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FEASIBILITY STUDY
for
SITES 1 AND 11 (OU 8)

NAVAL WEAPONS STATION EARLE
Colts Neck, New Jersey

Engineering Field Activity Northeast
Naval Facilities Engineering Command

Contract No. N62467-94-D-0888
Contract Task Order 0843

March 2003

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March 25, 2003

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Attn: Ms. M. DiGeambeardino, Code EV21/MD

Reference: Contract No. N62467-94-D-0888
Contract Task Order (CTO) No. 843

Subject: Submission of Final Feasibility Study Report for Sites 1 and 11 (OU-8)
NWS Earle - Colts Neck, New Jersey

Dear Ms. DiGeambeardino:

Tetra Tech NUS, Incorporated (TtNUS) is pleased to provide 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 Larry Burg at NWS Earle, three copies are enclosed for your use, and one copy has been sent to the Monmouth County Library, Eastern Branch for inclusion in the Administrative Record.

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

Sincerely,

Russell E. Turner

Russell E. Turner
Project Manager

RET/vh

Enclosures

c: Larry Burg (NWS Earle)
Jessica Mollin (EPA, Region II)
Bob Marcolina (NJDEP)
Garth Glenn (TtNUS) (without enclosures)
Mary Jane Kehoe (Monmouth County Library, Eastern Branch)
File

FEASIBILITY STUDY
for
SITES 1 AND 11 (OU 8)

NAVAL WEAPONS STATION EARLE
Colts Neck, New Jersey

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

Submitted to:
Engineering Field Activity Northeast
Environmental Branch, Code EV2
Naval Facilities Engineering Command
10 Industrial Highway, Mail Stop No. 82
Lester, Pennsylvania 19113-2090

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ACRONYMS

µg/Kg	micrograms per kilogram
µg/L	micrograms per liter
4,4'-DDT	1,1,1-trichloro-2,2-bis(4-chlorophenyl)ethane
ARAR	applicable or relevant and appropriate requirements
AS/SVE	air sparging/soil vapor extraction
AWQC	Ambient Water Quality Criterion
BOD	biological oxygen demand
B&RE	Brown and Root Environmental
CEA	classification exception area
CERCLA	Comprehensive Response, Compensation, and Liability Act
COD	chemical oxygen demand
CPT	cone penetrometer
CFR	Code of Federal Regulations
cm/sec	centimeters/second
COPC	chemical of potential concern
CQA	Construction Quality Assurance
CQC	Construction Quality Control
CTE	central tendency exposure
DCA	dichloroethane
DCE	dichloroethene
DOD	Department of Defense
DON	Department of the Navy
EA	EA Engineering, Science, and Technology
ECOC	ecological contaminant of concern
EFANE	Engineering Field Activity Northeast
ERA	Ecological Risk Assessment
ER-L	Effects Range-Low
ET	Ecotox Threshold
FFA	Federal Facilities Agreement
FS	Feasibility Study
ft/day	feet/day
FWENC	Foster Wheeler Environmental Corporation
HASP	Health and Safety Plan
HEAST	Health effects assessment summary tables
HHRA	human health risk assessment

HI	Hazard Index
HQ	hazard quotient
IAS	Initial Assessment Study
IC	Institutional Controls
IEUBK	Integrated Exposure Uptake Biokinetic
IR	Installation Restoration
IRIS	Integrated risk information system
IRP	Installation Restoration Program
K_{oc}	organic carbon partition coefficent
MCL	Maximum Contaminant Level
mg/kg	milligram per kilogram
MQA	Material Quality Assurance
msl	mean sea level
NCEA	National Center for Exposure analysis
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NFA	No Further Action
N.J.A.C.	New Jersey Administrative Code
NJDEP	New Jersey Department of Environmental Protection
NPL	National Priorities List
NWS	Naval Weapons Station
O&M	Operations and Maintenance
OME	Ontario Ministry of Environment
OSWER	Office of Solid Waste and Emergency Response
OU	Operable Unit
PAH	Polynuclear aromatic hydrocarbons
PCB	polychlorinated biphenyl
PCE	tetrachloroethene
PP	Proposed Plan
PPE	personal protective equipment
PRG	Preliminary Remediation goal
QA/QC	Quality Assurance/Quality Control
RAB	Restoration Advisory Board
RAC	Remedial Action Contractor
RAO	remedial action objectives
RBC	Risk-Based Concentrations
RCRA	Resource Conservation and Recovery Act
RD	Remedial Design

RfD	Reference dose
RI	Remedial Investigation
RME	reasonable maximum exposure
ROD	Record of Decision
SF	Slope factor
SVOC	semivolatile organic compounds
TAL	Target Analyte List
TBC	to be considered
TCE	trichloroethene
TCL	Target Compound List
TOC	total organic carbon
TPH	total petroleum hydrocarbons
TSD	transportation, storage and disposal
TtNUS	Tetra Tech NUS, Inc.
U.S.	United States
USEPA	United States Environmental Protection Agency
VC	vinyl chloride
VOC	volatile organic compound

EXECUTIVE SUMMARY

Under the Department of Defense's Installation Restoration Program (IRP), 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 1 (Ordnance Demilitarization Site) and 11 (Contract Ordnance Disposal Area), collectively designated as Operable Unit 8 (OU 8). 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 1 and 11.

The remedial options developed in this document will be used by the Navy to select a preferred remedy for Sites 1 and 11. 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 1 - Ordnance Demilitarization Site

The Ordnance Demilitarization Site (Site 1) is a 6-acre open field that was used for burning ordnance material between 1943 and 1975. During site abandonment, the area was plowed, and a layer of diesel-soaked hay was burned on site to remove residual ordnance. This procedure was carried out three times. For several years during the early 1990s, a United States Army communications station and tower were located near the center of the site. The site is currently cleared of all structures (see Figure 1-3).

The site is bordered by Macassar Road to the east, a railroad spur to the north, and an 8- to 10-foot-high berm to the west and south. No drainage swales or streams are located on the site. Groundwater flow is generally to the east-northeast, based on measured groundwater levels.

Site 11 - Contract Ordnance Disposal Area

Site 11 is a 2-acre site that was used for disposal of obsolete ordnance material for several years (dates unknown) (see Figure 1-4). The site was occasionally used from 1974 to 1977 for firefighting training. Training activities took place in two unlined pits, approximately 20 feet long. During firefighting training, reject vehicles were soaked with fuel or oil and ignited and then extinguished. Unburned fuel and waste oil used for ignition were allowed to evaporate or soak into the soil. It has been estimated that 50 gallons of oil per year may have been lost in this manner.

The site is a fan-shaped open area surrounded by woods and wetlands on all sides. An undeveloped dirt road off the transmission line right-of-way accesses the site. Groundwater flow direction is generally to the northeast, based on groundwater-level measurements. The topography of the site slopes to the northwest from approximately 100 feet above mean sea level (MSL) near MW11-02 to 90 feet above MSL near MW11-05. Most of the site is characterized as wetlands. An endangered plant, Knieskern's beaked-rush, has been observed on this site.

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 National Priorities List (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:

- 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 1 and 11 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 1 baseline human health risk assessment concluded that reasonable maximum exposure (RME) cancer risks estimated for future residents exposed to subsurface soil and consuming groundwater from beneath the site (5.6E-04) were at the upper end of the target maximum acceptable risk range. The estimated human health risk for the future industrial (subsurface soil and groundwater) exposure scenario (1.4E-04) was also at the upper end of the target maximum acceptable risk range. Arsenic (via ingestion of groundwater) was by far the greatest contributor to the estimated human health risks for the future residential (5.1E-04) and future industrial (1.2E-04) exposure scenarios. However, these RME estimates are probably overly conservative because a central tendency calculation shows that cancer risks are more likely to be within the mid-range of the target acceptable risk range.

Non-cancer risks estimated for the future residential and future industrial exposure scenarios exceeded 1.0, the cutoff value below which adverse non-carcinogenic effects are not expected to occur. Arsenic (maximum concentration 22.7 ug/L), chromium (maximum concentration 148 ug/L), and iron (maximum concentration 23,350 ug/L), all via ingestion of groundwater, were the principal compounds of concern in Site 1 groundwater that contributed to the estimated Hazard Index (HI) greater than the EPA guidance for these exposure scenarios. The RME estimates of non-cancer risk from exposure to groundwater for the future industrial receptor are probably overly conservative because associated central tendency non-cancer HIs are less than 1.0. However, central tendency risk estimates for residential exposure to groundwater yielded HIs greater than 1.0 for the target organs liver and digestive system (iron was the principal compound of concern).

The results of the Site 11 baseline human health risk assessment concluded that RME cancer risks estimated for future residents consuming and exposed to groundwater were approximately 3E-06, near the lower end of the target maximum acceptable risk range. Non-cancer risks estimated for the future residential and future industrial exposure scenarios were below 1.0; the cutoff point below which adverse effects are not expected to occur. The amended risk assessment procedure resulted in the elimination of all principal compounds of concern with associated risk above target guideline limits.

Lead concentrations encountered in all media at Sites 1 and 11 during the RIs were below the EPA guidance concentrations and would not be expected to be associated with significant increases in blood-lead 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 existing conditions at Sites 1 and 11. 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 1 and 11.

Site 1

Protection of Human Health RAO

- Prevent potential human exposure to metals in groundwater.

Protection of the Environment RAO

- None.

Site 11

Protection of Human Health RAO

No human health RAO for Site 11 was selected. No further action for Site 11 is warranted based on the findings of the RI and FS.

Protection of the Environmental RAO

No environmental RAO for Site 11 was selected. No further action for Site 11 is warranted based on the findings of the RI and FS.

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 8 included no action; and limited action (long-term monitoring and institutional controls). Summaries of remedial alternatives that passed the screening step for each site are presented in the following section.

Site 1 Remedial Alternatives

Three remedial alternatives were developed for Site 1. 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 alternative is to evaluate the overall human health and environmental protection provided by the site in its present state. No five-year reviews or monitoring would be performed under this alternative.

Alternative 2: Limited Action (Long-Term Monitoring)

Alternative 2 includes long-term annual monitoring of site groundwater to assess contaminant status and potential threats to human health and the environment. This alternative does not employ engineered treatment, containment, or institutional controls 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 or burning has occurred or will be allowed at the site. Since contaminated media would be left in place, site conditions and risks would be reviewed every five years.

Alternative 3: Limited Action (Long-Term Monitoring with CEA)

Alternative 2 includes long-term annual monitoring of site groundwater to assess contaminant status and potential threats to human health and the environment. Because site groundwater does not meet New Jersey groundwater quality standards, a Classification Exception Area (CEA) pursuant to N.J.A.C 7:9-6 would be established. 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 or burning has occurred or will be allowed at the site. Since contaminated soils would be left in place, site conditions and risks would be reviewed every five years.

Site 11 Remedial Alternatives

The no-action alternative is the only remedial alternative developed for Site 11 based on the findings of the previous site investigations and related human health risk assessment. Further study or remediation based on ecological concerns at Site 11 is considered undesirable, in that it may interfere with propagation of Knieskern's beaked-rush.

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

Tetra Tech NUS (TtNUS) submits this Feasibility Study (FS) report for the Naval Weapons Station Earle in response to Contract Task Order No. 843 under Contract N62467-94-D-0888, Comprehensive Long-Term Environmental Action Navy (CLEAN). This work is part of the Navy's Installation Restoration Program (IRP), which is designed to identify and characterize contamination of Navy and Marine Corps facilities resulting from past operations and to institute corrective measures as appropriate.

This FS report presents an executive summary (preceding this section), a summary of previous investigations for the two sites addressed in this FS (Section 1.0), identification and screening of remedial technologies for the two 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 two sites have also been presented. For a full understanding of site conditions, the Final Remedial Investigation (RI) Report, July 1996, must be reviewed. The RI report is an essential companion document 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 8 (OU 8), which includes Site 1 (Ordnance Demilitarization Site) and Site 11 (Contract Ordnance Disposal Area). The OU 8 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 location of NWS Earle in the region. Figure 1-2 shows the Mainside area Installation Restoration (IR) program sites and highlights the OU 8 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 1,500 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 12,300 people. Middletown Township, which is the location of the Waterfront area, has a total population of approximately 68,200 people.

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 8, 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 the site summary sections.

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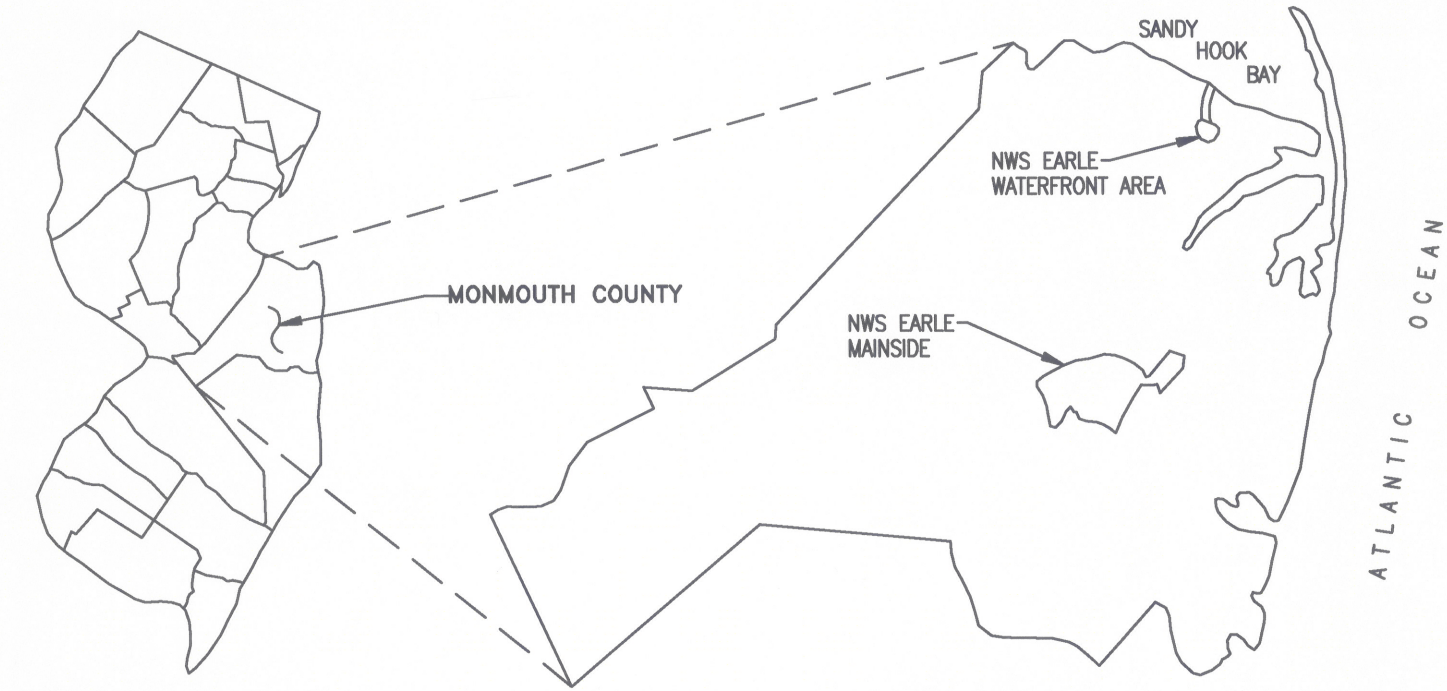

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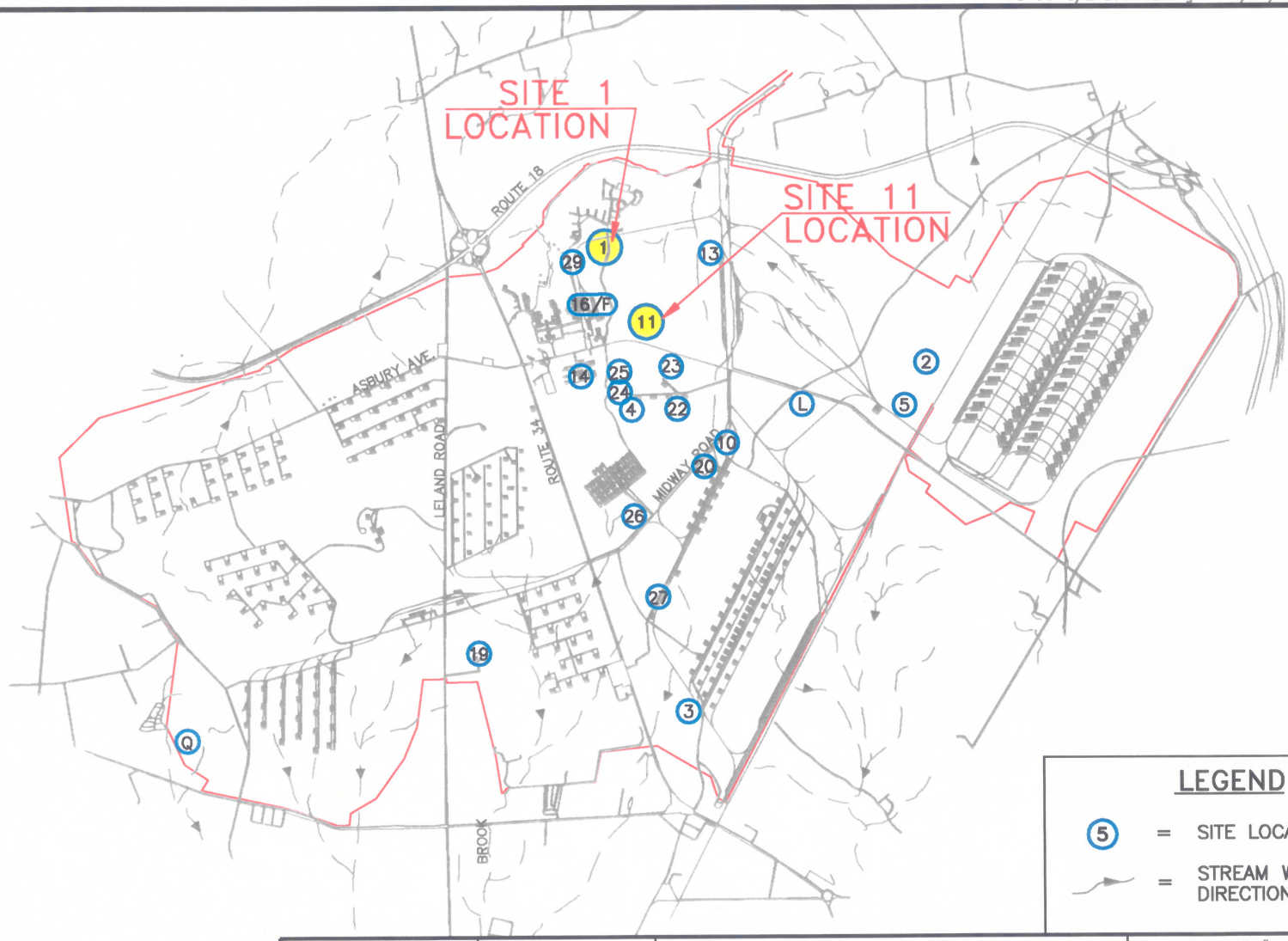

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5 = SITE LOCATION

= STREAM WITH FLOW DIRECTION

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Tetra Tech NUS, Inc.

OU-8 LOCATION

NAVAL WEAPONS STATION EARLE

COLTS NECK, NEW JERSEY

CONTRACT # – CTO # 2128 – 1101	
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APPROVED BY	DATE
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NWS Earle is situated in the Coastal Plain Physiographic Province of New Jersey. The New Jersey Coastal Plain is a seaward-dipping wedge of unconsolidated Cretaceous to Quaternary sediments that were deposited on a pre-Cretaceous basement-bedrock complex. The Coastal Plain sediments are primarily composed of clay, silt, sand, and gravel and were deposited in continental, coastal, and marine environments. The sediments generally strike northeast-southwest and dip to the southeast at a rate of 10 to 60 feet per mile. The approximate thickness of these sediments beneath NWS Earle is 900 feet. The pre-Cretaceous complex consists mainly of PreCambrian and lower Paleozoic crystalline rocks and metamorphic schists and gneisses. The Cretaceous to Miocene Coastal Plain Formations are either exposed at the surface or subcrop in a banded pattern that roughly parallels the shoreline. The outcrop pattern is caused by the 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 8 sites are situated in the recharge area of the Vincentown aquifer system. The Vincentown aquifer system is developed in the sands and calcarenites of the Vincentown Formation within its outcrop area and extends for approximately 8 to 10 miles downdip. The Vincentown aquifer was reported in previous investigations as being used extensively for residential wells in the Mainside area. This aquifer is underlain by confining beds of the Hornerstown and Tinton Sands.

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 2 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 two kilometers below the Swimming River Reservoir. Swimming River is tidally influenced below its confluence with Pine Brook and flows from there about four 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 five 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.

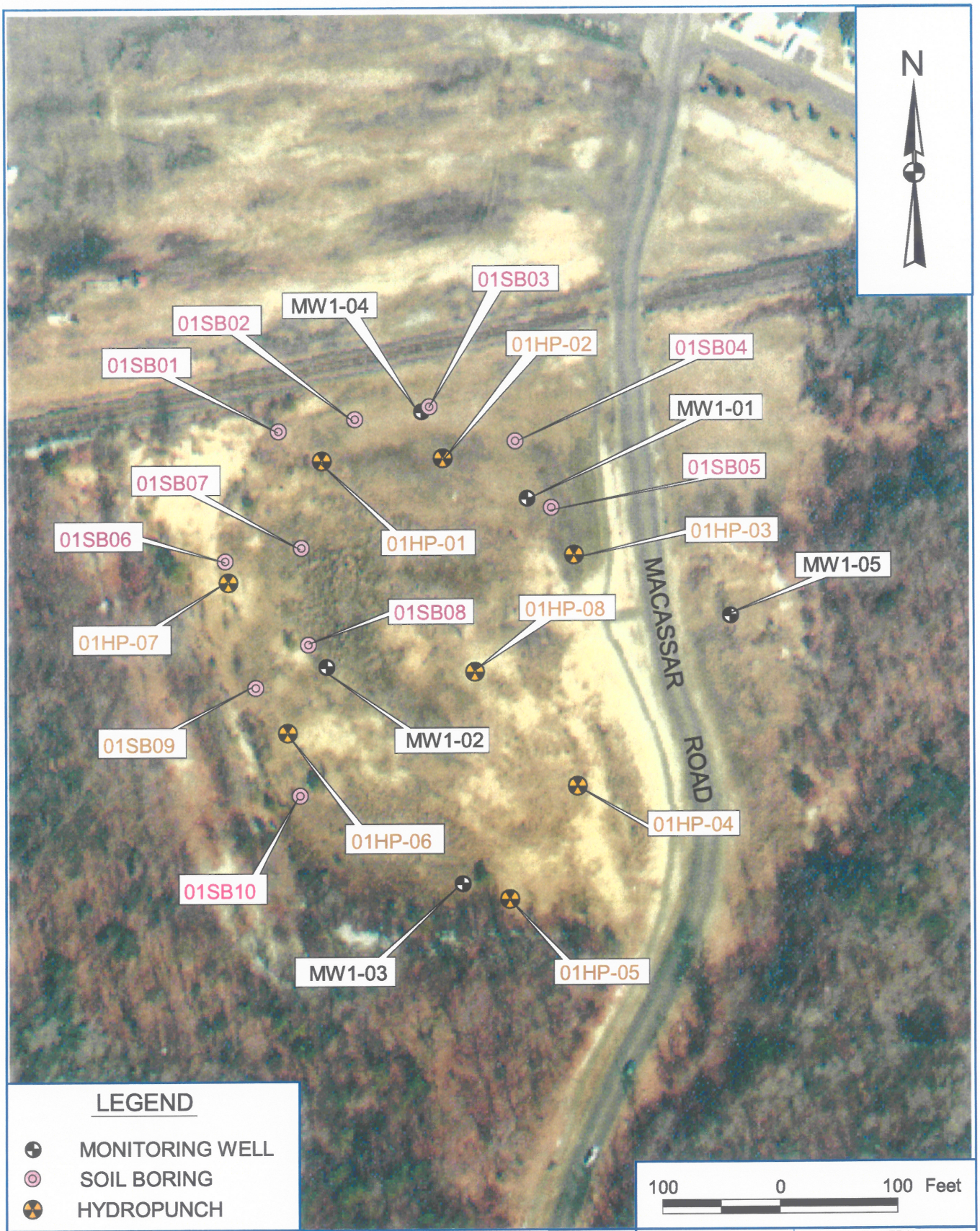
Two areas of NWS Earle, the Mainside Administration and Housing area and the Waterfront Administrative area, are not encumbered by ESQD arcs. These areas are used for offices, base support, housing, and recreational facilities. Any future development would be expected to occur in one of these areas unless the development had an ordnance-specific use. Site 1 is within the Mainside Administration and Housing area. 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. Site 11 is located at least partially within ESQD arcs. Therefore, future development at this site is severely restricted.

The sites were utilized for various purposes. The ordnance demilitarization site (Site 1) is a 6-acre open field that was used for burning ordnance material between 1943 and 1975 (Figures 1-3 and 1-3a). During site abandonment, the area was plowed, and a layer of diesel-soaked hay was burned on site to remove residual ordnance. This procedure was carried out three times. For several years during the early 1990s, a United States Army communications station and tower were located near the center of the site. The site is currently cleared of all structures.

The contract ordnance disposal area (Site 11) is a 2-acre site that was used for disposal of obsolete ordnance material for several years (dates unknown) (Figures 1-4 and 1-4a). The site was occasionally used from 1974 to 1977 for firefighting training. Training activities took place in two unlined pits, approximately 20 feet long. During firefighting training, reject vehicles were soaked with fuel or oil and ignited and then extinguished. Unburned fuel and waste oil used for ignition were allowed to evaporate or soak into the soil. It has been estimated that 50 gallons of oil per year may have been lost in this manner.

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 EPA. These documents include the Draft Report for Naval Weapons Station Earle, Colts Neck, New Jersey, IRP



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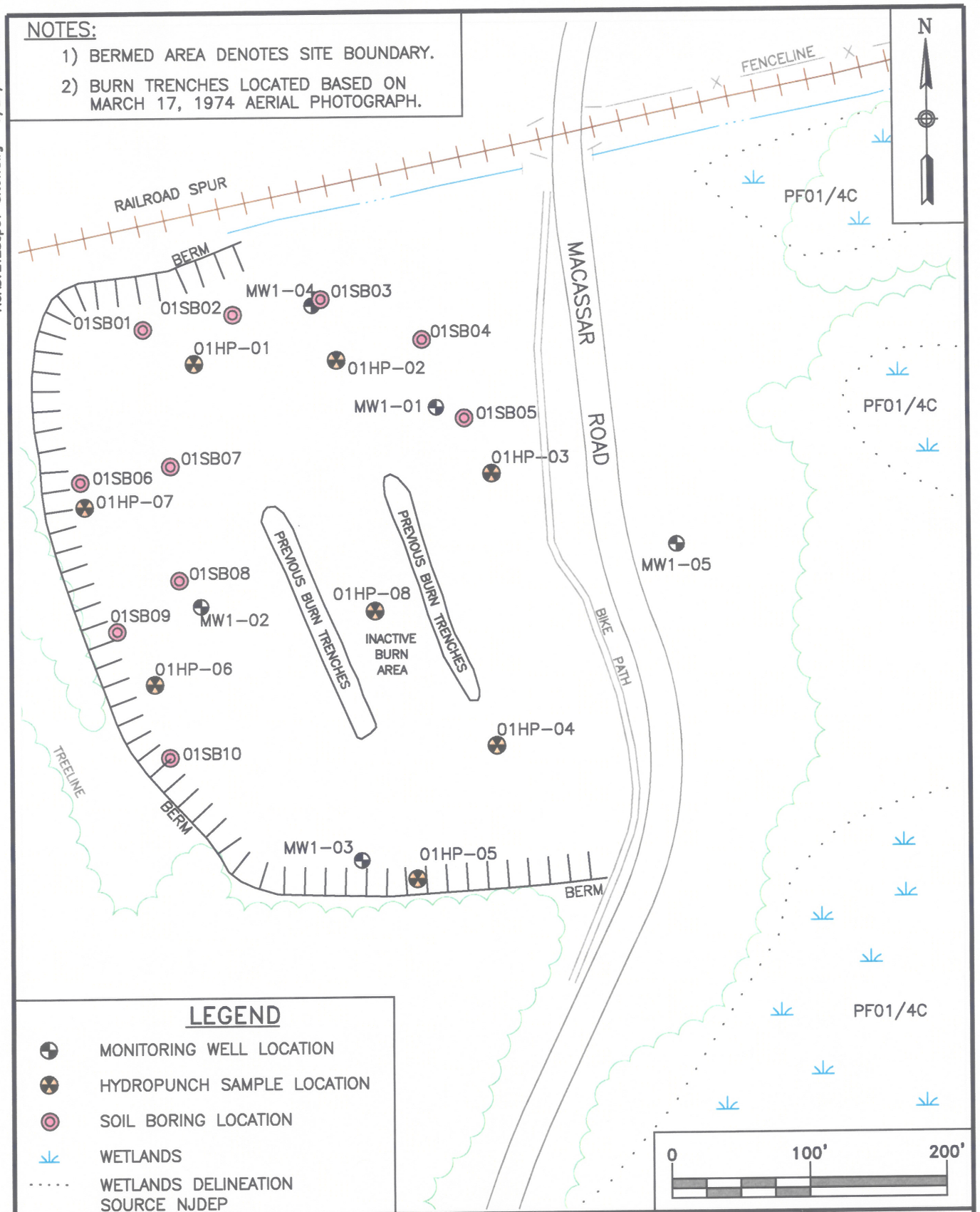
COST/SCHEDULE-AREA			APROVED BY / DATE 8/2/02
SCALE AS NOTED			DRAWING No. FIGURE 1-3 / REV



TETRA TECH NUS, INC.

SAMPLE LOCATIONS
SITE 1 – ORDNANCE DEMILITARIZATION SITE
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

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FIGURE NUMBER: FIGURE 1-3a

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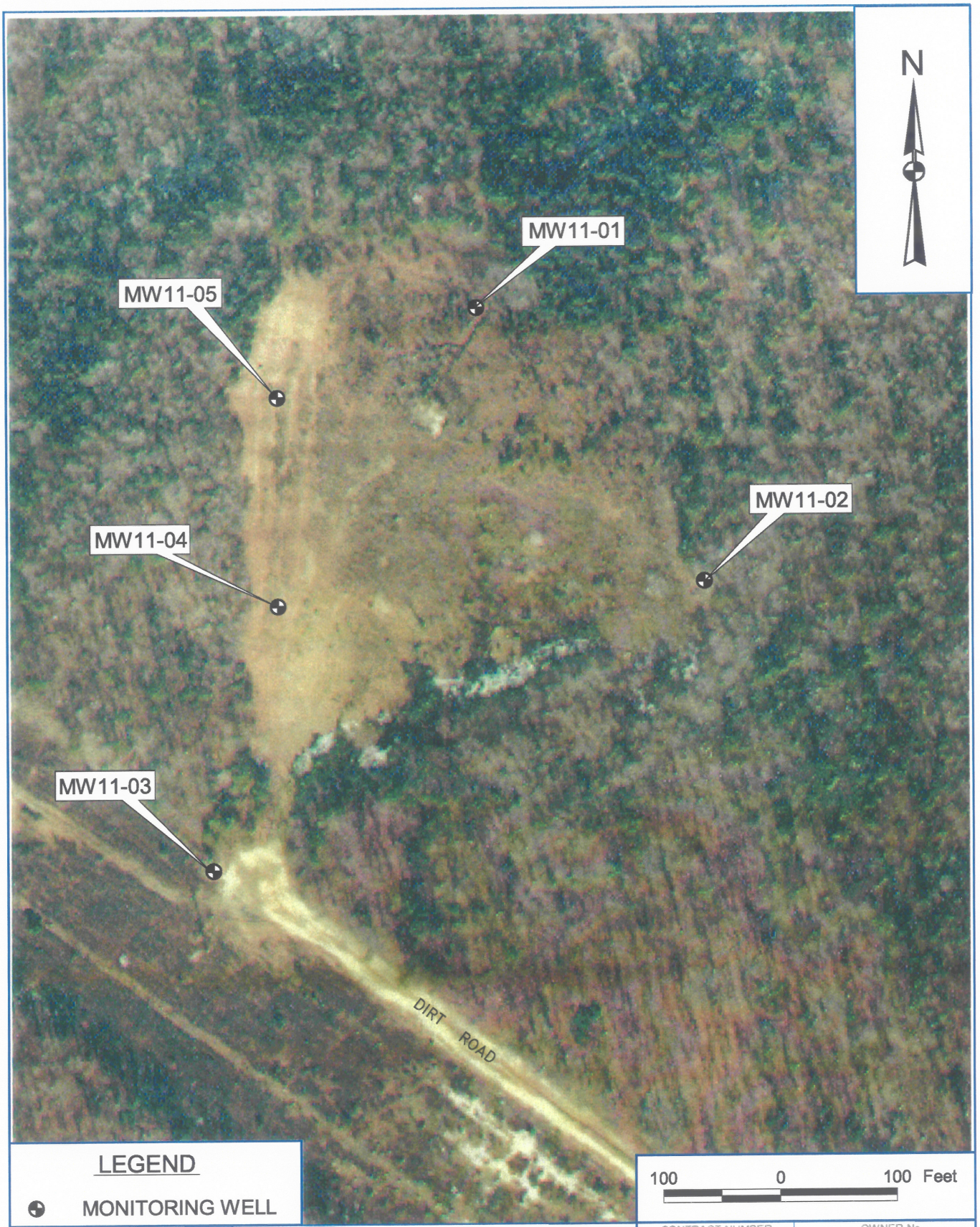
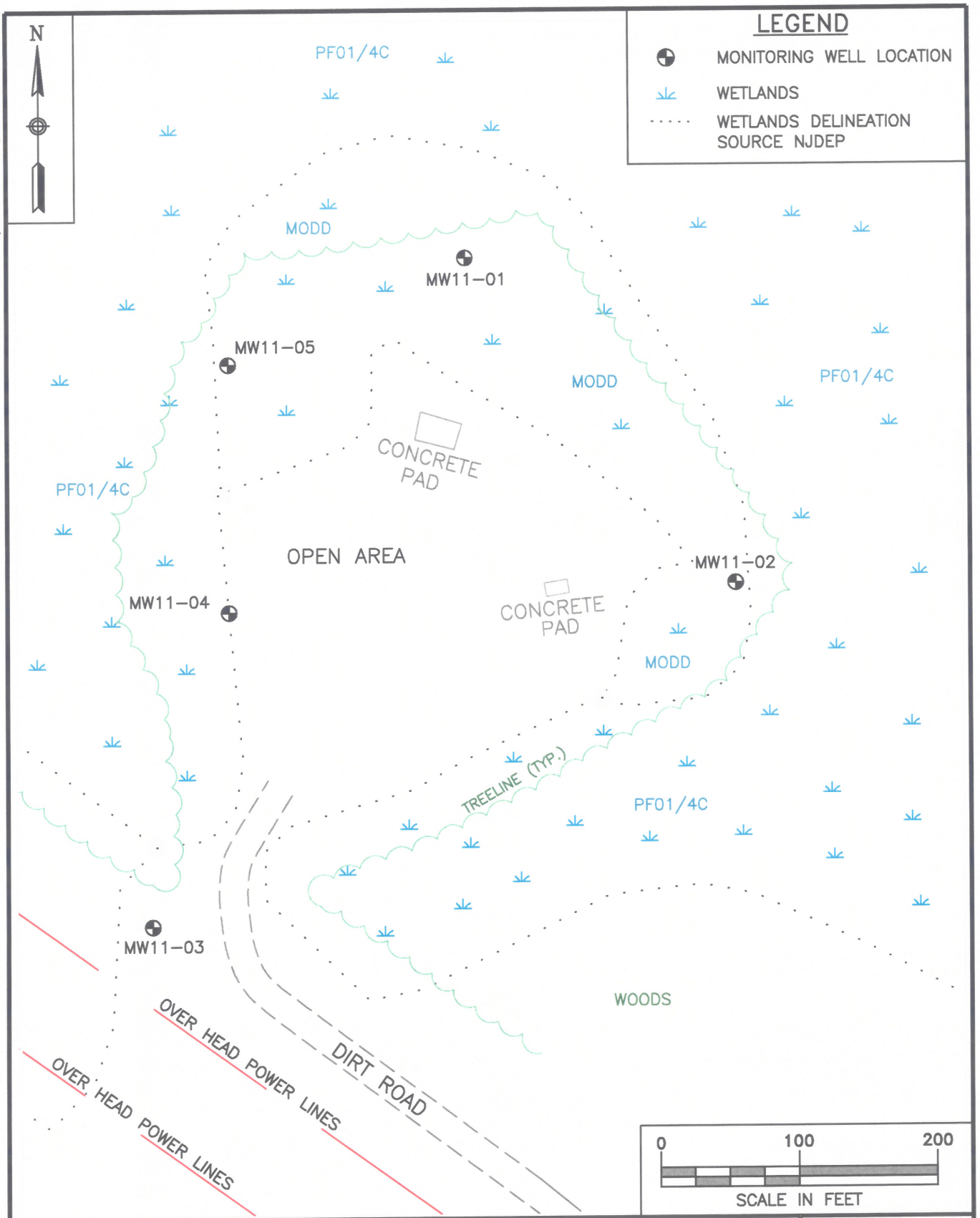


LEGEND

MONITORING WELL

DRAWN BY LDL	DATE 8/9/02	Tetra Tech NUS, Inc.	CONTRACT NUMBER 2128 / OWNER No. FS OU-8
CHECKED BY RET	DATE	SAMPLE LOCATIONS SITE 11 CONTRACT ORDNANCE DISPOSAL AREA NAVAL WEAPONS STATION EARLE COLTS NECK, NEW JERSEY	PROJECT FILE: NWS-Earle_Sites 1&11-PHL.apr LAYOUT: SITE-11 Sample Locations
COST/SCHEDULE-AREA			APROVED BY / DATE
SCALE AS NOTED			DRAWING No. FIGURE 1-4 / REV



ACAD: 2128cp02-Site11.dwg 8/9/02 LDL

TETRA TECH NUS, INC.

SAMPLE LOCATIONS
SITE 11 – CONTRACT ORDNANCE DISPOSAL AREA
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

SCALE	AS NOTED
FILE: 2128cp02.dwg	LDL PHL
REV	DATE 9/17/02
FIGURE NUMBER	FIGURE 1-4a

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 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 8 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 one 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.

TABLE 1-1
BACKGROUND MONITORING WELL CHARACTERISTICS SUMMARY
OU 8 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 8 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

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.

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.

TABLE 1-3
BACKGROUND WELLS AND UPGRADIENT WELLS GROUPED BY INTERPRETED AQUIFER
OU 8 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-8 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-8 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-8 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).

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.

1.3.2 Site 1

1.3.2.1 Initial Assessment and Confirmation Study

An Initial Assessment Study (IAS) in 1983, consisting of a document search and employee interviews, concluded minimal impact at Site 1.

1.3.2.2 Phase I Remedial Investigation

Phase I activities were conducted by Weston in 1993 at NWS Earle. In 1993, 16 soil samples were collected from a grid across the site at depths ranging from 0 to 0.5 feet below ground surface (bgs) and 0.5 to 1.5 feet bgs. The samples were submitted for Target Analyte List (TAL) metals, explosive compounds, and total petroleum hydrocarbons (TPH). Thirteen metals were detected in some or all of the samples at levels below regulatory concern. The most significant compounds detected were cadmium (up to 2.2 ppm), chromium (up to 65.7 ppm), mercury (up to 0.96 ppm), and lead (up to 179 ppm). Nitrite (0.32 ppm) was detected in one sample. Nitrate (up to 2.6 ppm) was detected in soil samples. Explosive compounds were found at very low levels in one surface soil sample. TPH concentrations ranged from non-detectable to 450 ppm.

During the 1993 activities, three monitoring wells were installed and groundwater samples were collected and submitted for Target Compound List (TCL) volatile organic compounds (VOC), TCL semi-volatile organic

TABLE 1-7
STATISTICAL EVALUATION OF BACKGROUND SURFACE SOIL METALS DATA
OU-8 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-8 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.

compounds (SVOC), and explosive compound analysis. Elevated levels of the following TCL VOCs were found in MW1-01: acetone (up to 7 ppb) and 1,1-dichloroethylene (up to 80 ppb). Elevated levels of the TAL inorganics such as chromium (up to 538 ppb), lead (up to 12.5 ppb), and iron (up to 76,000 ppb) were detected generally in all three monitoring wells. Explosive compounds RDX (up to 8.98 ppb), 2,4-DNT (up to 0.82 ppb), and nitrite - nitrate combined (up to 1.4 ppm) were detected in two wells.

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 8. Based on comparable findings from the 1983 IAS and the 1993 Phase I activities, surface soil was not sampled during the RI. Activities performed during this investigation of Site 1 are summarized below.

- Sampling and analysis of groundwater samples from eight hydropunch locations.
- Sampling and analysis of subsurface soil samples from 10 soil borings.
- Drilling and installation of two shallow permanent monitoring wells.
- Sampling and analysis of groundwater from the wells.
- Measurement of static-water levels in the monitoring wells.
- Execution of slug tests in two of the monitoring wells.

The field team surveyed to establish the horizontal locations and vertical elevations of the hydropunch sample locations, soil borings, newly installed monitoring wells, and selected existing wells.

1.3.2.4 Summary of 1995/1996 RI Results

The site is bordered by Macassar Road to the east, a railroad spur to the north, and an 8- to 10-foot-high berm to the west and south. No drainage swales or streams are located on the site. Groundwater flow is generally to the east-northeast, based on measured groundwater levels.

1.3.2.4.1 Site Geology, Hydrogeology, and Hydrology

<u>Geology</u>

Regional mapping places Site 1 within the outcrop area of the Vincentown Formation. The Vincentown Formation ranges between 10 and 130 feet in thickness and the soil borings are no more than 16 feet deep. The lithology of the sediments encountered in the on-site borings generally agrees with the published description of the Vincentown Formation. In general, the borings encountered alternating beds of yellowish-

brown, micaceous, silty, fine- to medium-grained sand and light olive brown, glauconitic, silty sand and sand. Trace amounts of clay and gravel are present in the upper two feet of some of the borings and possibly represent the plow zone.

Hydrogeology

Groundwater in the Vincentown aquifer beneath the site occurs under unconfined conditions. Static-water-level measurements and water-table elevations are summarized in Table 1-9. Groundwater elevations for August 1995 and October 1995 are contoured on Figures 1-5 and 1-6, respectively. The direction of shallow groundwater flow in the aquifer, as indicated by both the August and October groundwater contour maps, is toward the east-northeast. There does not appear to be a significant seasonal variation in groundwater flow direction. The hydraulic conductivities calculated for MW1-04 and MW1-05 are 6.06×10^{-4} cm/sec (1.71 ft/day) and 1.29×10^{-3} cm/sec (3.66 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 1-12 compare the results of background samples to samples collected at Site 1. Figure 1-7 shows sample locations and concentrations of compounds that exceed applicable or relevant and appropriate requirements (ARARs) and other guidance to be considered (TBCs).

Subsurface Soil

Twenty site-related subsurface soil samples were collected at Site 1. Table 1-10 presents the occurrence and distribution of inorganic chemicals detected in site-related subsurface soil samples and compares them to background concentrations.

Concentrations of most metals in site-related subsurface soil samples were similar to the ranges associated with background samples. Certain metals were detected at concentrations slightly greater than the range associated with background samples: antimony, 5.1 mg/kg in sample 01 SB 10-02; arsenic, 27.8 mg/kg in sample 01 SB 03-00; and silver, 2.2 mg/kg in 01 SB 07-00.

Explosive compounds were analyzed for in 20 subsurface soil samples. Nitrocellulose was detected at a depth of two feet in sample location 01 SB 02-02 at a concentration of 77,000 ug/kg. This compound was detected in one background subsurface soil sample.

TABLE 1-9
SITE 1 STATIC WATER-LEVEL MEASUREMENT STUDY
OU 8 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY

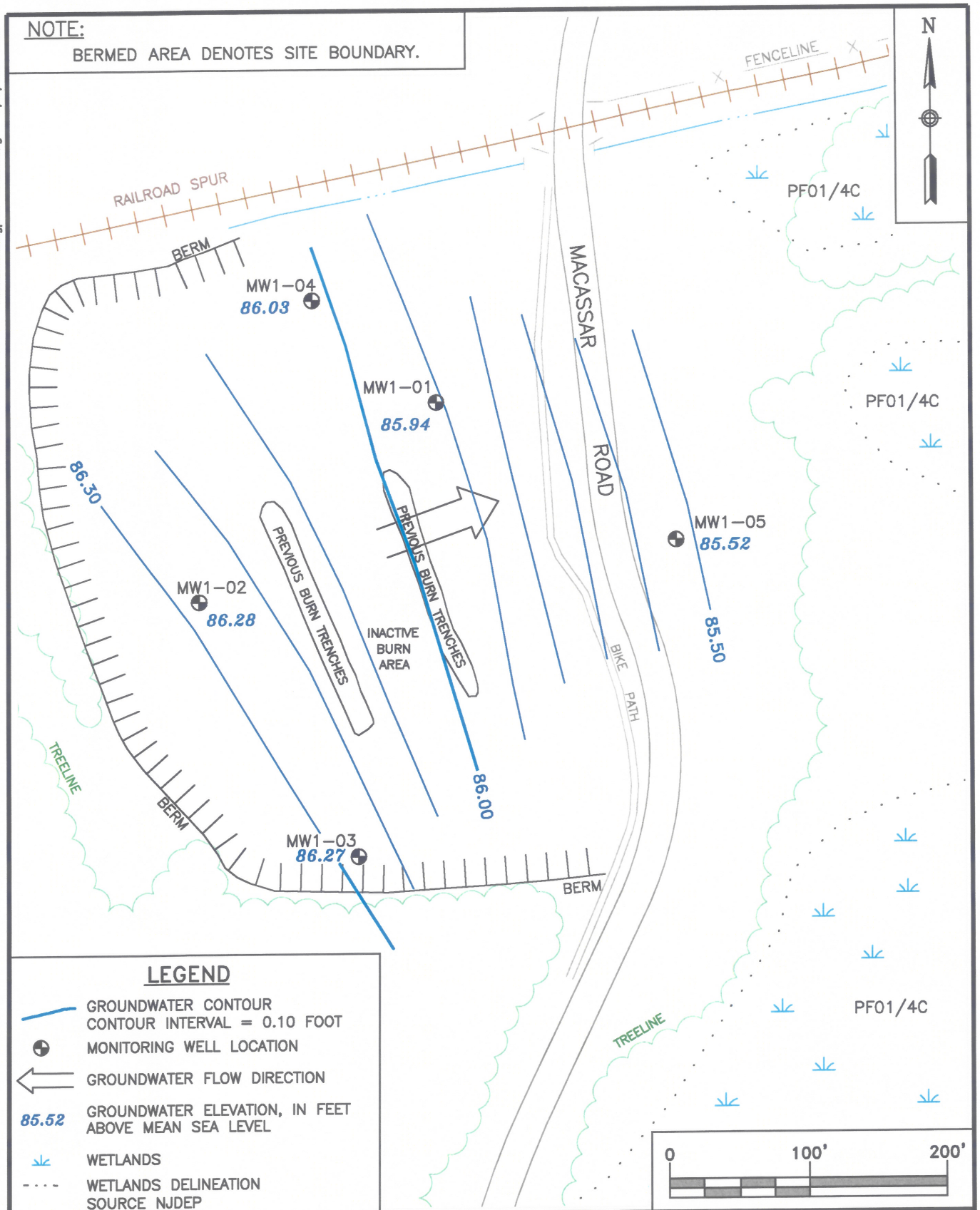
Monitoring Well Number	August 7, 1995			October 17, 1995		
	Depth to Water Table[1] (feet)	Top of PVC Riser[2] (feet)	Elevation of Water Table[2] (feet)	Depth to Water Table[1] (feet)	Top of PVC Riser[2] (feet)	Elevation of Water Table[2] (feet)
MW1-01	7.72	93.66	85.94	7.49	93.66	86.17
MW1-02	6.16	92.44	86.28	6.03	92.44	86.41
MW1-03	7.38	93.65	86.27	7.09	93.65	86.56
MW1-04	7.90	93.93	86.03	7.70	93.93	86.22
MW1-05	8.68	94.20	85.52	8.51	94.20	85.69

(1) In feet below top of riser.

(2) In feet above mean sea level (MSL).

ACAD: 2128gp01-Site1.dwg 8/2/02 LDL

NOTE:
BERMED AREA DENOTES SITE BOUNDARY.



LEGEND

- GROUNDWATER CONTOUR CONTOUR INTERVAL = 0.10 FOOT
- MONITORING WELL LOCATION
- GROUNDWATER FLOW DIRECTION
- 85.52 GROUNDWATER ELEVATION, IN FEET ABOVE MEAN SEA LEVEL
- WETLANDS
- WETLANDS DELINEATION SOURCE NJDEP

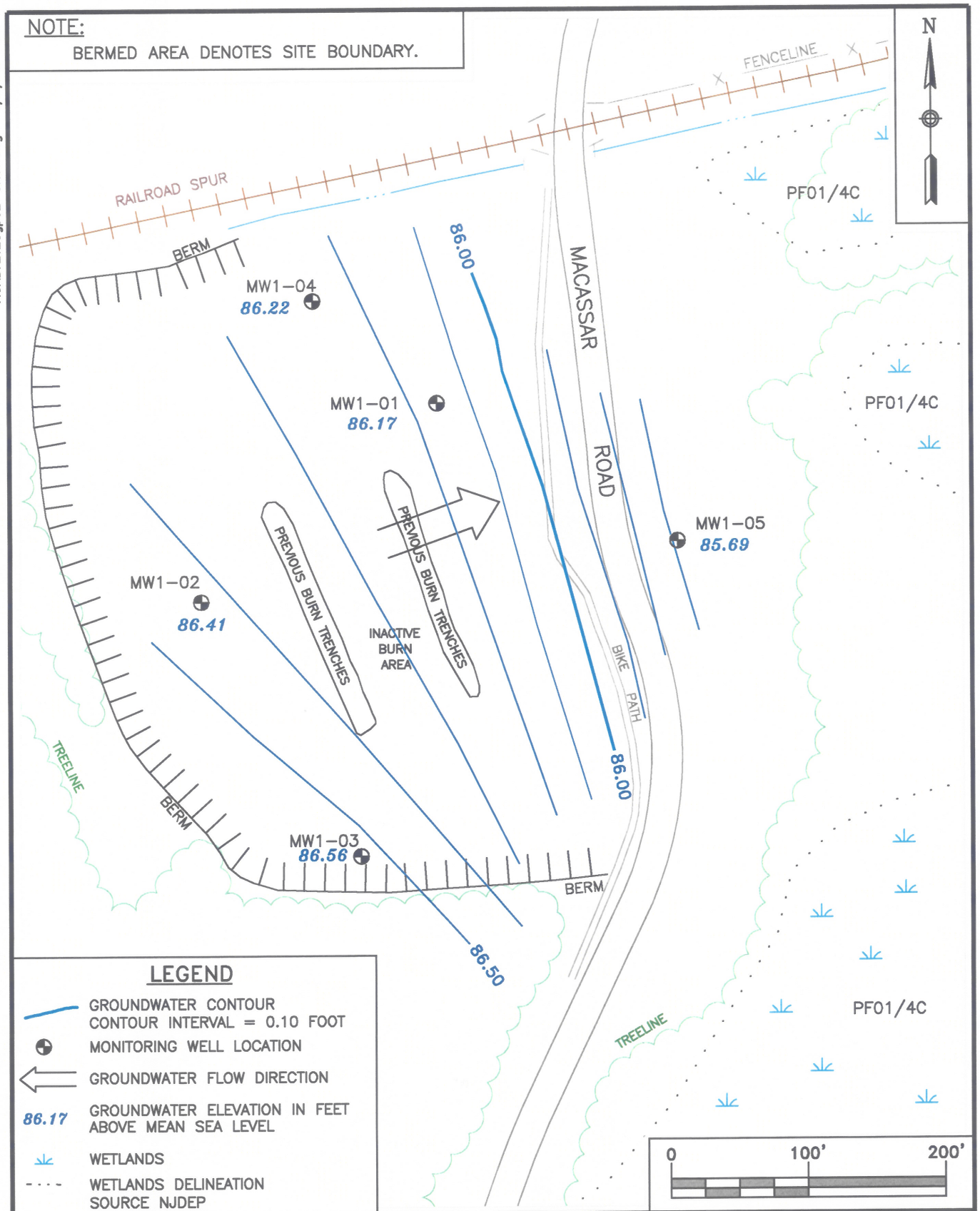
TETRA TECH NUS, INC.

GROUNDWATER CONTOUR MAP
AUGUST 7, 1995
SITE 1 – ORDNANCE DEMILITARIZATION SITE
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

SCALE	AS NOTED
FILE: 2128gp01.dwg	LDL PHL
REV	DATE 9/17/02
FIGURE NUMBER	FIGURE 1-5

ACAD: 2128gp02-Site1.dwg 8/2/02 LDL

NOTE:
BERMED AREA DENOTES SITE BOUNDARY.



LEGEND

- GROUNDWATER CONTOUR CONTOUR INTERVAL = 0.10 FOOT
- MONITORING WELL LOCATION
- GROUNDWATER FLOW DIRECTION
- 86.17 GROUNDWATER ELEVATION IN FEET ABOVE MEAN SEA LEVEL
- WETLANDS
- WETLANDS DELINEATION SOURCE NJDEP

TETRA TECH NUS, INC.

GROUNDWATER CONTOUR MAP
OCTOBER 17, 1995
SITE 1 – ORDNANCE DEMILITARIZATION SITE
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

SCALE	AS NOTED
FILE: 2128gp02.dwg	LDL PHL
REV	DATE 9/17/02
FIGURE NUMBER	FIGURE 1-6

TABLE 1-10

OCCURRENCE AND DISTRIBUTION OF INORGANICS IN SUBSURFACE SOIL AT SITE 1
NWS EARLE, COLTS NECK, NEW JERSEY
(mg/kg)

	BACKGROUND			SITE-RELATED				
SUBSTANCE	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	2 X AVERAGE BKGD CONCENTRATION	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	AVERAGE CONCENTRATION	MEAN > 2 X BKGD	REPRESENTATIVE CONCENTRATION
ALUMINUM	8 / 8	675 - 5310	5370.00	20 / 20	897 - 5180	2556.31	NO	3487.33
ANTIMONY	NOT DETECTED	-	-	2 / 20	1.3 - 5.1	0.00	YES	3.64
ARSENIC	8 / 8	1.35 - 14.4	13.29	20 / 20	2 - 27.8	5.81	NO	12.20
BARIUM*	8 / 8	0.92 - 31	17.92	20 / 20	1.8 - 121	3.72	NO	31.13
BERYLLIUM*	2 / 8	0.12 - 0.28	0.28	10 / 20	0.16 - 0.61	0.25	NO	0.26
CADMIUM*	1 / 8	0.57	0.58	5 / 20	0.1 - 0.61	0.35	NO	0.31
CALCIUM	8 / 8	28.6 - 799	577.55	20 / 20	30.1 - 1710	299.60	NO	312.96
CHROMIUM	8 / 8	4.7 - 59.5	54.73	20 / 20	28.4 - 84.6	71.08	YES	63.02
COBALT	4 / 8	0.75 - 5	2.77	4 / 20	0.19 - 1.1	0.34	NO	0.65
COPPER	8 / 8	0.97 - 8.6	8.66	16 / 20	0.68 - 57.6	3.26	NO	12.82
IRON	8 / 8	3745 - 62500	40871.25	20 / 20	2590 - 18500	9410.47	NO	13481.13
LEAD*	8 / 8	1.4 - 39.4	24.33	20 / 20	1.3 - 62.85	8.39	NO	18.26
MAGNESIUM	8 / 8	18.5 - 619	504.05	20 / 20	121 - 1130	348.20	NO	609.14
MANGANESE	8 / 8	2.6 - 214	92.51	16 / 20	0.53 - 23.3	4.24	NO	5.58
MERCURY*	8 / 8	0.03 - 0.17	0.13	18 / 20	0.025 - 0.2	0.02	NO	0.06
NICKEL	4 / 8	1.8 - 7.2	4.75	5 / 20	0.54 - 1.9	1.13	NO	1.07
POTASSIUM	7 / 8	95 - 792	793.35	20 / 20	214 - 2930	899.52	YES	1690.40
SELENIUM	2 / 8	0.57 - 0.93	0.79	3 / 20	0.56 - 0.61	0.52	NO	0.36
SILVER*	2 / 8	0.37 - 0.67	0.51	4 / 20	0.14 - 2.2	0.25	NO	0.74
SODIUM	8 / 8	17.5 - 94.8	79.35	10 / 20	11.3 - 115	61.72	NO	96.42
THALLIUM	4 / 8	0.7 - 1.9	1.38	7 / 20	0.7 - 1.2	0.64	NO	0.63
VANADIUM	8 / 8	11.05 - 64	64.71	20 / 20	5 - 50.4	40.86	NO	38.09
ZINC*	6 / 8	1.1 - 50.7	31.35	8 / 20	4.7 - 129	6.49	NO	27.14

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

TABLE 1-11

OCCURRENCE AND DISTRIBUTION OF INORGANICS IN GROUNDWATER AT SITE 1
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	5 / 5	1380 - 10800	5218.00	YES	10800
ARSENIC	1 / 11	5.8 - 5.8	4.05	3 / 5	5.8 - 22.7	9.31	YES	22.7
BARIUM	11 / 11	2.6 - 518	229.60	5 / 5	50.1 - 853	489.52	YES	853
BERYLLIUM*	4 / 11	0.21 - 1.6	0.49	4 / 5	0.21 - 0.85	0.375	NO	0.85
CADMIUM	5 / 11	0.6 - 1.9	1.21	5 / 5	1.5 - 3.3	2.53	YES	3.3
CALCIUM	11 / 11	506 - 17200	8306.55	5 / 5	1210 - 5450	3085	NO	5450
CHROMIUM	NOT DETECTED	-	-	5 / 5	19.6 - 148	72	YES	148
COBALT	6 / 11	0.7 - 10.1	4.06	5 / 5	0.7 - 3.4	1.95	NO	3.4
COPPER	9 / 11	0.79 - 13.5	6.53	5 / 5	1.8 - 75.45	25.93	YES	75.45
IRON	11 / 11	153 - 7690	4197.09	5 / 5	3550 - 23350	12568	YES	23350
LEAD	3 / 11	2.1 - 3	2.44	4 / 5	4.7 - 14.5	6.59	YES	14.5
MAGNESIUM	11 / 11	273 - 27400	8449.64	5 / 5	1060 - 2690	1859	NO	2690
MANGANESE	11 / 11	3.3 - 65	46.18	5 / 5	24.2 - 97.1	55.16	YES	90.85
MERCURY	11 / 11	0.005 - 0.12	0.12	5 / 5	0.082 - 0.28	0.1424	YES	0.22
NICKEL*	10 / 11	0.81 - 25.5	11.98	3 / 5	2.3 - 4.6	2.01	NO	4.6
POTASSIUM	11 / 11	350 - 3245	2810.55	5 / 5	2180 - 10700	5056	YES	10700
SILVER	NOT DETECTED	-	-	1 / 5	1.2	0.616	YES	1.09
SODIUM	11 / 11	1850 - 11650	8449.09	5 / 5	1850 - 29500	10335	YES	29500
THALLIUM*	3 / 11	4 - 5.1	5.15	1 / 5	4.8	2.4	NO	4.42
VANADIUM	10 / 11	0.69 - 42.25	16.48	5 / 5	8.2 - 58.4	30.39	YES	58.4
ZINC	9 / 6	3.7 - 348	178.61	5 / 5	131 - 1020	631.4	YES	1020

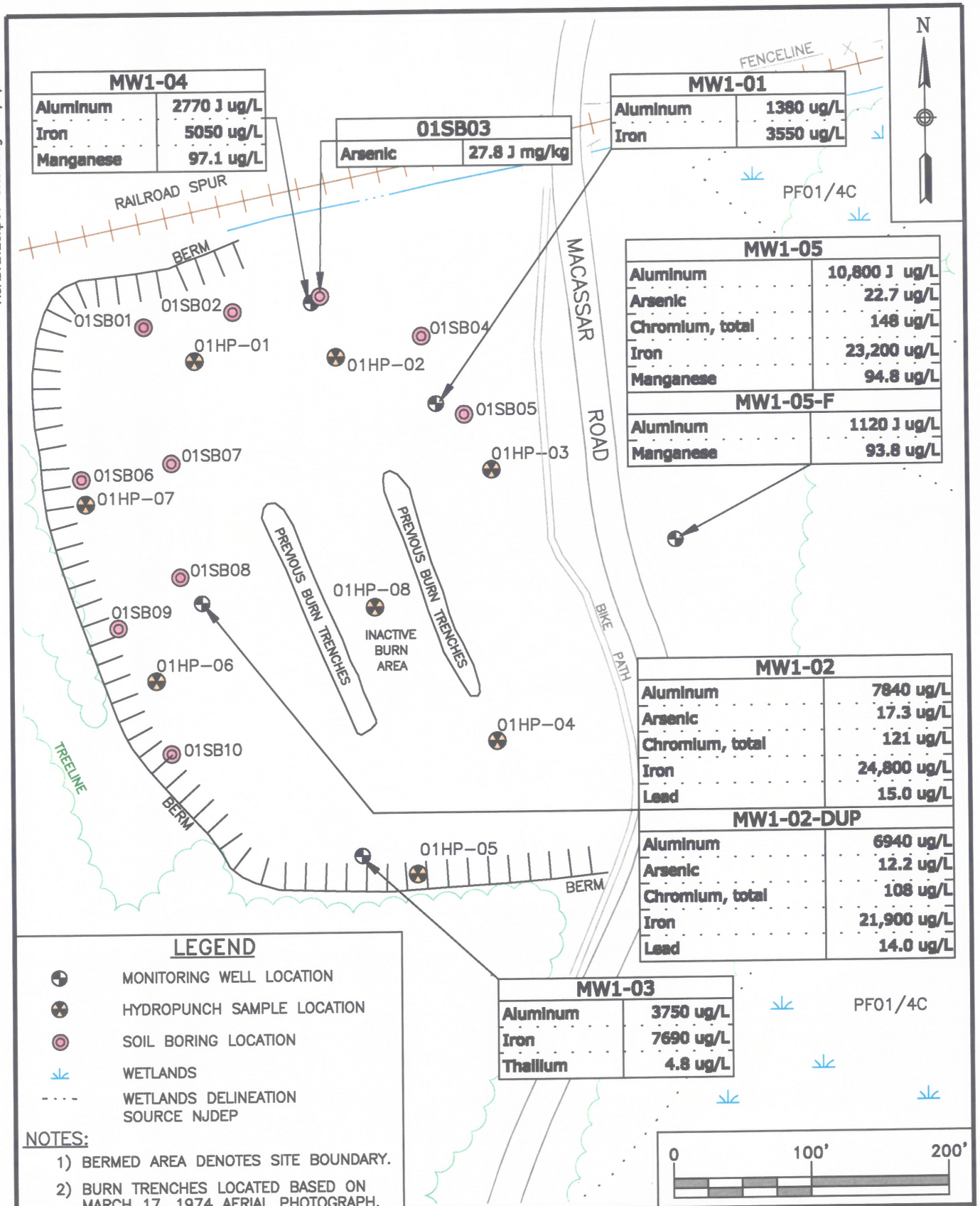
Note: Selected COPCs are indicated in boldface type.
* - Indicates COPCs eliminated based on amended risk assessment.

TABLE 1-12

OCCURRENCE AND DISTRIBUTION OF ORGANICS IN GROUNDWATER AT SITE 01
NWS EARLE, COLTS NECK, NEW JERSEY
(ug/L)

SUBSTANCE	BACKGROUND			SITE-RELATED		
	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	REPRESENTATIVE CONCENTRATION	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	REPRESENTATIVE CONCENTRATION
CHLOROFORM	NOT DETECTED		-	1 / 5	3	3
GAMMA-BHC (LINDANE)	NOT DETECTED		-	1 / 5	0.001	0.001
METHYLENE CHLORIDE	NOT DETECTED		-	1 / 5	1	1

ACAD:2128kp01-Site1.dwg 8/2/02 LDL



MW1-04	
Aluminum	2770 J ug/L
Iron	5050 ug/L
Manganese	97.1 ug/L

01SB03	
Arsenic	27.8 J mg/kg

MW1-01	
Aluminum	1380 ug/L
Iron	3550 ug/L

MW1-05	
Aluminum	10,800 J ug/L
Arsenic	22.7 ug/L
Chromium, total	148 ug/L
Iron	23,200 ug/L
Manganese	94.8 ug/L

MW1-05-F	
Aluminum	1120 J ug/L
Manganese	93.8 ug/L

MW1-02	
Aluminum	7840 ug/L
Arsenic	17.3 ug/L
Chromium, total	121 ug/L
Iron	24,800 ug/L
Lead	15.0 ug/L

MW1-02-DUP	
Aluminum	6940 ug/L
Arsenic	12.2 ug/L
Chromium, total	108 ug/L
Iron	21,900 ug/L
Lead	14.0 ug/L

MW1-03	
Aluminum	3750 ug/L
Iron	7690 ug/L
Thallium	4.8 ug/L

LEGEND

- MONITORING WELL LOCATION
- HYDROPUNCH SAMPLE LOCATION
- SOIL BORING LOCATION
- WETLANDS
- WETLANDS DELINEATION SOURCE NJDEP

NOTES:

1) BERMED AREA DENOTES SITE BOUNDARY.
2) BURN TRENCHES LOCATED BASED ON MARCH 17, 1974 AERIAL PHOTOGRAPH.

TETRA TECH NUS, INC.

CONCENTRATIONS ABOVE SCREENING LEVELS
SITE 1 – ORDNANCE DEMILITARIZATION SITE
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

SCALE: AS NOTED
FILE: 2128kp01.dwg
LDL PHL
REV
DATE: 9/17/02
FIGURE NUMBER: FIGURE 1-7

The miscellaneous parameters analyzed at Site 1 consisted of nitrate, nitrite, and TPH. TPH levels found in the background samples ranged from 9.0 mg/kg to 660 mg/kg, which is three times greater than the upper range reported for site-related samples (120 mg/kg to 240 mg/kg). In addition, nitrate levels were less than 0.7 mg/kg in all samples, which is within the range found in background samples and less than one-third of the maximum nitrate level reported in soil sampled during the previous 1992 investigation. Therefore, nitrate and TPH results do not demonstrate subsurface soil impacts related to past ordnance burning activities.

Groundwater

Five site-related groundwater samples (01 GW 01 through 01 GW 05) were collected at Site 1. Tables 1-11 and 1-12 present the occurrence and distribution of inorganic and organic chemicals detected in site-related groundwater samples compared to background.

Three unfiltered monitoring well samples, 01 GW 02, 01 GW 03, and 01 GW 05, exhibited elevated levels of several metals. Unfiltered monitoring well samples 01 GW 02 and 01 GW 05 exhibited the highest concentrations of aluminum, arsenic, cadmium, chromium, iron, lead, and zinc. Thallium was detected in 01 GW 03 but was not detected in background groundwater samples. Sample 01 GW 05 required filtering in the field, despite the use of micro-flow purge techniques to minimize suspended solids. Filtered sample results from the same location did not exhibit elevated levels of any metals except cadmium (3.0 ug/L) and zinc (182 ug/L).
Chloroform (3 ug/L), gamma-BHC (0.001 ug/L), and methylene chloride (1 ug/L) were each detected in one site-related groundwater sample collected at Site 1. None of these compounds were detected in background groundwater samples.

Explosives or their degradation by-products were detected in two groundwater samples. 01 GW 01 contained low levels of 2-amino-4,6-dinitrotoluene, and 01 GW 02 contained levels of 2,4-dinitrotoluene and RDX.

The following landfill parameters were analyzed in the Site 1 groundwater samples: biochemical oxygen demand (BOD), chemical oxygen demand (COD), nitrate, and total organic carbon (TOC). In addition, samples were analyzed for TPH (both 0.20 mg/L). Nitrate levels in site-related groundwater samples were within a range from 0.28 mg/L to 1.5 mg/L, which is less than the upper range detected in background samples and consistent with results of the 1992 sampling investigation. Therefore, nitrate results do not demonstrate groundwater impacts from past ordnance burning activities. No TPH was detected in background groundwater samples above the detection limit of 0.30 mg/L.

1.3.2.4.3 Contaminant Fate and Transport

Elevated levels of certain metals in groundwater may not indicate the potential for groundwater transport because suspended solids in the unfiltered groundwater samples were found. Metals in suspension are expected to have a greatly diminished potential for in-situ transport compared to metals in solution, given the

geologic formation, which does not include conditions conducive to solution channeling or fracture-based flow. Only cadmium and zinc were detected at slightly elevated levels in filtered groundwater and these metals were not found at elevated levels in other media sampled at Site 1. Furthermore, historical groundwater data for this site show elevated aluminum levels. This too suggests the presence of suspended solids. Overall, groundwater data do not indicate migration of dissolved inorganic contamination from the site.

Subsurface soils from this investigation generally revealed low concentrations of TPH. In comparison, a 1993 investigation revealed only slightly elevated levels of TPH in a sampling grid consisting of 16 subsurface soil locations.

Based upon limited detections, it is safe to conclude that there is not a widespread potential for groundwater contamination with methylene chloride, chloroform, or gamma-BHC at this site.

The presence of low levels of three explosives or explosive degradation products in two monitoring wells indicates that groundwater has been impacted by past site activities. The levels detected in one well were similar to those from a 1993 investigation. One well located downgradient and 400 feet east of one of the contaminated wells did not show the presence of explosives. The TNT degradation products are known to be susceptible to biodegradation; RDX is anaerobically biodegradable. These explosives are considered to be somewhat mobile in groundwater, but to a lesser extent than VOCs. Therefore, impacts from the low levels of explosives would be expected to be less widespread than impacts on groundwater from VOCs.

One out of 20 subsurface soil samples revealed the presence of nitrocellulose. This compound is readily adsorbed onto soil, has low solubility, and is not expected to migrate significantly in the subsurface environment.

Antimony, arsenic, and silver each exhibited elevated concentrations in only one subsurface soil sample. Inorganic compounds have a strong tendency to adsorb onto soil/sediment particles, a factor that greatly reduces their mobility. These metals were not detected at elevated levels in filtered groundwater and may or may not be related to past site activities.

1.3.2.4.4 Baseline Human Health Risk Assessment

Subsurface soil and groundwater were sampled at Site 1. This risk assessment does not take into account future loading of COPCs from subsurface soils to groundwater. It is assumed that loading of COPCs from subsurface soils to groundwater is currently occurring; therefore, groundwater exposure to potential receptors will adequately characterize this phenomenon, and risks from subsurface soils and groundwater are combined. The potential receptors for this site were future industrial and residential receptors.

The results of the Site 1 baseline human health risk assessment concluded that reasonable maximum exposure (RME) cancer risks estimated for future residents exposed to subsurface soil and consuming groundwater from beneath the site (5.6E-04) were at the upper end of the target maximum acceptable risk range. The estimated human health risk for the future industrial (subsurface soil and groundwater) exposure scenario (1.4E-04) was also at the upper end of the target maximum acceptable risk range. Arsenic (via ingestion of groundwater) was by far the greatest contributor to the estimated human health risks for the future residential (5.1E-04) and future industrial (1.2E-04) exposure scenarios. However, these RME estimates are probably overly conservative because a central tendency calculation shows that cancer risks are more likely to be within the mid-range of the target acceptable risk range.

RME estimates for non-carcinogenic HIs associated with future industrial (subsurface soil and groundwater) and future residential (subsurface soil and groundwater) exposure scenarios exceeded 1.0, the cutoff point below which adverse non-carcinogenic effects are not expected to occur. Arsenic (maximum concentration 22.7 ug/L), chromium (maximum concentration 148 ug/L), and iron (maximum concentration 23,350 ug/L), all via ingestion of groundwater, were the principal compounds of concern in Site 1 groundwater that contributed to the estimated Hazard Index (HI) greater than the EPA guidance for these exposure scenarios. The RME estimates of non-cancer risk from exposure to groundwater for the future industrial receptor are probably overly conservative because associated central tendency non-cancer HIs are less than 1.0. However, central tendency risk estimates for residential exposure to groundwater yielded HIs greater than 1.0 for the target organs liver and digestive system (iron was the principal COPC).

Lead groundwater concentrations at the site were below the EPA action level for public water supplies and lead soil concentrations were below EPA guidelines. These lead concentrations 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).

1.3.2.4.5 Ecological Risk Assessment

Site 1 contains limited terrestrial habitat, mainly scattered grass, brush, and some small trees. The site is probably utilized by small mammals, but receptor use is not extensive. Upland habitats around the site provide excellent terrestrial habitat. Runoff of contaminants to the upland areas is inhibited by the berm that surrounds portions of the site and the lack of drainage ditches or other surface water on the site. Also, groundwater is not expected to discharge to surface water on or near the site.

In site surface soils, HQ values for final COPCs were indicative of low potential risk, with the exception of chromium and mercury. Nonetheless, chromium was detected in concentrations comparable to background, and mercury was only detected in three of 12 samples. HQ values for terrestrial plants were indicative of low potential risk, with the exception of aluminum, chromium, and vanadium, but all three of these inorganics were detected below or comparable to background. In addition, these inorganics were not detected in roughly one-half of the samples. Some metals and explosives were detected at slightly elevated levels in

groundwater and some metals were present at slightly elevated levels in subsurface soil samples taken as part of the 1995 RI effort. However, no surface water is present near the site, so groundwater discharge to surface water is not expected to be relevant for Site 1. The closest surface water body is a branch of Hockhockson Brook 1/2 mile to the west.

In summary, Site 1 contains limited terrestrial habitat due to the previous burning activities, which removed the existing natural organic matter. No migration pathways exist at the site that could carry contaminants to the higher quality upland areas that border the site or contribute contaminants to the Hockhockson Brook Watershed. Some metals are present in surface soil that had HQs indicative of moderate potential risks to terrestrial receptors, but almost all of these compounds were detected at concentrations comparable to background. Surface soil samples taken as part of the 1993 SI were sufficient to characterize potential ecological risks and, therefore, further study based on ecological risk should not be necessary.

If unaltered, succession should continue to progress at the site, and subsequent receptor use should increase. Remediation, such as soil removal, based on potential risks would disrupt succession at the site. Any potential risks caused by inorganics at this site should attenuate over time. For these reasons, remediation at Site 1 based on ecological concerns is considered undesirable.

1.3.3 Site 11

1.3.3.1 Initial Assessment and Confirmation Study

The IAS in 1983 consisting of a document search, interviews, and on-site observations concluded minimal impact. The site was not selected for a Confirmation study because of the small quantity of waste materials believed to be available for migration.

1.3.3.2 Phase I Remedial Investigation

During the 1993 SI, four soil borings were drilled and three monitoring wells were installed and sampled at the site perimeter. A soil sample from one of the soil borings had high concentrations of oil and grease. Eight total soil samples (from 0.5 to 1.5 feet) were collected from the site during the 1993 RI/FS. Soil and groundwater samples were analyzed for explosives, TPH, and nitrite/nitrate. Analytical results indicated that no explosive compounds were present, although six samples showed low TPH results. Two monitoring wells were installed during the RI/FS. All SI and RI/FS monitoring wells were sampled and analyzed for TCL volatiles, SVOCs, TAL metals/CN, pesticides/PCBs, and explosives. One semivolatile, three volatiles (common laboratory artifacts), and metals were detected in site wells. Groundwater results indicate that no pesticides, PCBs, or explosives were detected at the site. Similar results were obtained during later rounds of sampling at these wells.

1.3.3.3 Phase II Remedial Investigation

Between July and October 1995, B&R Environmental conducted the following field investigation activities at Site 11:

- Sampling and analysis of groundwater from the five existing monitoring wells.
- Measurement of static-water levels in the monitoring wells.

Site soil was not sampled during the RI; due to the close proximity of the water table to the surface at Site 11, and the location of the site amid area wetlands, monitoring of site groundwater is comparable to monitoring of surface site conditions. In addition, the 1993 RI/FS report concluded that impacts to site soils were negligible. No runoff of contaminants from the site is expected to occur, nor any groundwater to surface water discharge. For these reasons, the nature and extent of contamination in Site 11 soils could be further defined, but subsequent data would be of little practical use. Phase II RI results are discussed in Section 1.3.3.4.2.

1.3.3.4 Summary of Results

The site is a fan-shaped open area surrounded by woods and wetlands on all sides. An undeveloped dirt road off the transmission line right-of-way accesses the site. Groundwater flow direction is generally to the northeast, based on groundwater-level measurements. The topography of the site slopes to the northwest from approximately 100 feet above MSL near MW11-02 to 90 feet above MSL near MW11-05. Most of the site is characterized as wetlands. An endangered plant, Knieskern's beaked-rush, has been observed on this site.

1.3.3.4.1 Site Geology, Hydrogeology, and Hydrology

<u>Geology</u>

Regional mapping places Site 11 within the outcrop area of the Vincentown Formation; upper colluvium may be present at the site. The upper colluvium has a maximum thickness of 10 feet, the Vincentown Formation ranges between 10 and 130 feet in thickness, and the soil borings are no more than 25 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 Vincentown Formation. In general, the borings encountered gray and black silt and white sand (possibly representative of the upper colluvium), and brownish-yellow, olive, glauconitic, fine- to medium-grained sand (probably representative of the Vincentown Formation). Based upon the boring log descriptions, wells MW11-1, MW11-2, MW11-4, and MW11-5 penetrated the upper colluvium and the Vincentown Formation, and well MW11-3 penetrated the Vincentown Formation.

Hydrogeology

Groundwater in the upper colluvium 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 1-13. Groundwater elevations for August 1995 and October 1995 are contoured on Figures 1-8 and 1-9, respectively. The direction of shallow groundwater flow in the aquifer, as indicated by both the August and October groundwater contour maps, is toward the northeast. There does not appear to be a significant seasonal variation in groundwater flow direction. Based on boring log descriptions, well MW11-04 was screened across the contact between the upper colluvium and the Vincentown Formation, and wells MW11-01 through MW11-03 and MW11-05 were screened in the Vincentown Formation. The hydraulic conductivities calculated for MW11-02 (Vincentown Formation), and MW11-04 (upper colluvium and Vincentown Formation) are 3.56 x 10^{-4} cm/sec (1.01 ft/day) and 8.64 x 10^{-4} cm/sec (2.45 ft/day), respectively.

1.3.3.4.2 Nature and Extent of Contamination

This section evaluates the occurrence and distribution of samples from the 1995 RI and 1996 RI Addendum field activities. Five groundwater samples (11 GW 01 through 11 GW 05) were collected at Site 11. Tables 1-14 and 1-15 present the occurrence and distribution of inorganic and organic chemicals in site-related groundwater samples and compare them to background. Figure 1-10 shows sample locations and concentrations of compounds that exceed applicable or relevant and appropriate requirements (ARARs) and other guidance to be considered (TBCs).

Inorganics

Concentrations of most metals in site-related groundwater samples were similar to background ranges. Sample 11 GW 03 exhibited concentrations greater than background for aluminum (3010 ug/L), barium (518 ug/L), and zinc (348 ug/L) and sample 11 GW 05 indicated aluminum (2770 ug/L) at a level greater than background.

Organics

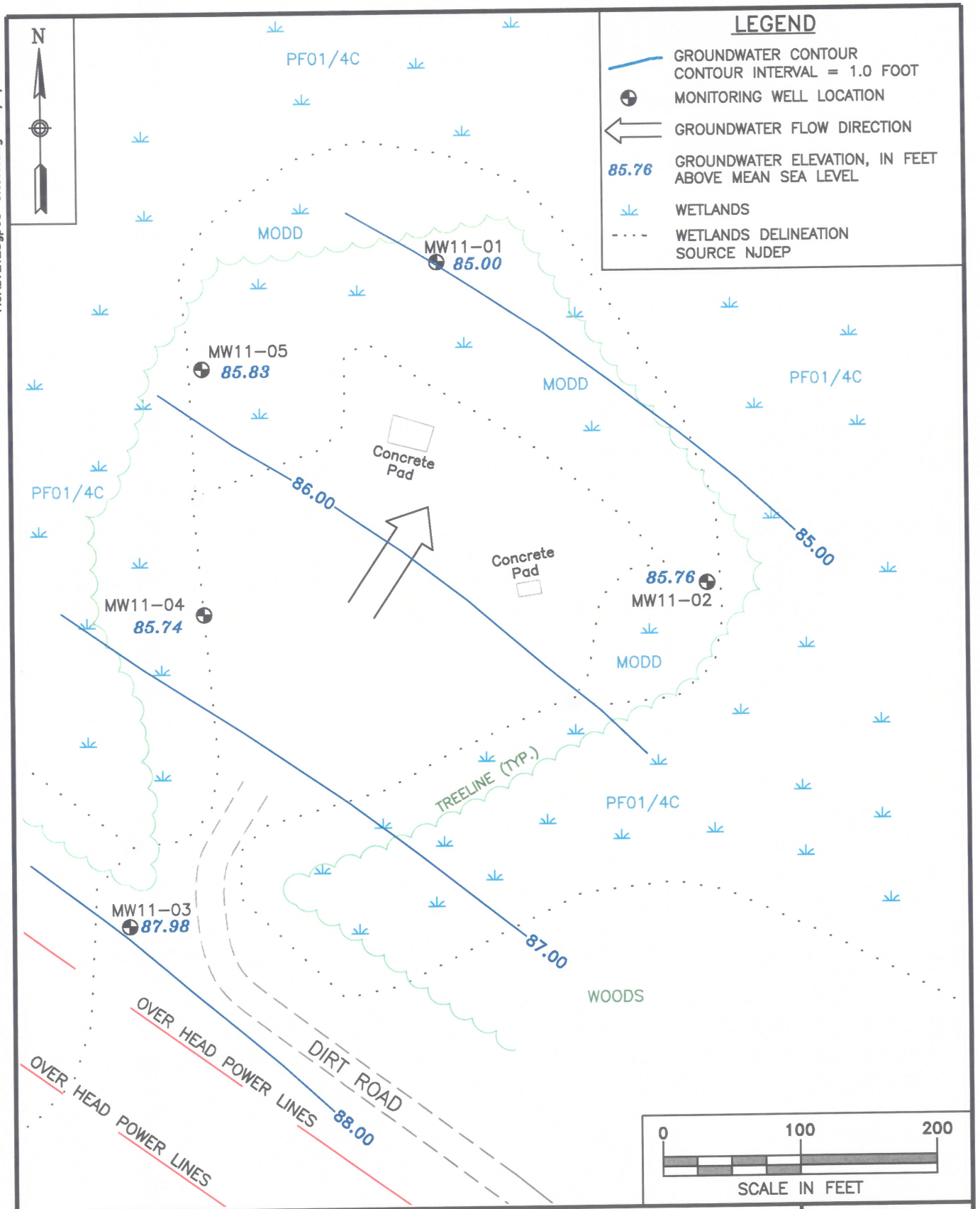
Chloroform was detected at low levels in groundwater samples 11 GW 01 (3.0 ug/L), 11 GW 03 (2.0 ug/L), and 11 GW 04 (1.0 ug/L) collected at Site 11. This compound was not detected in background groundwater samples.

TABLE 1-13
SITE 11 STATIC WATER-LEVEL MEASUREMENT SUMMARY
OU 8 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]
MW11-01	2.91	87.91	85.00	3.22	87.91	84.69
MW11-02	3.90	89.66	85.76	4.22	89.66	85.44
MW11-03	9.22	97.20	87.98	9.54	97.20	87.66
MW11-04	4.26	91.00	86.74	4.53	91.00	86.47
MW11-05	3.63	89.46	85.83	3.91	89.46	85.55

(1) In feet below top of riser

(2) In feet above mean sea level

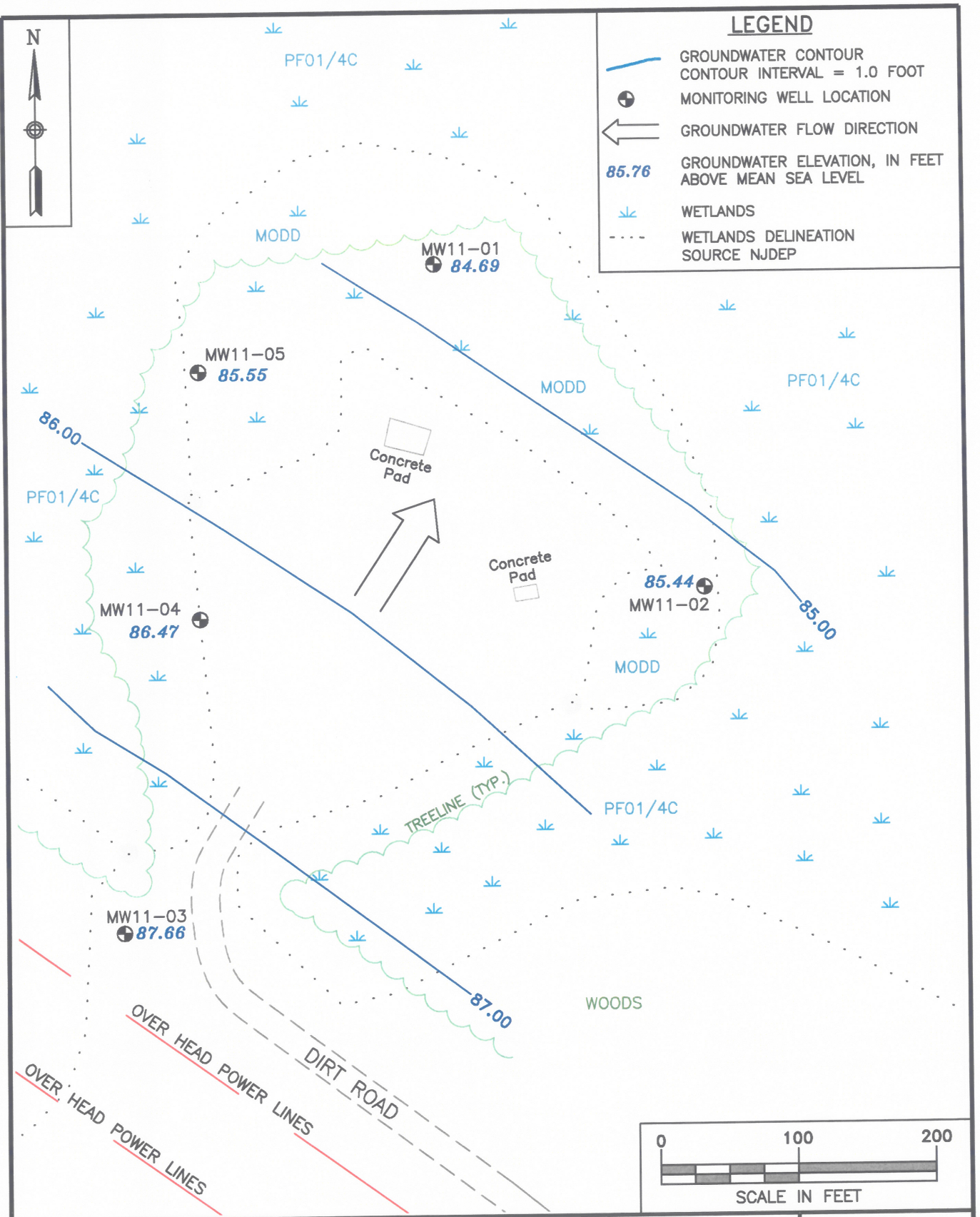


TETRA TECH NUS, INC.

GROUNDWATER CONTOUR MAP
AUGUST 7, 1995
SITE 11 – CONTRACT ORDNANCE DISPOSAL AREA
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

SCALE	AS NOTED
FILE: 2128gp03.dwg	LDL PHL
REV	DATE 9/17/02
FIGURE NUMBER	FIGURE 1-8

ACAD: 2128gp04-Site11.dwg 8/9/02 LDL



TETRA TECH NUS, INC.

GROUNDWATER CONTOUR MAP
OCTOBER 17, 1995
SITE 11 – CONTRACT ORDNANCE DISPOSAL AREA
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

SCALE	AS NOTED
FILE: 2128gp04.dwg	LDL PHL
REV	DATE 9/17/02
FIGURE NUMBER	FIGURE 1-9

TABLE 1-14

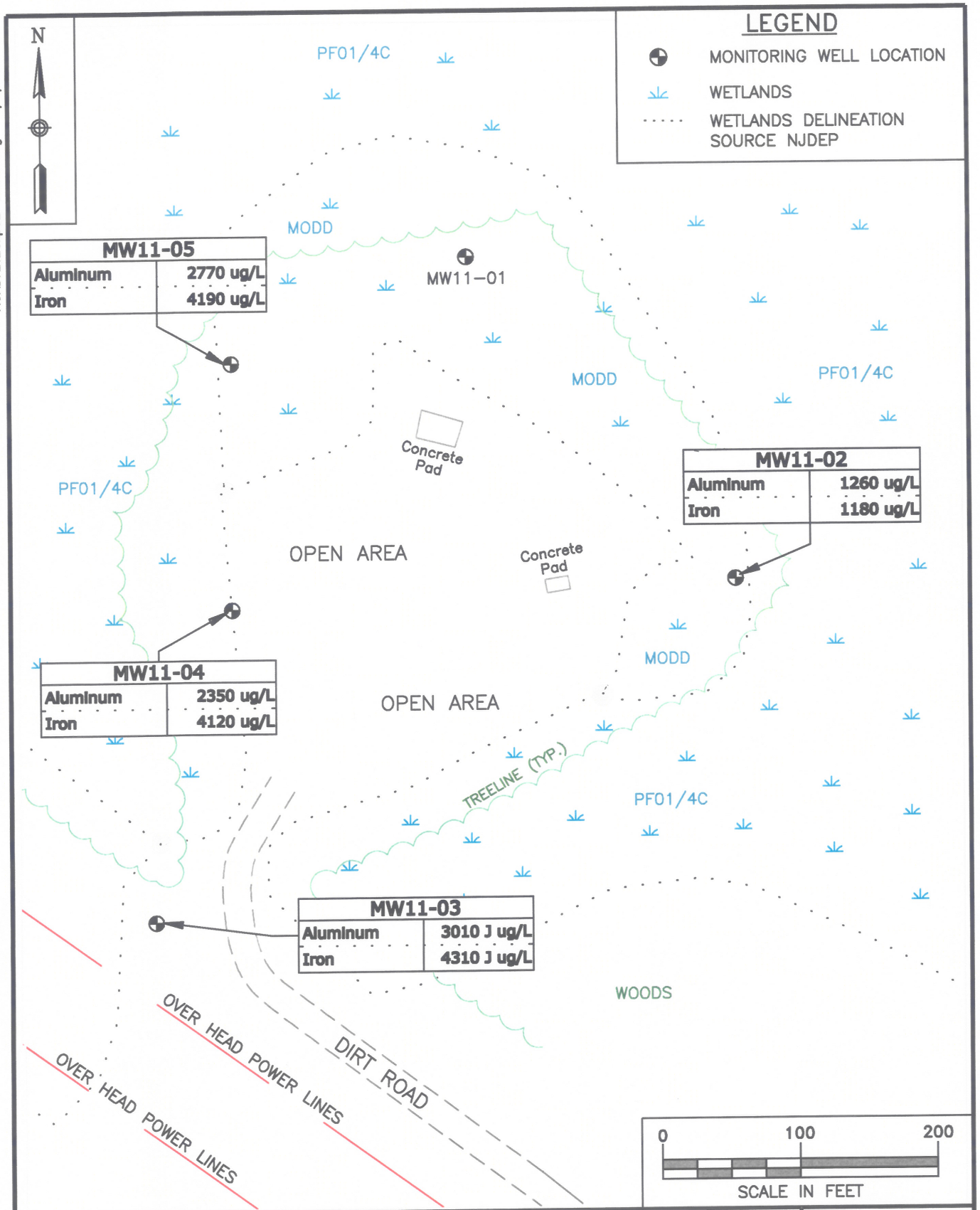
OCCURRENCE AND DISTRIBUTION OF INORGANICS IN GROUNDWATER AT SITE 11
NWS EARLE, COLTS NECK, NEW JERSEY
(ug/L)

	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	5 / 5	177 - 3010	1913.40	NO	3010
BARIUM*	11 / 11	2.6 - 518	229.60	5 / 5	27.4 - 518	131.68	NO	337.63
CADMIUM*	5 / 11	0.6 - 1.9	1.21	3 / 5	0.57 - 0.62	0.43	NO	0.62
CALCIUM	11 / 11	506 - 17200	8306.55	5 / 5	274 - 2090	999.60	NO	2090
CHROMIUM	NOT DETECTED	-	-	5 / 5	4.4 - 31	21.34	YES	31.00
COBALT	6 / 11	0.7 - 10.1	4.06	5 / 5	0.63 - 1.8	1.03	NO	1.73
COPPER*	9 / 11	0.79 - 13.5	6.53	5 / 5	0.85 - 13.5	3.57	NO	13.50
IRON	11 / 11	153 - 7690	4197.09	5 / 5	166 - 4310	2793.20	NO	4310
LEAD*	3 / 11	2.1 - 3	2.44	1 / 5	3	1.20	NO	3.00
MAGNESIUM	11 / 11	273 - 27400	8449.64	5 / 5	811 - 2240	1394.20	NO	2240
MANGANESE	11 / 11	3.3 - 65	46.18	5 / 5	5.1 - 18	12.24	NO	18.00
MERCURY*	11 / 11	0.005 - 0.12	0.12	5 / 5	0.013 - 0.12	0.09	NO	0.12
NICKEL	10 / 11	0.81 - 25.5	11.98	5 / 5	1 - 4.7	2.38	NO	4.70
POTASSIUM	11 / 11	350 - 3245	2810.55	5 / 5	1140 - 2160	1578.00	NO	2064.66
SODIUM	11 / 11	1850 - 11650	8449.09	5 / 5	2200 - 3530	2938.00	NO	3530
VANADIUM	10 / 11	0.69 - 42.25	16.48	4 / 5	1.4 - 13.5	7.84	NO	13.50
ZINC*	6 / 9	3.7 - 348	178.61	1 / 5	348	70.27	NO	218.29

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

TABLE 1-15
OCCURRENCE AND DISTRIBUTION OF ORGANICS IN GROUNDWATER AT SITE 11
NWS EARLE, COLTS NECK, NEW JERSEY
(ug/L)

SUBSTANCE	BACKGROUND			SITE-RELATED		
	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	REPRESENTATIVE CONCENTRATION	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	REPRESENTATIVE CONCENTRATION
CHLOROFORM	NOT DETECTED	-	-	3 / 5	1 - 3	3



TETRA TECH NUS, INC.

CONCENTRATIONS ABOVE SCREENING LEVELS
SITE 11 – CONTRACT ORDNANCE DISPOSAL AREA
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

SCALE: AS NOTED
FILE: 2128kp02.dwg
LDL PHL
REV
DATE: 9/17/02
FIGURE NUMBER: FIGURE 1–10

ACAD: 2128kp02–Site11.dwg 8/9/02 LDL

1.3.3.4.3 Contaminant Fate and Transport

Substances detected in the groundwater at Site 11 do not indicate that significant impacts from site-related activities have occurred. One VOC, chloroform, appeared at trace level in one downgradient well; however, chloroform detection in an upgradient wells suggests that the presence of this compound is not site related. One downgradient well revealed a concentration of aluminum slightly greater than the background range, however, the level was similar to that found in an upgradient well.

1.3.3.4.4 Baseline Human Health Risk Assessment

Groundwater was sampled at Site 11. The potential receptors considered for this site were future industrial and residential receptors. The cancer risks associated with the future residential (groundwater) exposure scenario was approximately 3E-06; near the lower end of the acceptable target risk range. The non-carcinogenic 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 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).

1.3.3.4.5 Ecological Risk Assessment

Site 11 and the surrounding area contain extensive wetland and upland habitat. Most of the site is classified as a wetland, and contains grasses and some small trees. Nearby wooded areas, primarily south and southeast of the site, provide excellent upland habitats that are expected to attract most upland wildlife species found on the installation. The federally threatened Knieskern's beaked-rush, a grasslike plant, has been identified on Site 11. Runoff from the site is minimal since the topography results in perched water on the site. Groundwater to surface water discharge is precluded by the absence of surface water near the site.

Six soil samples were taken around the site from 6 to 18 inches below ground surface during 1993 RI/FS activities; no samples from 0 to 6 inches were taken. Data from these samples indicated that no explosives were present in site soils but that some low levels of petroleum hydrocarbons were present. Groundwater samples taken during the RI/FS indicated the presence of some slightly elevated concentrations of VOCs and metals. Groundwater samples taken during 1995 RI activities contained slightly elevated levels of some metals and chloroform.

The 1993 RI/FS report concluded that due the presence of the threatened plant species on the site, future disturbance of surface soils is not desirable. Soil samples taken from 0 to 6 inches may provide a limited amount of additional information on the nature and extent of soil contamination at the site, but data from

additional soil samples would also be of limited use since no soil remediation would be appropriate with the presence of the threatened plant. Based on the findings of the groundwater investigation, the RI/FS report concluded that impacts to site soils were negligible and that the petroleum hydrocarbons detected in soils are expected to degrade over time. No runoff of contaminants from the site is expected to occur, nor any groundwater to surface water discharge. For these reasons, the nature and extent of contamination in Site 11 surface soils could be further defined, but subsequent data would be of little practical use. Hence, further study or remediation based on ecological concerns at Site 11 is considered unwarranted. However, monitoring of the status of the Knieskern's beaked-rush on the site should be considered, and is actually underway as a responsibility of the NWS Earle staff ecologist.

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-8 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 Site 1 are presented in Section 2.6. Section 2.7 contains the corresponding Site 11 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 1 and 11 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-8 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-8 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.	Soil removal is not anticipated for OU-8. However, 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-8 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-8 sites are 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-8 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY

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.

TABLE 2-2
POTENTIAL STATE CHEMICAL-SPECIFIC ARARs AND TBCs
OU-8 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 Site 1 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-8 sites. MCLs can be used to derive potential soil clean-up levels.

TABLE 2-2
POTENTIAL STATE CHEMICAL-SPECIFIC ARARs AND TBCs
OU-8 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY
PAGE 2 OF 2

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-8 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 Site 11. 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 sensitive habitats at the OU-8 sites, including an endangered plant species present at Site 11 (Knieskern's beaked-rush).
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-8 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY
PAGE 2 OF 2

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-8 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-8 sites.

TABLE 2-4
POTENTIAL STATE LOCATION-SPECIFIC ARARs AND TBCs
OU-8 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 at and adjacent to Site 11.
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 at Site 11 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-8 sites.

TABLE 2-4
POTENTIAL STATE LOCATION-SPECIFIC ARARs AND TBCs
OU-8 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY
PAGE 2 OF 2

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-8 sites. However, if remedial alternatives employ 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 promulgated to 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 treatment media 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-8 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-8 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY

REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION IN THE FS
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 parts per million (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 2-6
POTENTIAL STATE ACTION-SPECIFIC ARARs AND TBCs
OU-8 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 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.
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 groundwater, soils, sediments, and materials would be designed and operated in consistent with this regulation.

TABLE 2-6
POTENTIAL STATE ACTION-SPECIFIC ARARs AND TBCs
OU-8 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY
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REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	COMMENTS
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 grams per hour (g/hr) (or 0.1 pounds per hour)	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 pounds per hour (lb/hr), would incorporate appropriate vapor control measure to comply with these requirements.

[N.J.A.C. 7:26-9]; thermal treatment [N.J.A.C. 7:26-11.6]; and physical, chemical, and biological treatment [N.J.A.C. 7:26-11.7].

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 habitat quality) or to address contaminant concentrations that exceed regulatory standards (e.g., New Jersey GWQS).

RAO development for Sites 1 and 11 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/TBC 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 the Navy has no plans to use either 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 organisms 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 1996 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 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 1 and 11 are presented in Sections 2.6 and 2.7 of 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, 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 1 TECHNOLOGY SCREENING

The selection of viable remedial technologies and process options for assemblage into remedial alternatives for Site 1 is presented in this section.

2.6.1 Site 1 Remedial Action Objectives

The results of the RI, previous investigations, and the human health and ecological risk assessments for Site 1 were evaluated to determine the remedial action objectives that may be needed to protect human health and the environment.

Human Health Protection Considerations

Subsurface soil and groundwater were sampled at Site 1. The potential receptors considered for this site were future industrial and residential receptors.

The estimated Reasonable Maximum Exposure (RME) (groundwater) cancer risk for the future industrial employee and the future residential receptor exceeded the conservative EPA target cancer risk range guideline, assuming dermal contact and ingestion of groundwater. The estimated RME non-cancer HI for the future industrial and 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 1 being considered for future residential land use.

Ecological Receptors Risk Considerations

NJDEP Geographic Information System data originally indicated the presence of wetlands east of the site. However, ground-truthing of the site revealed that no wetlands were present in these areas. The Site 1 ecological risk assessment (ERA) indicated that runoff from the site is precluded by excessively drained soils and the high berm and roadway that surround most of the site. Compounds found in soil generally confirmed the presence of widespread metals and TPH at levels below regulatory concern concluded from past sampling programs. However, arsenic was found in one subsurface soil sample at a concentration of 27.8 mg/kg, higher than the New Jersey residential direct contact clean-up criterion, 20.0 mg/kg. Arsenic is a common component of soils in this vicinity (Pine Barrens type soils) as discussed in

Section 3.5 of the RI. A single exceedance of this New Jersey guidance criterion, from among 37 surface and subsurface soil samples, indicates that there may be no significant site-related metals contamination related to previous site activities.

Low levels of organics found in groundwater at levels below regulatory limits, such as explosives, which were not found in background, indicate minor impact from past site activities.

Metals found in groundwater at levels above regulatory guidelines included aluminum, arsenic, chromium, iron, manganese, lead, and thallium. High turbidity in groundwater samples may have contributed to higher measured concentrations of some metals than is representative of actual concentrations in the formation. The risk assessment procedure resulted in a non-cancer risk above guideline limits. Iron by groundwater ingestion remained, with an HQ slightly above one.

The inorganics aluminum, chromium, copper, mercury, and vanadium, were retained as surface soil COCs since their related HQs exceeded 1.0. The inorganics aluminum, chromium, copper, lead, mercury, silver, vanadium, and zinc were retained as terrestrial plant COCs since their related HQs exceeded 1.0. Natural ecological succession should continue to progress and subsequent receptor use should increase. Metals found in near-surface soils, although sometimes at levels of potential concern to future ecological receptors, were generally found in the range of natural background levels and should attenuate with time. Therefore, no remedial action based on potential risks to ecological receptors or additional ecological study is recommended at Site 1.

Environmental Media Protection Considerations

The RI determined that groundwater adjacent to the site contained contaminants at concentrations in excess of the state GWQS (see Table 2-7). Review of the RI data revealed that arsenic, chromium, 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 soils.

Chemical constituents detected in the surface soil at Site 1 have low potential for impact to groundwater. Detected chemicals in the groundwater do not conclusively demonstrate groundwater impact or identify a particular source location. Elevated levels of certain metals in groundwater may not indicate the potential for groundwater transport because suspended solids in the unfiltered groundwater samples were found. Metals in suspension are expected to have a greatly diminished potential for in-situ transport compared to metals in solution, given the geologic formation, which does not include conditions conducive to solution

TABLE 2-7
SITE 1 GROUNDWATER CONTAMINANTS OF CONCERN
OU-8 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY

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

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.

channeling or fracture-based flow. Only cadmium and zinc were detected at slightly elevated levels in filtered groundwater and these metals were not found at elevated levels in other media sampled at Site 1. Furthermore, historical groundwater data for this site show elevated aluminum levels. This too suggests the presence of suspended solids. Overall, groundwater data do not indicate migration of dissolved inorganic contamination from the site. 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 1:

Protection of Human Health RAO

Prevent potential human exposure to metals in groundwater.

Protection of the Environment RAO

None.

2.6.2 Site 1 Preliminary Remediation Goals

Data from the RI, the human health risk assessment, and ARARs were reviewed to identify COCs for Site 1. A summary and the basis for selecting the COCs are provided in Table 2-7. Arsenic, chromium, and iron in groundwater that could contribute to an HI greater than 1.0 were selected as human health risk-based COCs.

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 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 1 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

TABLE 2-8
SITE 1 GROUNDWATER PRELIMINARY REMEDIATION GOALS (μg/L)
OU-8 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY

Contaminant of Concern	ARARS NJ GWQS	SDWA MCLs	Maximum Background Conc.	Maximum Detected Site Conc.
Arsenic	8.0	50	5.8	22.7
Chromium	100	100	ND	148
Iron	300	--(1)	7,690	23,350

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.
ND Not detected.

TABLE 2-9
SITE 1 PROPOSED GROUNDWATER PRGs
OU-8 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY

Contaminant of Concern	Proposed PRG (ug/L)	Basis of Selection
Arsenic	8	NJ GWQS
Chromium	100	NJ GWQS
Iron	300	NJ GWQS

Notes:

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

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 1 General Response Actions

General response actions were selected based on the RAOs for Site 1 and the consideration that the site is an inactive ordnance demilitarization site. General response actions that address potential human exposure to groundwater contaminants associated with the site include:

- No action
- Long-term monitoring (limited action)
- Long-term monitoring with establishment of a CEA (limited action)

2.6.4 Identification, Screening, and Evaluation of Technologies and Process Options for Site 1

Table 2-10 presents a summary of potential remedial technologies and process options that apply to the Site 1 RAOs and general response actions. Screening of the remedial technologies considered their overall applicability to the media of concern (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 the natural ecological succession and subsequent receptor use, and erosion and runoff from site soils into the adjacent areas.

The preliminary screening of groundwater response remedial technologies is summarized in Table 2-11. Detailed evaluations of the remedial technologies and process options for contaminated groundwater is presented in Table 2-12.

2.6.5 Summary of Site 1 Selected Remedial Technologies and Process Options

Table 2-12 identifies 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.

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

TABLE 2-10
SITE 1 REMEDIAL ACTION OBJECTIVES, GENERAL RESPONSE ACTIONS, TECHNOLOGY TYPES, AND PROCESS OPTIONS
OU-8 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
Groundwater	**Protection of Human Health** Prevent human exposure to metal contaminants in groundwater. **Protection of the Environment** Prevent exposure to metal contaminants in groundwater.	No Action	No Action	Not applicable
		Limited Action	Long-Term Monitoring	Groundwater monitoring
		Limited Action and Institutional Controls	Long-Term Monitoring	Groundwater monitoring
			Institutional Controls	Establishment of CEA

TABLE 2-11
PRELIMINARY SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS FOR SITE 1 CONTAMINATED GROUNDWATER
OU-8 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	DESCRIPTION	SCREENING COMMENTS
No Action	No Action	Not Applicable	No active remediation would be conducted to address contamination.	Retained for baseline comparison purposes in accordance with NCP.
Limited Action	Long-Term Monitoring	Groundwater Monitoring	Periodic sampling and analysis of media to assess groundwater contaminant status and potential migration downgradient.	Potentially applicable. Retained.
Limited Action with Institutional Controls	Long-Term Monitoring	Groundwater Monitoring	Periodic sampling and analysis of media to assess groundwater contaminant status and potential migration downgradient.	Potentially applicable. Retained.
	Institutional Controls	CEA	Classification Exception Area (CEA) 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.	Potentially applicable. Retained.

TABLE 2-12
EVALUATION OF TECHNOLOGIES AND PROCESS OPTIONS FOR SITE 1 CONTAMINATED GROUNDWATER
OU-8 FEASIBILITY STUDY
NAVAL WEAPONS STATION EARLE, COLTS NECK, NEW JERSEY

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	EFFECTIVENESS	IMPLEMENTABILITY	COST	CONCLOSION
No Action	No Action	No Action	Does not achieve remedial action objectives.	Implementable	Capital: None O&M: None	Retained.
Limited Action	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.
Limited Action with Institutional Controls	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.
	Institutional Controls	CEA	Effectiveness dependent on continued future enforcement to prevent use of underlying groundwater. Does not reduce contamination.	Readily implementable.	Capital: Low O&M: Low	Retained.

2.7 SITE 11 TECHNOLOGY SCREENING

The selection of viable remedial technologies and process options for assemblage into remedial alternatives for Site 11 is presented in this section. The identification and evaluation of remedial technologies and process options for Site 11 are similar to those performed for Site 1 because both served as ordnance burning or disposal sites, although Site 11 also served as a firefighting training area. However, the amended risk assessment for Site 11 resulted in the elimination of all COPCs with associated risk above target guidelines, and ecological considerations preclude alteration of current site conditions.

2.7.1 Site 11 Remedial Action Objectives

The results of the RI, previous investigations, and the human health and ecological risk assessments for Site 11 were evaluated to determine the remedial action objectives that may be needed to protect human health and the environment. It is assumed that leaching compounds from subsurface soils to groundwater is currently occurring; therefore, groundwater exposure to potential receptors will adequately characterize this phenomenon, and subsurface soil risks will be addressed through achievement of groundwater-based remedial action objectives.

Human Health Protection Considerations

Groundwater was sampled at Site 11. The potential receptors considered for this site were future industrial and residential receptors. The cancer risks associated with the future residential (mainly groundwater) exposure scenario was approximately 3E-06; near the lower end of the acceptable target risk range. The non-carcinogenic HIs associated with the future industrial and future residential (mainly groundwater) exposure scenarios were below 1.0; the cutoff point below which adverse effects are not expected to occur. Lead 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 amended 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 11 being considered for future residential land use.

Ecological Receptors Risk Considerations

Site 11 is a circular, open field approximately two acres in size. Scattered pitch pines and grasses are present throughout the site, with soils normally saturated at ten inches. Most of the site has been classified as wetlands, but standing water and moist soils are ephemeral. No waterways or drainage ditches exist in the area, and water tends to perch on the site after heavy rainfall. The closest surface water is a branch of Hockhockson Brook located approximately 300 yards to the north; thus, the site is located in the Hockhockson Brook Watershed. The surrounding areas to the northwest, north, east, and southeast are classified as forested wetlands and are dominated by Atlantic white cedar and red maple. Soils in these areas are Atsion sands characterized by a thick layer of black organic muck over grey-streaked sand. Upland woods are located south of the site, along the overhead powerlines, and are predominantly chestnut oak, white oak, and mountain laurel. The entire area provides excellent habitat, primarily for terrestrial receptors. The border of the site provides at extensive "edge effect," that can potentially attract a wide variety of wildlife found on the base, such as bobwhite quail, ruffed grouse, and cottontail rabbit. No sensitive habitats, other than the wetlands, exist on or near the site. However, a federally threatened plant species, the Knieskern's beaked-rush (*Rhynchospora knieskernii*), has been identified on the site.

The major release pathway from the site is overland runoff. Precipitation runoff may carry constituents to adjacent wetland areas, but the compacted soils and site topography tend to perch water on the site. Infiltrating precipitation may cause the contamination of subsurface soil and groundwater. Upon infiltrating the soil column and reaching the water table, a contaminant may be carried with the flow of groundwater to downgradient locations. Groundwater from the site may eventually discharge to surface water; contaminants may be subsequently deposited in sediment or they may accumulate in the tissues of aquatic organisms. However, surface water is limited near the site, even in the forested wetlands, largely inhibiting this migration pathway.

Six soil samples were taken around the site from 6 to 18 inches below ground surface during 1993 RI/FS activities; no samples from 0 to 6 inches were taken. Data from these samples indicated that no explosives were present in site soils, but that some low levels of petroleum hydrocarbons were present. Groundwater samples taken during the RI/FS indicated the presence of some slightly elevated concentrations of VOCs and metals. Groundwater samples taken during 1995 RI activities contained slightly elevated levels of some metals and chloroform. The 1993 RI/FS report concluded that due the presence of the threatened plant species on the site, future disturbance of surface soils is not desirable. Soil samples taken from 0 to 6 inches may provide a limited amount of additional information on the nature and extent of soil contamination at the site, but data from additional soil samples would also be of limited use since no soil remediation would be

appropriate with the presence of the threatened plant. In addition, the RI/FS report concluded that impacts to site soils were negligible and that the petroleum hydrocarbons detected in soils are expected to degrade over time. No runoff of contaminants from the site is expected to occur, nor any groundwater to surface water discharge. For these reasons, the nature and extent of contamination in Site 11 surface soils could be more further defined, but subsequent data would be of little practical value.

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.

Further study or remediation based on ecological concerns at Site 11 is considered undesirable, in that it may interfere with propagation of Knieskern's beaked-rush.

RAOs Selection

Based on the considerations provided above, no human health or environmental remedial action objectives have been selected for Site 11.

2.7.2 Site 11 Preliminary Remediation Goals

Data from the RI, the human health risk assessment, and ARARs were reviewed to identify COCs for Site 11. The risk assessment procedure resulted in the elimination of all COPCs with associated risk above target guideline limits. Based on the results of the amended risk assessment, no COCs were identified for Site 11.

Since it would be impractical to attempt groundwater remediation for the common metals found above GWQS (aluminum and iron) 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 and iron were found at concentrations above the corresponding GWQS but near the range of background. Although the organic contaminant chloroform was above the comparison to background (background was non-detect) and contributes to groundwater cancer risk, the groundwater cancer risk is within the EPA guideline maximum acceptable risk range.

2.7.3 Site 11 General Response Actions

Selection of general response actions were based on RAOs and site conditions. Treatment of groundwater is considered technically impracticable, and would result in potential detriment to the identified endangered plant species. No general response actions for Site 11 to address ecological issues or potential human exposures to the low concentrations of compounds found in groundwater were selected. It is recommended that no further action be taken at Site 11 based on the findings of the RI and FS.

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 1 - DEVELOPMENT AND SCREENING OF ALTERNATIVES

This section will discuss the rationale for development of remedial action alternatives for Site 1, 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 1 - Rationale for Development of Alternatives

Factors considered in formulating the remedial alternatives to achieve the RAOs for Site 1 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.

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. However, the recommendations provided from the RI investigations advised that remediation of site soils by excavation and removal, or other containment, would disrupt succession, and that remediation of the shallow groundwater beneath the site may not be necessary or desirable. Therefore, Site 1 is not an appropriate site for the application of presumptive remedies. The resulting alternatives development process was streamlined to focus on non-disruptive alternatives.

Protection of Human Health Considerations - The RAOs for protection of human health specify preventing human exposure to contaminants in site groundwater. The alternatives were formulated to meet this objective.

Protection of the Environment Considerations - No RAO for protection of the environment was found to be needed.

3.1.2 Site 1 - Remedial Alternatives Descriptions

This section presents detailed descriptions of the remedial alternatives for Site 1. As discussed in Section 2, no active groundwater response actions are anticipated because groundwater appears to be minimally impacted, if at all. Through establishment of institutional controls in Alternative 3 [Classification Exception Area (CEA) waiver], groundwater will not be used for potable purposes. Long-term (annual) groundwater monitoring is included in each Site 1 remedial alternative, except for the No Action alternative. The key components of Alternatives 1 through 3 are identified on Table 3-1.

3.1.2.1 Site 1 - Alternative 1: No Action

The no-action alternative is developed as a baseline case, as required by the NCP. No actions would be performed under this alternative. 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 site soils or site groundwater or to preclude contaminant migration to the environment. Key components of Alternative 1 are identified on Table 3-1 and described below.

TABLE 3-1
SITE 1- REMEDIAL ALTERNATIVE COMPONENTS
OU-8 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY

	ALTERNATIVE	KEY COMPONENTS OF ALTERNATIVE
1	No Action	• No actions would be taken.
2	Limited Action (Long-Term Monitoring)	• Long-term annual groundwater monitoring • Five-year reviews
3	Limited Action (Long-Term Monitoring and Institutional Controls)	• Long-term annual groundwater monitoring • Institutional controls (CEA*) • 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.

Existing Features - Currently, site features offer limited protection of human health and the environment. The main protective feature is a thin sandy soil cover that reduces the potential for human and animal contact with site groundwater. The cover is moderately vegetated, serving to limit infiltration of precipitation into the groundwater and to control surface runoff and erosion. The vegetated cover is present over the majority of the site; however, areas of little vegetation are interspersed over the surface.

Because no actions would be conducted under Alternative 1 to maintain or further cover the ordnance demilitarization site, the site surface may continue to erode, potentially exposing more bare soils and potentially increasing infiltration. Remnants of the Army communications station tower (e.g., concrete pad, protruding wires and metal objects) would remain at the surface of the site.

3.1.2.2 Site 1 - Alternative 2: Limited Action (Long-Term Monitoring)

Alternative 2 was developed as an option that relies on long-term groundwater monitoring on an annual basis to assess the contaminant status, and potential threats to human health and the environment. This alternative does not rely on access restrictions or other institutional controls to limit exposures to site risks. This alternative does not employ treatment or containment to address site contamination.

Since contaminated media would be left in place, site conditions and risks would be reviewed every five 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 vegetated sandy soil cover that reduces the potential for human and animal contact with groundwater. The cover is moderately vegetated and serves to reduce infiltration of precipitation into soils and limit surface runoff and erosion. Where present and in good condition, the vegetation may reduce precipitation infiltration and surface runoff.

Because no actions would be conducted under Alternative 2 to maintain or further cover the ordnance demilitarization site, the site surface may continue to erode, potentially exposing more bare soils and potentially increasing infiltration. Remnants of the Army communications station tower (e.g., concrete pad, protruding wires and metal objects) would remain at the surface of the site.

Long-Term Monitoring - Under Alternative 2, the groundwater would be sampled annually to monitor the migration of contaminants from the site and the potential for impacts to downgradient areas. Background well data would be used for evaluation of site contaminant status. The 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 one new monitoring well, along with three existing monitoring wells, and the samples would be analyzed for site-specific contaminants (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 five 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 1 - Alternative 3: Limited Action (Long-Term Monitoring and Institutional Controls)

Alternative 3 relies on long-term groundwater monitoring conducted on an annual basis and institutional controls to limit exposures to site-related contaminants. 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.

Long-term annual monitoring of site groundwater 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 five years. Key components of Alternative 3 are identified on Table 3-1 and described below.

Institutional Controls - 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.

Long-Term Monitoring - Under Alternative 3, one new downgradient well would be installed. The groundwater would be sampled periodically to monitor the migration of contaminants from the site and the potential impacts to downgradient areas. As mentioned for Alternative 2, background well data

would be used for comparison to evaluate site contaminant status. 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 one new monitoring well, along with four existing monitoring wells, and the samples would be analyzed for site-specific contaminants (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 five 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 1 - 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 1. All three alternatives for Site 1 remediation have been retained for development and detailed analysis. The screening is presented in Table 3-2.

3.2 SITE 11 – DEVELOPMENT AND SCREENING OF ALTERNATIVES

This section will discuss the rationale for development of remedial action alternatives for Site 11, describe the assembled alternatives, and present the screening of alternatives. A detailed evaluation of the retained alternative is presented in Section 4.0.

3.2.1 Site 11 - Rationale for Development of Alternatives

Factors considered in formulating the remedial alternatives RAOs for Site 11 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:

TABLE 3-2
SITE 1 - SCREENING OF REMEDIAL ALTERNATIVES
OU-8 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.	Readily implementable. No technical or administrative difficulties.	Capital: none O&M: low	Retained as baseline alternative in accordance with NCP.
2	Limited Action (Long-Term Monitoring including 5-year reviews)	Provides some protection of human health through annual monitoring assessment of contaminant status.	Readily implementable. No technical or administrative difficulties.	Capital: low O&M: low	Relative to Alt. 1, provides additional human health protectiveness through ongoing site groundwater monitoring. Retained.
3	Limited Action (Long-Term Monitoring and Institutional Controls, including 5-year reviews)	Protects human health through annual monitoring assessment of contaminant status and establishment of CEA; 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	Relative to Alt. 2, prevents exposure to groundwater contaminants. Retained.

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

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. However, the recommendations provided from the RI investigations advised that remediation of site soils by excavation and removal, or other containment, would disrupt succession and the status of the endangered plant Knieskern's beaked-rush, and that remediation of the shallow groundwater beneath the site may not be necessary or desirable. Therefore, Site 11 is not an appropriate site for the application of presumptive remedies. The resulting alternatives development process was streamlined to focus on non-disruptive alternatives.

Protection of Human Health Considerations - No human health RAO for groundwater at Site 11 was selected. No action for Site 11 groundwater is warranted based on the findings of the RI and FS.

Protection of the Environment Considerations - No environmental RAO for Site 11 was selected. Further study or remediation based on ecological concerns at Site 11 is considered undesirable, in that it may interfere with propagation of the endangered species, Knieskern's beaked-rush. Based on the findings of the RI and FS, monitoring of the status of the Knieskern's beaked-rush on the site is recommended. Since base personnel currently conduct the recommended monitoring, no further action is necessary.

3.2.2 Site 11 - Remedial Alternatives Descriptions

As previously discussed, no active groundwater response or other actions are anticipated based on the evaluation of current site conditions. No Action is the only alternative presented based on investigative findings and human health and ecological risk evaluation.

3.2.2.1 Site 11 - Alternative 1: No Action

The no-action alternative is developed for Site 1 based on the low potential of exposure for human and ecological receptors and to limit disturbance to the endangered species located on the site. 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 the site.

Existing Features - Currently, site features offer limited protection of human health and the environment. The main protective feature is a fan-shaped open area surrounded by woods and wetlands on all sides that reduces the potential for human and animal contact with site soils. An endangered plant, Knieskern's beaked-rush, has been observed on the site. Existing site vegetation may promote propagation of the endangered plant. No actions would be taken under Alternative 1 to protect, maintain or promote propagation of the endangered plant.

3.2.3 Site 11 - 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. The only alternative presented, No Action, was retained in accordance with requirements of the NCP. The No Action alternative provides no additional protection of the environment or the endangered species, however it is readily implementable. There are no administrative or technical difficulties, or costs involved with implementation of the No Action Alternative.

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 1 alternatives are evaluated in Section 4.1; Site 11 alternatives are evaluated in Section 4.2.

4.1 INDIVIDUAL ANALYSIS OF SITE 1 ALTERNATIVES

Detailed evaluations of the three Site 1 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 1 - Alternative 1: No Action

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

Overall Protection of Human Health and the Environment

The no-action alternative would not provide additional protection of human health or the environment. Contaminants in the ordnance demilitarization site groundwater would not be remediated or isolated and would continue to pose potential risk to humans.

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.

Compliance with ARARs

Alternative 1 would not comply with long-term monitoring requirements, since no monitoring and evaluation of groundwater would be performed under this alternative.

Because groundwater beneath Site 1 exceeds GWQSs 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 unchanged.

The Site 1 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 1 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.

No controls would be used to manage the site 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 site contamination.

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 not be an issue of concern. Current risks would remain unabated.

The RAO would not 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 capital or maintenance costs for the no-action alternative, since no activities would be performed under this alternative.

4.1.2 Site 1 - Alternative 2: Limited Action (Long-Term Monitoring)

Alternative 2 relies on long-term groundwater monitoring to achieve the RAO. Over time, groundwater contamination is expected to gradually decrease by chemical and physical mechanisms. Long-term annual monitoring and five-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 not prevent direct exposure to site groundwater or institute restrictions on use of site groundwater.

Alternative 2 would not 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. These risks would be assessed through a program of annual groundwater monitoring, with five-year reviews of the monitoring results.

The long-term annual 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 personal protective equipment (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 eventually comply with all ARARs identified in Tables 2-1 through 2-6. Alternative 2 does not include active treatment of groundwater. 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 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. Assessing contaminant status at the site through long-term groundwater monitoring would allow for evaluation of site risks and determine the necessity of any further actions to protect human health or the environment.

The groundwater underlying Site 1 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, or if groundwater monitoring results prompt further action, potential residential users of groundwater could be protected by implementation of institutional controls (access restrictions and CEA) until GWQSs are achieved.

Monitoring and evaluation of groundwater would allow the responsible agency to monitor the quality of groundwater beneath and leaving the site, assess potential impacts to the adjacent lands and downgradient receptors, and determine whether additional remedial actions are necessary. Unless site conditions change, the monitoring program should be effective in minimizing the risks to downgradient receptors and the environment.

Five-year reviews would be required to assess whether the controls provided under this alternative are 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.

No difficulties or uncertainties are anticipated in performing the long-term monitoring and reviews. Groundwater monitoring wells may require replacement if sedimentation or damage occur; the wells would be readily replaceable.

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 site soils or groundwater.

Short-Term Effectiveness

Implementation of Alternative 2 is not expected to pose any significant risks to station personnel or the local community.

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 media, 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 under this alternative.

Implementability

Alternative 2 is implementable. Long-term monitoring (sampling and analyses) requires readily available resources. Since long-term monitoring is included under Alternative 2, contaminant presence and migration can be assessed. Monitoring of groundwater 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 ARARs would be met.

Since no treatment is proposed, the criterion of availability of treatment technologies, treatment and disposal (TSD) facilities, and capacity is not applicable.

There is ample availability of companies with the trained personnel, equipment, and materials to perform

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

Cost

The capital costs for Alternative 2 total $15,900. The average annual O&M costs are $8,050, and 5-year reviews cost $15,500 per event. Over a 30-year period, the net present-worth cost is $149,200 (at a 7 percent discount rate).

4.1.3 Site 1 - Alternative 3: Limited Action (Long-Term Monitoring with CEA)

Alternative 3 relies on long-term groundwater monitoring and institutional controls (establishment of a CEA) to achieve the RAO. A CEA would prohibit the use of untreated groundwater as drinking water. Over time, groundwater contamination is expected to gradually decrease by chemical and physical mechanisms. Long-term annual 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 protection of human health and the environment by instituting restrictions on use of site groundwater.

Alternative 3 would 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. Establishing the site as a groundwater CEA would provide interim protection by prohibiting use of the aquifer.

The long-term annual 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 personal protective equipment (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 eventually comply with all ARARs identified in Tables 2-1 through 2-6. Alternative 3 does not include active treatment of groundwater. Initially, the groundwater beneath Site 1 would not meet the constituent concentrations specified in the New Jersey GWQS [N.J.A.C. 7:9-6]. 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.

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 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. Implementing institutional controls to prohibit use of untreated groundwater would reduce these risks and provide long-term protection of human health.

The groundwater underlying Site 1 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 (CEA) until GWQSs are achieved.

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

Five-year reviews would be required to assess whether the controls provided under this alternative are 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 the CEA in preventing exposure to site contaminants would be reviewed.

No difficulties or uncertainties are anticipated in performing the long-term monitoring. Groundwater monitoring wells may require replacement if sedimentation or damage occur; the wells would be readily replaceable.

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 site soils or groundwater.

Short-Term Effectiveness

Implementation of Alternative 3 is not expected to pose any significant risks to station personnel or the local community.

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 media, 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 under this alternative. The establishment of the groundwater CEA would require approximately 12 months to implement.

Implementability

Alternative 3 is implementable. Long-term monitoring (sampling and analyses) requires readily available resources. Since long-term monitoring is included under Alternative 3, contaminant presence and migration can be assessed. Monitoring of groundwater would be effective for detecting changes in media quality that may indicate 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 ARARs would be met as described previously.

Since no treatment is proposed, the criterion of availability of treatment technologies, treatment and disposal (TSD) facilities, and capacity is not applicable.

There is ample availability of companies with the trained personnel, equipment, and materials to perform long-term monitoring. Regulatory personnel and environmental specialists are readily available to perform 5-year reviews.

Cost

The capital costs for Alternative 3 total $41,900. The average annual O&M costs are $8,050, and 5-year reviews cost $15,500 per event. Over a 30-year period, the net present-worth cost is $175,200 (at a 7 percent discount rate).

4.1.4 Comparative Analysis of Site 1 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 and 2 to prevent use of contaminated site groundwater, health risks and adverse impacts to the environment are expected to be greater compared to Alternative 3.

Alternative 2 is more protective of human health and the environment than Alternative 1. The use of long-term groundwater monitoring would allow for assessment of site contaminant status and subsequent evaluation of risk to human and ecological receptors.

Alternative 3 is most protective of human health and the environment. Use of institutional controls (CEA) in addition to long-term groundwater monitoring would provide assurance that untreated contaminated groundwater is not used as a potable water source in the future during the period in which contaminant status is being assessed.

TABLE 4-1
SITE 1 - COMPARATIVE ANALYSIS OF REMEDIAL ACTION ALTERNATIVES
0U-8 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY

CRITERION:	ALTERNATIVE 1: NO ACTION	ALTERNATIVE 2: LIMITED ACTION (LONG-TERM MONITORING)	ALTERNATIVE 3: LIMITED ACTION (LONG-TERM MONITORING AND INSTITUTIONAL CONTROLS)
OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT			
Prevent Human Exposure to Metals 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 institutional controls would be implemented to prohibit use of untreated groundwater.	Same as Alternative 1. In time, a gradual reduction of contaminants in groundwater due to continued dissipation/dilution would occur.	Institutional controls would minimize potential exposure to groundwater by prohibiting access. In time, a gradual reduction of contaminants in groundwater due to continued dissipation/dilution would occur. CEA would preclude use of groundwater for human consumption until GWQSs are met.
Minimize Contaminant Migration	No actions would be taken to reduce infiltration of surface water or precipitation to groundwater. Contaminants would continue to leach into groundwater and migrate.	Same as Alternative 1.	Same as Alternative 1.

TABLE 4-1
SITE 1 - COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES
0U-8 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY

CRITERION:	ALTERNATIVE 1: NO ACTION	ALTERNATIVE 2: LIMITED ACTION (LONG-TERM MONITORING)	ALTERNATIVE 3: LIMITED ACTION (LONG-TERM MONITORING AND INSTITUTIONAL CONTROLS)
COMPLIANCE WITH ARARs			
Chemical-Specific ARARs	Would not comply with state groundwater quality standards.	Same as Alternative 1. Groundwater contaminant concentrations would initially exceed state GWQS. Over time, GWQS would be achieved by dissipation/dilution.	Same as Alternative 2. 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.	Not applicable.	Would comply with federal and state ARARs for floodplains and other sensitive receptors.
Action-Specific ARARs	Not applicable.	Not applicable.	Not applicable.
LONG-TERM EFFECTIVENESS AND PERMANENCE			
Magnitude of Residual Risk	Existing (HI greater than 1) non-carcinogenic risk from exposure to site groundwater would remain.	Same as Alternative 1. Existing risks would remain. Over time, concentrations of metals in groundwater downgradient of the site would be expected to decrease as a result of natural influences.	Same as Alternative 2. Existing risks would remain. Institutional controls would preclude use of groundwater. Over time, concentrations of metals in groundwater downgradient of the site would be expected to decrease as a result of natural influences.

TABLE 4-1
SITE 1 - COMPARATIVE ANALYSES OF REMEDIAL ALTERNATIVES
OU-8 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY

CRITERION:	ALTERNATIVE 1: NO ACTION	ALTERNATIVE 2: LIMITED ACTION (LONG-TERM MONITORING)	ALTERNATIVE 3: LIMITED ACTION (LONG-TERM MONITORING AND INSTITUTIONAL CONTROLS)
Adequacy and Reliability of Controls	No new controls would be implemented. Existing site features provide limited controls.	Same as Alternative 1.	If implemented and enforced, the CEA could prevent use of contaminated groundwater.
Need for 5-Year Review	Not applicable.	Review would be required since soil and groundwater contaminants would be left in place.	Same as Alternative 2.
REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT			
Reduction of Toxicity, Mobility, or Volume Through Treatment	No reduction, since no treatment would be employed.	Same as Alternative 1.	Same as Alternative 1.
SHORT-TERM EFFECTIVENESS			
Community Protection	No risk to community is anticipated.	No significant risk to community anticipated.	Same as Alternative 2.
Worker Protection	Not applicable.	No risk to workers is anticipated if proper PPE is used during long-term monitoring.	Same as Alternative 2.
Environmental Impacts	No adverse impacts to the environment are anticipated.	Same as Alternative 1.	Same as Alternative 1.
Time Until Action is Complete	Not applicable.	Not applicable.	Approximately 12 months to institute CEA.

TABLE 4-1
SITE 1 - COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES
0U-8 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY

CRITERION:	ALTERNATIVE 1: NO ACTION	ALTERNATIVE 2: LIMITED ACTION (LONG-TERM MONITORING)	ALTERNATIVE 3: LIMITED ACTION (LONG-TERM MONITORING AND INSTITUTIONAL CONTROLS)
IMPLEMENTABILITY			
Ability to Construct and Operate	No construction or operation would be involved.	No difficulties are anticipated. Well installation is a readily implementable technology.	Same as Alternative 2.
Ease of Doing More Action if Needed	Additional actions would be easily implemented if required.	Additional actions, such as establishment of a CEA, would be easily implemented if required.	Additional actions would be easily implemented if required.
Ability to Monitor Effectiveness	No monitoring would be involved.	Monitoring would provide assessment of potential exposures, contaminant presence, migration, or changes in site conditions.	Same as Alternative 2.
Ability to Obtain Approvals and Coordinate with Other Agencies	No coordination would be required.	Coordination for 5-year reviews may be required and would be obtainable.	Same as Alternative 2. 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	None required.	Equipment and personnel are available to perform long-term monitoring and 5-year reviews.	Same as Alternative 2.
Availability of Technology	None required.	None required.	None required.

TABLE 4-1
SITE 1 - COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES
OU-8 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY
PAGE 5 OF 5

CRITERION:	ALTERNATIVE 1: NO ACTION	ALTERNATIVE 2: LIMITED ACTION (LONG-TERM MONITORING)	ALTERNATIVE 3: LIMITED ACTION (LONG-TERM MONITORING AND INSTITUTIONAL CONTROLS)
COST			
Capital Cost	$0	$15,900	$41,900
First-Year Annual O&M Cost	$0	$8,050	$8,050
Five-Year Reviews	$0	$15,500	$15,500
Present Worth Cost*	$0	$149,200	$175,200

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

Compliance with ARARs

Because Alternative 1 does not include any remedial actions, it would not comply with state and federal ARARs. Alternatives 2 and 3 would comply with these requirements. Alternative 3 would offer greater protection since a CEA would be established.

Alternatives 2 and 3 would comply with federal and state long-term monitoring requirements through annual monitoring and evaluation of groundwater.

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

Long-Term Effectiveness and Permanence

Alternative 3 offers the most substantial long-term protection of human health and the environment of the three alternatives. Under all three alternatives, risks would remain the same or decrease over time as the site surface vegetation continues to follow natural ecological succession, thereby improving the vegetative cover. However, potential future users of site groundwater may be at risk under Alternatives 1 and 2 because they lack institutional controls that would prohibit use of untreated contaminated groundwater.

Alternatives 2 and 3 would allow for assessment of contaminant status through the use of long-term groundwater monitoring.

Alternative 3 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.

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.

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.

No on-site actions are proposed under Alternative 1. Alternatives 2 and 3 would present a greater opportunity for short-term effectiveness due to long-term groundwater monitoring and institutional controls (Alternative 3 only).

Impacts to the environment are not anticipated under any of the three alternatives since minimal activities would be conducted.

Alternative 1 would not achieve a the RAO. Alternative 2 would achieve the RAO within approximately one year, which would be the time to conduct annual groundwater monitoring and evaluate the results. Alternative 3 would achieve the RAO within approximately less than one year, which would be the time to implement the CEA.

Implementability

Alternative 1 is the most easily implemented since no activities are proposed. Alternative 2 would be more difficult to implement since it would involve long-term monitoring; 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 implementation of the CEA; however, no difficulties are anticipated.

If additional actions are warranted, they could be easily implemented under all three alternatives.

Cost

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

4.2 INDIVIDUAL ANALYSIS OF SITE 11 ALTERNATIVE

A detailed evaluation of the Site 11 remedial alternative retained for further evaluation is presented in this section.

4.2.1 Site 11 - Alternative 1: No - Action

The no-action alternative was developed as a baseline case as required by the NCP and to support the recommendation for no further action at Site 11. There will be no activities conducted under this alternative.

It is also recommended that no further action be taken at Site 11 based on the findings of previous investigations, and on the results of the human health and ecological risk assessments. 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. Further study or remediation based on ecological concerns at Site 11 is considered undesirable, in that it may interfere with propagation of knieskern's beakrush. Monitoring of the status of the knieskern's beakrush on the site was recommended in the RI, however base personnel are conducting monitoring as part of their current assignments.

Overall Protection of Human Health and the Environment

The no-action alternative would not provide additional protection of human health or the environment. Risks to human health, the environment and the endangered species would be unchanged.

Compliance with ARARs

Alternative 1 would comply with ARARs since there are no corresponding RAOs for Site 11.

Long-Term Effectiveness and Permanence

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

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 (or found necessary) to address site media.

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 unchanged. Achievement of RAOs is not applicable.

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.

TABLE 4-2
SITE 11 - ANALYSIS OF REMEDIAL ACTION ALTERNATIVES
0U-8 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY

CRITERION:	ALTERNATIVE 1: NO ACTION
OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT	
Prevent Potential Human Interference With Propagation of the Endangered Species	No additional action would be taken.
COMPLIANCE WITH ARARs	
Chemical-Specific ARARs	Not applicable.
Location-Specific ARARs	Not applicable.
Action-Specific ARARs	Not applicable.
LONG-TERM EFFECTIVENESS AND PERMANENCE	
Magnitude of Residual Risk	No change in risk would be anticipated over time.
Adequacy and Reliability of Controls	No new controls would be implemented. Existing site features provide limited controls.
Need for 5-Year Review	Not applicable.
REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT	
Reduction of Toxicity, Mobility, or Volume Through Treatment	No reduction, since no treatment would be employed.
SHORT-TERM EFFECTIVENESS	
Community Protection	No risk to community is anticipated.
Worker Protection	No risk to workers is anticipated.
Environmental Impacts	No adverse impacts to the environment are anticipated.
Time Until Action is Complete	Not applicable
IMPLEMENTABILITY	
Ability to Construct and Operate	No construction or operation is involved.
Ease of Doing More Action if Needed	Additional actions would be easily implemented if required.
Ability to Monitor Effectiveness	No monitoring will be performed.
Ability to Obtain Approvals and Coordinate with Other Agencies	Not applicable.
Availability of Treatment, Storage Capacities, and Disposal Services	None required.
Availability of Equipment, Specialists, and Materials	Not applicable.
Availability of Technology	Not required
COST	
Capital Cost	$0
Annual Ecological Monitoring	$0
Five -Year Review	$0
Present Worth Cost*	$0

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

APPENDIX A
COST ESTIMATES

NAVAL WEAPONS STATION EARLE
Colts Neck, New Jersey
Operable Unit 8 (Site 1)
Alternative 2 - Limited Action (Long-Term Monitoring)
Capital Cost Summary

11/6/2002 10:18 AM

Item	Subcontract	Material	Labor	Equipment	Total
1 MONITORING WELL INSTALLATION	$6,000	$0	$0	$0	$6,000
2 OVERSIGHT	$0	$0	$1,500	$0	$1,500
	$6,000	$0	$1,500	$0	$7,500
Overhead on Labor Cost @ 30%			$450		$450
G & A on Labor Cost @ 10%			$150		$150
G & A on Material Cost @ 10%		$0			$0
G & A on Subcontract Cost @ 10%	$600				$600
Total Direct Cost	$6,600	$0	$2,100	$0	$8,700
Indirects on Total Direct Cost @ 75%			$1,575		$1,575
Profit on Total Direct Cost @ 10%					$870
Subtotal					$11,145
Health & Safety Monitoring @ 10%					$1,115
Total Field Cost					$12,260
Contingency on Total Field Costs @ 20%					$2,452
Engineering on Total Field Cost @ 10%					$1,225.95
TOTAL COST					$15,937

NAVAL WEAPONS STATION EARLE
Colts Neck, New Jersey
Operable Unit 8 (Site 1)
Alternative 2 - Limited Action (Long-Term Monitoring)
Capital Cost

11/6/2002 10:18 AM

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	$5,000.00				$5,000	$0	$0	$0	$5,000	1 well / 25' deep
1.2 Well Survey	1	ls	$1,000.00				$1,000	$0	$0	$0	$1,000	
							$6,000	$0	$0	$0	$6,000	
2 OVERSIGHT												
2.1 Engineering Oversight	1	ls			$1,500.00		$0	$0	$1,500	$0	$1,500	For 1 week
							$0	$0	$1,500	$0	$1,500	

NAVAL WEAPONS STATION EARLE
Colts Neck, New Jersey
Operable Unit 8 (Site 1)
Alternative 2 - Limited Action (Long-Term Monitoring)
Annual Cost

11/6/2002 10:18 AM

Item	Item Cost Annually	Item Cost per 5 years	Notes
Sampling	$3,000		Collect nine groundwater samples, per sampling period, plus travel, living, and shipping cost
Analysis/Water	$1,050		Seven water samples, per sampling period (including blanks and duplicates), metals only
Annual Report	$4,000		Ten hours per sampling report plus other direct costs
Site Review		$15,500	Review of site conditions by 3 engineers for Years 5, 10, 15, 20, 25, and 30
TOTALS	$8,050	$15,500	

NAVAL WEAPONS STATION EARLE 11/6/2002 10:18 AM

Colts Neck, New Jersey

Operable Unit 8 (Site 1)

Alternative 2 - Limited Action (Long-Term Monitoring)

Present Worth Analysis

Year	Capital Cost	Annual Cost	Total Year Cost	Annual Discount Rate at 7%	Present Worth
0	$15,937		$15,937	1.000	$15,937
1		$8,050	$8,050	0.935	$7,527
2		$8,050	$8,050	0.873	$7,028
3		$8,050	$8,050	0.816	$6,569
4		$8,050	$8,050	0.763	$6,142
5		$23,550	$23,550	0.713	$16,791
6		$8,050	$8,050	0.666	$5,361
7		$8,050	$8,050	0.623	$5,015
8		$8,050	$8,050	0.582	$4,685
9		$8,050	$8,050	0.544	$4,379
10		$23,550	$23,550	0.508	$11,963
11		$8,050	$8,050	0.475	$3,824
12		$8,050	$8,050	0.444	$3,574
13		$8,050	$8,050	0.415	$3,341
14		$8,050	$8,050	0.388	$3,123
15		$23,550	$23,550	0.362	$8,525
16		$8,050	$8,050	0.339	$2,729
17		$8,050	$8,050	0.317	$2,552
18		$8,050	$8,050	0.296	$2,383
19		$8,050	$8,050	0.277	$2,230
20		$23,550	$23,550	0.258	$6,076
21		$8,050	$8,050	0.242	$1,948
22		$8,050	$8,050	0.226	$1,819
23		$8,050	$8,050	0.211	$1,699
24		$8,050	$8,050	0.197	$1,586
25		$23,550	$23,550	0.184	$4,333
26		$8,050	$8,050	0.172	$1,385
27		$8,050	$8,050	0.161	$1,296
28		$8,050	$8,050	0.150	$1,208
29		$8,050	$8,050	0.141	$1,135
30		$23,550	$23,550	0.131	$3,085
				TOTAL PRESENT WORTH	**$149,247**

NAVAL WEAPONS STATION EARLE
Colts Neck, New Jersey
Operable Unit 8 (Site 1)
Alternative 3 - Limited Action (Long-Term Monitoring with CEA)
Capital Cost Summary

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Item	Subcontract	Material	Labor	Equipment	Total
1 MONITORING WELL INSTALLATION	$6,000	$0	$0	$0	$6,000
2 OVERSIGHT	$0	$0	$1,500	$0	$1,500
3 INSTITUTIONAL CONTROLS	$15,000	$0	$0	$0	$15,000
	$21,000	$0	$1,500	$0	$22,500
Overhead on Labor Cost @ 30%			$450		$450
G & A on Labor Cost @ 10%			$150		$150
G & A on Material Cost @ 10%		$0			$0
G & A on Subcontract Cost @ 10%	$2,100				$2,100
Total Direct Cost	$23,100	$0	$2,100	$0	$25,200
Indirects on Total Direct Cost @ 75%			$1,575		$1,575
Profit on Total Direct Cost @ 10%					$2,520
Subtotal					$29,295
Health & Safety Monitoring @ 10%					$2,930
Total Field Cost					$32,225
Contingency on Total Field Costs @ 20%					$6,445
Engineering on Total Field Cost @ 10%					$3,222.45
TOTAL COST					$41,892

NAVAL WEAPONS STATION EARLE
Colts Neck, New Jersey
Operable Unit 8 (Site 1)
Alternative 3 - Limited Action (Long-Term Monitoring with CEA)
Capital Cost

11/6/2002 10:19 AM

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	$5,000.00				$5,000	$0	$0	$0	$5,000	1 well / 25' deep
1.2 Well Survey	1	ls	$1,000.00				$1,000	$0	$0	$0	$1,000	
							$6,000	$0	$0	$0	$6,000	
2 OVERSIGHT												
2.1 Engineering Oversight	1	ls			$1,500.00		$0	$0	$1,500	$0	$1,500	For 1 week
							$0	$0	$1,500	$0	$1,500	
3 INSTITUTIONAL CONTROLS												
3.1 Establish CEA	1	ls	$15,000.00				$15,000	$0	$0	$0	$15,000	
							$15,000	$0	$0	$0	$15,000	

NAVAL WEAPONS STATION EARLE
Colts Neck, New Jersey
Operable Unit 8 (Site 1)
Alternative 3 - Limited Action (Long-Term Monitoring with CEA)
Annual Cost

11/6/2002 10:19 AM

Item	Item Cost Annually	Item Cost per 5 years	Notes
Sampling	$3,000		Collect nine groundwater samples, per sampling period, plus travel, living, and shipping cost
Analysis/Water	$1,050		Seven water samples, per sampling period (including blanks and duplicates), metals only
Annual Report	$4,000		Ten hours per sampling report plus other direct costs
Site Review		$15,500	Review of site conditions by 3 engineers for Years 5, 10, 15, 20, 25, and 30
TOTALS	$8,050	$15,500	

NAVAL WEAPONS STATION EARLE 11/6/2002 10:19 AM

Colts Neck, New Jersey

Operable Unit 8 (Site 1)

Alternative 3 - Limited Action (Long-Term Monitoring with CEA)

Present Worth Analysis

Year	Capital Cost	Annual Cost	Total Year Cost	Annual Discount Rate at 7%	Present Worth
0	$41,892		$41,892	1.000	$41,892
1		$8,050	$8,050	0.935	$7,527
2		$8,050	$8,050	0.873	$7,028
3		$8,050	$8,050	0.816	$6,569
4		$8,050	$8,050	0.763	$6,142
5		$23,550	$23,550	0.713	$16,791
6		$8,050	$8,050	0.666	$5,361
7		$8,050	$8,050	0.623	$5,015
8		$8,050	$8,050	0.582	$4,685
9		$8,050	$8,050	0.544	$4,379
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11		$8,050	$8,050	0.475	$3,824
12		$8,050	$8,050	0.444	$3,574
13		$8,050	$8,050	0.415	$3,341
14		$8,050	$8,050	0.388	$3,123
15		$23,550	$23,550	0.362	$8,525
16		$8,050	$8,050	0.339	$2,729
17		$8,050	$8,050	0.317	$2,552
18		$8,050	$8,050	0.296	$2,383
19		$8,050	$8,050	0.277	$2,230
20		$23,550	$23,550	0.258	$6,076
21		$8,050	$8,050	0.242	$1,948
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23		$8,050	$8,050	0.211	$1,699
24		$8,050	$8,050	0.197	$1,586
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26		$8,050	$8,050	0.172	$1,385
27		$8,050	$8,050	0.161	$1,296
28		$8,050	$8,050	0.150	$1,208
29		$8,050	$8,050	0.141	$1,135
30		$23,550	$23,550	0.131	$3,085
				TOTAL PRESENT WORTH	**$175,202**