	
5.4 Install Aggregate Base Course	2285	cy		$35.50	$1.19	$1.47	$0	$81,118	$2,719	$3,359	$87,196	
5.5 Install Asphalt Wear Course - 2"	8228	sy		$3.29	$0.37	$0.30	$0	$27,070	$3,044	$2,468	$32,583	
							$0	$111,890	$6,737	$7,502	$126,129	
6 SITE RESTORATION												
6.1 Hydroseed w/ mulch & fertilizer	17.4	msf		$26.78	$7.54	$7.20	$0	$466	$131	$125	$722	#7 utility mix
6.2 Install New 6' High Chain Link Fence	1500	lf	$16.40				$24,600	$0	$0	$0	$24,600	
6.3 Double Swing Gate (12' opening)	1	ea	$925.00				$925	$0	$0	$0	$925	
							$25,525	$466	$131	$125	$26,247	
7 POST CONSTRUCTION SUBMITTALS												
7.1 Construction As-Builts	1	ls			$5,000.00		$0	$0	$5,000	$0	$5,000	
7.2 CEA & Modify Base Master Plan	1	ls	$15,000.00				$15,000	$0	$0	$0	$15,000	
							$15,000	$0	$5,000	$0	$20,000	

NAVAL WEAPONS STATION EARLE
Colts Neck, New Jersey
Operable Unit 6 (Site 10)
Alternative 3 - Landfill Cover System
Annual Cost

Prepared by TJR

Checked by DCW

Item	Item Cost Years 10 & 20	Notes
Cap Repaving	$35,400	Repave cap in years 10 & 20 with 2" wear course
TOTAL	$35,400	

NAVAL WEAPONS STATION EARLE
Colts Neck, New Jersey
Operable Unit 6 (Site 10)
Alternative 3 - Landfill Cover System
Present Worth Analysis

Prepared by JJR
Checked by DCW

Year	Capital Cost	Annual Cost	Total Year Cost	Annual Discount Rate at 7%	Present Worth
0	$675,859		$675,859	1.000	$675,859
1			$0	0.935	$0
2			$0	0.873	$0
3			$0	0.816	$0
4			$0	0.763	$0
5			$0	0.713	$0
6			$0	0.666	$0
7			$0	0.623	$0
8			$0	0.582	$0
9			$0	0.544	$0
10		$35,400	$35,400	0.508	$17,983
11			$0	0.475	$0
12			$0	0.444	$0
13			$0	0.415	$0
14			$0	0.388	$0
15			$0	0.362	$0
16			$0	0.339	$0
17			$0	0.317	$0
18			$0	0.296	$0
19			$0	0.277	$0
20		$35,400	$35,400	0.258	$9,133
21			$0	0.242	$0
22			$0	0.226	$0
23			$0	0.211	$0
24			$0	0.197	$0
25			$0	0.184	$0
26			$0	0.172	$0
27			$0	0.161	$0
28			$0	0.150	$0
29			$0	0.141	$0
30			$0	0.131	$0
				TOTAL PRESENT WORTH	**$702,976**