N60478.AR.000853
NWS EARLE
5090.3a

FEASIBILITY STUDY
for
SITE 7
LANDFILL SOUTH OF "P" BARRICADES
(OU 10)

NAVAL WEAPONS STATION EARLE
Colts Neck, New Jersey

Naval Facilities Engineering Command
Mid-Atlantic

Contract No. N62472-03-D-0057
Contract Task Order 029

June 2008

TETRA TECH

PHIL-19039

FEASIBILITY STUDY
for
SITE 7
LANDFILL SOUTH OF "P" BARRICADES (OU 10)

NAVAL WEAPONS STATION EARLE
Colts Neck, New Jersey

COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

Submitted to:
Naval Facilities Engineering Command
Mid-Atlantic
9742 Maryland Avenue
Norfolk, Virginia 23511-3095

Prepared and Submitted by:
Tetra Tech NUS, Inc.
234 Mall Blvd., Suite 260
King of Prussia, Pennsylvania 19406

Contract No. N62472-03-D-0057
Contract Task Order 029

June 2008

PREPARED UNDER THE DIRECTION OF:

MARY M. MANG, CHMM
PROJECT MANAGER
TETRA TECH NUS, INC
KING OF PRUSSIA, PENNSYLVANIA

APPROVED FOR SUBMISSION BY:

JOHN J. TREPANOWSKI, P.E.
PROGRAM MANAGER
TETRA TECH NUS, INC
KING OF PRUSSIA, PENNSYLVANIA

TABLE OF CONTENTS

SECTION **PAGE**

ACRONYMS ..... **v**

EXECUTIVE SUMMARY **ES-1**

1.0 INTRODUCTION AND BACKGROUND INFORMATION **1-1**
1.1 SITE DESCRIPTION AND SETTING 1-1
1.2 SITE OPERATING HISTORY 1-6
1.3 PREVIOUS ENVIRONMENTAL INVESTIGATIONS 1-8
1.3.1 Initial Assessment and Site Investigation Studies 1-8
1.3.2 1991-1992 Remedial Investigation 1-9
1.3.3 1995 Remedial Investigation 1-9
1.3.4 April 2005 Groundwater Sampling 1-11
1.4 BACKGROUND ENVIRONMENTAL SAMPLING 1-11
1.4.1. Background Sample Location 1 1-12
1.4.2 Background Sample Location 2 1-12
1.4.3 Background Sample Location 3 1-12
1.4.4 Background Sample Location 4 1-12
1.4.5 Background Well Geology 1-12
1.4.6 Background Groundwater Statistical Analysis 1-13
1.5 NATURE AND EXTENT OF CONTAMINATION 1-14
1.5.1 Sediment 1-14
1.5.2 Groundwater 1-15
1.5.3 Surface Water 1-16
1.6 CONTAMINANT FATE AND TRANSPORT 1-16
1.6.1 Detected Chemicals and Transport Potential 1-16
1.6.2 Contaminant Persistence 1-17
1.6.3 Observed Chemical Contaminant Trends 1-17
1.7 HUMAN HEALTH RISK ASSESSMENT 1-18
1.7.1 Baseline Human Health Risk Assessment 1-20
1.8 ECOLOGICAL RISK ASSESSMENT 1-21
1.8.1 Ecological Screening - Surface Soil 1-22
1.9 QUALITATIVE EVALUATION OF HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT RESULTS 1-23

2.0 IDENTIFICATION AND SCREENING OF TECHNOLOGIES **2-1**
2.1 POTENTIAL ARARs AND TBCs 2-1
2.1.1 Potential Chemical-Specific ARARs and TBCs 2-2
2.1.2 Potential Location-Specific ARARs and TBCs 2-3
2.1.3 Potential Action-Specific ARARs and TBCs 2-4
2.2 METHOD USED FOR DEVELOPMENT OF REMEDIAL ACTION OBJECTIVES 2-5
2.3 METHOD USED FOR DEVELOPMENT OF PRELIMINARY REMEDIAL GOALS 2-5
2.3.1 ARAR/TBC Basis 2-6
2.3.2 Human Health Risk Basis 2-6
2.3.3 Ecological Risk Basis 2-6
2.3.4 Protection of Groundwater Basis 2-7
2.3.5 Background Concentration Basis 2-7
2.4 METHOD USED FOR DEVELOPMENT OF GENERAL RESPONSE ACTIONS 2-7
2.5 METHOD USED FOR IDENTIFICATION, SCREENING, AND EVALUATION OF REMEDIAL TECHNOLOGIES 2-8
2.6 SITE 7 TECHNOLOGY SCREENING 2-9

TABLE OF CONTENTS (Continued)

SECTION **PAGE**

2.6.1 Site 7 Remedial Action Objectives 2-9
2.6.2 Site 7 Preliminary Remediation Goals 2-12
2.6.3 Site 7 General Response Actions 2-14
2.6.4 Identification, Screening, and Evaluation of Technologies and Process Options for Site 7 2-14
2.6.5 Summary of Site 7 Selected Remedial Technologies and Process Options 2-15
2.7 VOLUME OF CONTAMINATED MEDIA 2-15
2.7.1. Landfill Wastes 2-15
2.7.2 Groundwater 2-16

3.0 DEVELOPMENT AND SCREENING OF REMEDIAL ACTION ALTERNATIVES 3-1
3.1 SITE 7 - DEVELOPMENT AND SCREENING OF ALTERNATIVES 3-1
3.1.1 Site 7 - Rationale for Development of Alternatives 3-1
3.1.2 Site 7 - Remedial Alternative Descriptions 3-2
3.1.3 Site 7 - Alternatives Screening 3-9

4.0 DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES 4-1
4.1 INTRODUCTION 4-1
4.2 CRITERIA FOR DETAILED ANALYSIS 4-1
4.3 INDIVIDUAL ANALYSIS OF SITE 7 ALTERNATIVES 4-3
4.3.1 Alternative 1: No Action 4-3
4.3.2 Alternative 2: Land Use Controls and Long-Term Monitoring 4-6
4.3.3 Alternative 3: Soil Cover, Land Use Controls and Long-Term Monitoring 4-9
4.3.4 Alternative 4: Single Barrier Cap, Land Use Controls, and Long-Term Monitoring 4-13
4.3.5 Alternative 5: Removal and Off-Site Disposal 4-16

5.0 COMPARISON OF ALTERNATIVES 5-1
5.1 OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT 5-1
5.2 COMPLIANCE WITH ARARS 5-2
5.3 LONG-TERM EFFECTIVENESS AND PERMANENCE 5-2
5.4 REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT 5-3
5.5 SHORT-TERM EFFECTIVENESS 5-4
5.6 IMPLEMENTABILITY 5-4
5.7 COSTS 5-5

REFERENCES R-1

APPENDICES

A APRIL 2005 GROUNDWATER SAMPLING RESULTS
B HUMAN HEALTH RISK/EXPOSURE SUMMARY TABLES
C SITE 7 INSPECTION PICTURES TAKEN IN JANUARY 2005
D HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT EVALUATION
E TEST PIT LOGS
F COSTS
G SUPPORTING DOCUMENTATION - DEVELOPMENT OF GROUNDWATER RISK-BASED CLEANUP GOALS
H EPA COMMENTS ON DRAFT FEASIBILITY STUDY

TABLE OF CONTENTS (Continued)

TABLES

NUMBER

ES-1 Site 7 - Remedial Alternative Components
ES-2 Site 7 - Comparative Analysis of Remedial Action Alternatives
1-1 Site 7 - Static Water-Level Measurement Summary
1-2 Occurrence and Distribution of Inorganics in Surface Soil
1-3 Summary of 1996 RI Detected Compounds in Groundwater Compared to Background
1-4 Summary of 1996 RI Detected Compounds in Surface Water Compared to Background
1-5 April 2005 Data Summary of Inorganic and Organic Analytical Results Groundwater
1-6 Background Monitoring Well Characteristics Summary
1-7 Background Static Water Level Measurement Summary
1-8 Background Wells and Upgradient Wells Grouped by Interpreted Aquifer
1-9 Statistical Evaluation of Background groundwater Metals Data Red Bank Sand and Navesink Formations
1-10 Site 7 - Occurrence and Distribution of Inorganics in Sediment
1-11 Site 7 - Occurrence and Distribution of Substances in Groundwater
1-12 Ecological Screening Table - Surface Soil
2-1 Potential Federal Chemical-Specific ARARs and TBCs
2-2 Potential State Chemical-Specific ARARs and TBCs
2-3 Potential Federal Location-Specific ARARs and TBCs
2-4 Potential State Location-Specific ARARs and TBCs
2-5 Potential Federal Action-Specific ARARs and TBCs
2-6 Potential State Action-Specific ARARs and TBCs
2-7 Site 7 Groundwater Contaminants of Potential Concern (COPCs)
2-8 Site 7 Groundwater COPCs Preliminary Remediation Goals
2-9 Site 7 Remedial Action Objectives, General Response Actions, Technology Types, and Process Options
2-10 Preliminary Screening of Technologies and Process Options for Site 7 Landfill Materials
2-11 Preliminary Screening of Technologies and Process Options for Site 7 Contaminated Groundwater
2-12 Detailed Evaluation of Technologies and Process Options for Site 7 Landfill Materials
2-13 Detailed Evaluation of Technologies and Process Options for Site 7 Contaminated Groundwater
3-1 Site 7 - Remedial Alternative Components
3-2 Site 7 - Screening of Remedial Alternatives
5-1 Site 7 - Comparative Analysis of Remedial Action Alternatives

FIGURES

NUMBER

ES-1 Background Sample Locations - Mainside Area
ES-2 Background Sample Locations - Waterfront Area
ES-3 Proposed Groundwater Monitoring Locations
1-1 Site Location Map
1-2 General Location Map Waterfront Area
1-3 General Location Map Mainside Area
1-4 Site Locations Waterfront Area
1-5 Groundwater Contour Map - August 7, 1995
1-6 Groundwater Contour Map - October 17, 1995
1-7 Groundwater Contour Map - April 12, 2005

TABLE OF CONTENTS (Continued)

FIGURES

NUMBER

1-8 Approximate Landfill Boundary
1-9 Sample Location Map
1-10 Background Sample Locations-Mainside Area
1-11 Background Sample Locations-Waterfront Area
1-12 1995 Remedial Investigation Concentrations above Screening Levels Site 7 - Landfill South of “P” Barricades
1-13 April 2005 Groundwater Sampling concentrations Above Screening Levels Site 7 - Landfill South of “P” Barricades
3-1 Limit of Proposed Classification Exception Area

LIST OF ACRONYMS

ARARs	Applicable or Relevant and Appropriate Requirements
BOD	Biological Oxygen Demand
BTU	British Thermal Unit
CEA	Classification Exception Area
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COC	Chemical of Concern
COPC	Chemical of Potential Concern
ECO-SSL	Ecological Soil Screening Level
EPA	United States Environmental Protection Agency
EPC	Exposure Point Concentration
EPIC	Environmental Photographic Interpretation Center
FS	Feasibility Study
GWQS	Groundwater Quality Standard
HEAST	Health Effects Assessment Summary Table
HQ	Hazard Quotient
HI	Hazard Index
HHRA	Human Health Risk Assessment
IAS	Initial Assessment Study
IRIS	Integrated Risk Information System
LUCs	Land Use Controls
MCL	Maximum Contaminant Level
msl	mean sea level
NCEA	National Center for Exposure Analysis
NJDEP	New Jersey Department of Environmental Protection
N.J.A.C.	New Jersey Administrative Code
NPL	National Priorities List
NWS	Naval Weapons Station
O&M	Operation and Maintenance
OSHA	Occupational Safety and Health Act
OU	Operable Unit
PA	Preliminary Assessment
PPRTV	Provisional Peer Reviewed Toxicity Value
PQL	Practical Quantitation Level
PRGs	Preliminary Remediation Goals

LIST OF ACRONYMS (CONTINUED)

QA/QC	Quality Assurance/Quality Control
RA	Remedial Action
RAO	Remedial Action Objective
RBC	Risk-Based Concentration
RD	Remedial Design
RCRA	Resource Conservation and Recovery Act
RfD	Reference Dose
RI	Remedial Investigation
RME	Reasonable Maximum Exposure
ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act
SF	Slope Factor
SI	Site Inspection
SSL	Soil Screening Level
TAL	Target Analyte List
TBC	To Be Considered
TOC	Total Organic Carbon
1,1,2-TAC	1,1,2-Trichloroethane

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 feasibility study (FS) of a former landfill disposal site at Naval Weapons Station Earle (NWS Earle), which is located in Colts Neck, New Jersey. The purpose of the FS report is to meet the requirements of the U.S. Environmental Protection Agency (EPA) Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA). CERCLA activities are typically performed in four distinct phases. The first phase consists of a Preliminary Assessment followed by a Site Inspection. The third phase is a Remedial Investigation/Feasibility Study (RI/FS), which characterizes physical and chemical parameters and risks associated with the facility and develops viable remedial alternatives for those media which have identified actionable risks. The remedial investigation (RI) for the NWS Earle Sites was completed in July 1996. The last phase of the CERCLA process consists of Remedial Design (RD) and Action (RA) to control and mitigate contamination.

The objective of the RI/FS process is to gather and evaluate information sufficient to select the most appropriate remedy for a given site based on an informed risk management decision-making process. This report presents the FS performed for Site 7 (Landfill South of “P” Barricades) designated as Operable Unit 10 (OU 10). The FS incorporates the results of the RI to develop and evaluate potential remedial alternatives for addressing unacceptable risks to human health and the environment associated with landfilled waste materials and groundwater. This report addresses the remedial alternatives developed for Site 7. The OU 10 site is located within the Waterfront Area of NWS Earle.

As part of the FS, remedial technologies and process options were evaluated and screened to select those which were most viable for site conditions and contaminants. The technologies and process options that passed the screening process were combined to form remedial alternatives that address site contamination and unacceptable risks. The alternatives were then evaluated to distinguish positive and negative aspects of each alternative. A hypothetical carcinogenic risk increase from exposure should ideally fall below or within a risk range of 1×10^{-6} (an increase in one case of cancer for one million people exposed) to 1×10^{-4} (an increase of one case of cancer per 10,000 people exposed). When the sum of calculated carcinogenic risks for all COPCs exceeds the upper end of EPA's target acceptable risk range, risks are considered unacceptable. For non-carcinogenic compounds risks are estimated using Hazard Indices (HIs), where a HI exceeding one (HI>1) indicates that there may be unacceptable health risks, considering only those chemicals that impact the same target organ(s) or exhibit similar critical effect(s) as truly additive.

The remedial options developed in this document will be used by the Navy to select a preferred remedy for

Site 7. A Proposed Remedial Action Plan (PRAP) 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 (ROD).

NWS Earle Site Summary

NWS Earle is located in Monmouth County, New Jersey, approximately 47 miles southeast of New York City. The facility was commissioned in 1943, and its primary mission is to supply ammunition to the naval fleet. The 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.

Regulatory History

An Initial Assessment Study (IAS) conducted in 1983 identified 29 waste disposal areas at NWS Earle and led to the further investigation of 11 of those sites. Following the listing of NWS Earle on the NPL in 1990, site investigations (SI) were initiated at 16 sites. Two sites were not included in these investigations because they were permitted to operate under the Resource Conservation and Recovery Act (RCRA). In 1992, EPA requested that preliminary assessments (PA) be performed on 17 of the sites.

To date, the following reports have been completed and documented. Only documents involving Site 7 are listed below:

- Initial Assessment Study (Fred C. Hart and Associates; February 1983);
- Interim Report for a Confirmation Study to Determine Existence and Possible Migration of Specific Chemicals in Situ (Roy F. Weston (Weston), December 1986);
- Current Situation and Draft Plan of Action (Weston, December 1988);
- Remedial Investigation/Feasibility Study for 11 Sites, Volumes 1-3 (Weston, September 1993); and
- Remedial Investigation Report, Volumes IA, IB and II (Brown & Root Environmental, July 1996)

Site 7 - Landfill South of "P" Barricades

The Site 7 Landfill South of "P" Barricades is located in the Waterfront Area of NWS Earle. Approximately 3.6 acres of the site contains landfilled waste materials as determined by a 1974 EPA Environmental Photographic Interpretation Center (EPIC) photo. From 1965 to 1977, the site was used to dispose of municipal-type solid waste and waste from Waterfront industrial operations. Wastes reportedly consisted of munitions shipping wastes (dunnage, packing), shop wastes from the Waterfront Public Works Shop and the Munitions Handling Laboratory (glass, wood, and small quantities of waste paint, thinners, and solvents), and domestic refuse. The landfilled materials were covered with a thin layer of loose sand quarried from the surrounding area. The current landfill cover does not comply with New Jersey Solid Waste Regulations (N.J.A.C. 7:26) for final cover systems.

An unpaved road borders the site to the north, west, and south. The ground surface slopes downward to the north from approximately 160 feet mean sea level (msl) near MW7-03 to approximately 125 feet msl near MW7-02. Groundwater generally flows toward the north, based on measured groundwater levels. A site visit was performed by Tetra Tech NUS, Inc. (TtNUS) personnel in January 2005 to assess current site appearance. During the site visit it was noted that there were large white pine trees (up to 20-30 feet in height) as well as heavy ground vegetation growing within the landfill area. A small marginal wetland area, formed in a depression on top of the landfill, was evident with heavy grasses and tall reeds.

Nature and Extent of Contamination

Sediment: One sediment sample was collected north of the landfill edge in a broad drainageway of runoff from Site 7. No organic chemicals were detected in the site-related sediment sample. Concentrations of most metals were within similar ranges to those detected in sediment background samples. Manganese was detected in the site-related sample at a concentration slightly greater than background.

Miscellaneous parameter analyses for the site 7 sediment sample consisted of COD, chlorides, moisture, sulfates, TOC, and phosphates. The sample did not reveal concentrations greater than background.

Three background samples were collected for sediment. The background sampling locations were BG-1, BG-2, and BG-4 located within the Mainside Area (See Figure ES-1). Sediment background samples were collected using stainless-steel trowels from 0 to 6 inches below the sediment/water interface and were analyzed for TCL VOCs, TCL SVOCs, TCL Pesticides/PCBs, TAL metals, ammonia, chloride, nitrite/nitrate, phosphate, TOC, cyanide, moisture pH, TPH, grain size, and explosives. For comparison purposes, the Site 7 sediment results were compared to the range of results obtained from the

background sediment samples.

Groundwater: As part of the 1995, RI five site-related groundwater samples (07GW01 through 07GW05) were collected from the monitoring well network at Site 7. A second round of sampling was conducted in April 2005. In 1995 concentrations of most metals in Site 7 groundwater were within the range of background results except for aluminum, chromium, copper, lead, mercury, and thallium. Chromium, copper, lead, and thallium were detected in two or less groundwater samples, but were not detected in background samples. The 2005 sampling results indicated that only aluminum and iron exceeded the normal range of background results.

1,1,2-Tetrachloroethane (1,1,2-TCA) (1 ug/L), 1,2-Dichloroethene (1,2-DCE) (4 ug/L), benzene (1 ug/L), chlorobenzene (11 ug/L), and chloroform (2 ug/L) were each detected in one groundwater sample collected at Site 7 during the 1995 RI. Only chlorobenzene at 11 ug/L exceeded applicable Federal and/or state ARARs and/or TBCs. None of these compounds were detected in background groundwater samples. During the April 2005 sampling event, only one well had a detection of an organic compound, chlorobenzene at a concentration of 4.4 ug/L, significantly below the New Jersey Groundwater Quality Standard (GWQS) of 50 ug/L. All other VOCs were not detected or exhibited an estimated concentration below the analytical method detection limit (during the April 2005 sampling).

Miscellaneous parameter analyses of five groundwater samples at Site 7 consisted of ammonia, biological oxygen demand (BOD), chemical oxygen demand (COD), chlorides, nitrates, sulfates, total organic carbon (TOC), phosphates, and turbidity. Most indicator parameters revealed lower concentrations in upgradient well MW07-03 than in all downgradient wells. None of the indicator parameters in upgradient or downgradient wells were high enough to be within a range typically associated with concentrated landfill leachate.

For Site 7, two wells were used for comparison purposes to background, Site 7 upgradient well MW7-03 (07 GW 03) and background well BGMW-3. Thee wells were identified as suitable background wells for comparison purposes because of location and similar geologic formations; MW7-03 is located in the Red Bank Sand formation and background well BGMW-3 is located in the Red Bank Sand and Navesink Formation south of Site 7 (See Figure ES-2). The 1995 RI groundwater inorganic results were compared to the 95 percent upper tolerance limits (UTLS) that were calculated based on the results obtained from wells MW7-03 (07GW 03) and BGMW-3. Volatile organic compound results from the 1995 RI sampling were compared directly to results obtained from wells MW7-03 and BGMW-3. The Site 7 2005 groundwater inorganic and organic results were compared to the results obtained from background well MW7-03.

Surface Water: A watershed sample WSSW30, was taken north of Site 7. This surface water sample is most closely related to potential runoff and stream recharging originating from Site 7. No organic compounds were found in the sample and all other parameters were found in the range of background. Three background samples were collected for surface water. The background sampling locations were located within the Mainside Area (BG-1, BG-2 and BG-4) as shown on Figure ES-1. Surface water background samples were collected by dipping the sample bottle directly into the water and analyzed for TCL VOCs, TCL SVOCs, TCL pesticides/PCBs, TAL metals, ammonia, TOC, phosphate, COD, cyanide, TPH, nitrite/nitrate, turbidity, BOD, chloride, hardness and explosives. For comparison purposes the Site 7 surface water results were compared to the range of results obtained from the background surface water samples.

Summary of Site Risks

The results of the RI were evaluated using EPA guidance and directives to gauge potential impacts from Site 7 conditions on human health and the environment. The exact procedures used for the estimation of the human health risk assessment (HHRA) and ecological risk screening are presented in the RI report (July 1996) and are summarized in Section 1 of this document. At the request of EPA, since the RI HHRA was performed several years ago; the Navy has performed a review of the human health risks based on current EPA risk assessment guidelines and risk factors. This review concluded that there would be minor additions and deletions of chemicals of potential concern (COPCs), but no major change, sufficient to redirect the findings of this FS. The review process and results are presented in Section 1.10 and Appendix D.

Analytical data from sediment and groundwater obtained at Site 7 during 1995 RI field activities were used in assessing risks. Surface soil from two test pits was collected for analysis during the 1993 Phase II Site Inspection study. The soil contained only slightly elevated levels of a phthalate compound. Due to the low concentration of only one phthalate compound found, the 1993 soil data was not used in the risk assessment. The level of bis(2-ethylhexyl) phthalate detected in the 1993 sample is below current (October 2007) EPA Region 3 risk based screening levels for residential and industrial exposure scenarios. Surface water is not present near the site in the direction of groundwater flow, and hence, groundwater-to-surface water contaminant migration is not of concern. The potential receptors considered for this site were future industrial, residential, and recreational receptors. Currently the majority of the landfill is covered with tall grasses and mature pine trees. Appendix B contains summary tables of the estimated human health risks for Site 7.

The reasonable maximum exposure (RME) cancer risk associated with future residential groundwater exposure (5.3E-06) is within the 1E-04 to 1E-06 EPA target acceptable risk range. 1,1,2-trichloroethane

(1,1,2-TCA) and benzene via ingestion and chloroform via inhalation during showering are the COPCs that contributed to the cancer risks for the hypothetical future residential exposure scenario. The RME cancer risk associated with the future recreational sediment exposure (2.0E-07) is below the 1E-04 to 1E-06 target acceptable risk range. The RME cancer risk associated with future industrial groundwater exposure (1.1E-05) is within the 1E-04 to 1E-06 target acceptable risk range. Beryllium via ingestion is the principal COPC that contributed to the cancer risks for these exposure scenarios.

RME estimates for non-carcinogenic hazard index (HI) risk associated with the future child residential groundwater ingestion exposure scenario exceeded 1.0. Thallium was the principal COPC responsible for HIs in the range of 2.8 to 3.0 for the target organs skin, kidney, liver, and central nervous system (ingestion exposures contributed the significant portion of the risk). Adverse noncarcinogenic effects cannot be ruled out when the HI is greater than 1.0. The RME estimates for non-carcinogenic HI risk associated with the future recreational sediment exposure (7.5E-03) and the future industrial groundwater exposure (4.7E-01) are below the HI risk (1.0). Adverse noncarcinogenic effects are not expected when the HIs are below 1.0.

Data collected during the 1993 RI/FS and the 1996 RI indicate that potential risk to ecological receptors is negligible at Site 7. Groundwater-to-surface water migration is not an issue because no surface water is present on or near the site. Current site conditions show no evidence of erosion or migration of soil and/or waste constituents. Any soil contamination that might exist at the site is probably below the surface, and is not available to most receptors. Bis(2-ethylhexyl)phthalate was detected at 90J ug/kg and 110 ug/kg during the 1993 SI at Site 7. The October 2007 EPA Region 3 risk based concentration (RBC) for industrial soil exposure is 2.6 mg/kg (2,600 ug/kg); for residential soil exposure, the RBC is 0.58 mg/kg (580 ug/kg).

Lead was found at concentrations exceeding the EPA action level (15 ug/L) in groundwater samples taken in previous investigations, but not in groundwater, samples collected using low flow techniques during the 1995 RI. Lead was not found at levels exceeding 400 mg/kg in subsurface soil from previous investigations or in the 1995 RI sediment sample.

April 2005 Groundwater Sampling

Groundwater sampling performed in April 2005 shows that volatile organic compounds (VOCs) have decreased in concentration below State of New Jersey GWQS since the previous sampling round in 1995. In the April 2005 sampling round there were three metals above GWQS: aluminum, iron and manganese. However, manganese was also detected in an upgradient well at a level significantly above its respective GWQS.

Description of the FS Process

The overall objective of this FS is to develop and evaluate remedial alternatives that address existing conditions at Site 7. 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 (PRGs). The PRGs (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 NCP and the RI/FS guidance document. Finally, compare and evaluate the alternatives.

Remedial Action Objectives (RAOs) for Site 7

Based on the baseline HHRA, the ecological risk assessment, the RI results, and the April 2005 groundwater sampling event, RAOs were developed to address the landfilled waste materials and contaminated environmental media (groundwater) present at Site 7.

Protection of Human Health RAO

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

Protection of the Environment RAO

- None.

Alternatives Development

Following the technology screening and detailed evaluation, remedial technologies were assembled into alternatives that address contaminated 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 10 included no action, limited action (long-term monitoring and land use controls [LUCs]), surface controls (soil cover, revegetation, long-term monitoring, and LUCs), single barrier cap, and removal and off-site disposal.

Site 7 Remedial Alternatives

Alternative 1: No Action

The no-action alternative was developed as a baseline case, as required by the NCP. No activities would be conducted under this alternative. The only activity that would occur under the no action alternative is a review of site conditions and risks every five years.

Under this alternative, no remedial actions would be taken to protect human health or the environment. No measures would be implemented to prevent potential human exposure to site groundwater or to prevent potential human exposure to landfill contents. Key components of Alternative 1 are identified on Table ES-1 and described below.

Existing Features - Currently, the site is located in a wooded area on Chapel Hill within the NWS Earle Waterfront Area. All facilities located in the Waterfront 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. The primary protective feature is that groundwater underlying Site 7 is not used as a potable water supply. There is currently no pathway for human exposure to metals-contaminated groundwater. No actions would be conducted under Alternative 1 to monitor the status of or to preclude potential contact with groundwater.

Alternative 2: Land Use Controls and Long-Term Monitoring

Alternative 2 relies on land use controls to limit potential exposure to contaminated groundwater and landfill contents. This alternative does not employ engineered treatment or containment to address groundwater contamination.

Land use restrictions placed in the Base Master Plan would be enacted to prohibit use of impacted groundwater and preclude contact with landfill contents. Long-term periodic monitoring would be conducted to assess the alternative's effectiveness and potential threats to human health and the environment. Site conditions and risks would be reviewed every five years because contaminants would be left in place. Key components of Alternative 2 are identified on Table ES-1 and described below.

Existing Features - Currently, Site 7 features offer some limited protection of human health and the environment. Groundwater underlying Site 7 is not used as a potable water supply. As a result, there is currently no pathway for human exposure to contaminated groundwater.

Security Fencing - Security fencing and signage consistent with other NWS Earle landfill sites would be installed to deter human entry into the landfill area to protect the integrity of the existing cover. The fence will be a post and cable fence with treated wood posts and a strung cable. The fence will follow the same specifications as the fences installed at other landfill sites at NWS Earle (e.g., Sites 4 and 5).

Land Use Controls - Under Alternative 2, land use restrictions would be incorporated into the Base Master Plan to restrict the future use of Site 7 groundwater until natural processes have reduced contaminant concentrations to acceptable levels (GWQSs). Use of untreated, contaminated Site 7 groundwater for drinking water would be prohibited. Restrictions on future development of the site would also be placed in the Base Master Plan unless landfilled waste materials were removed or disposed of properly.

Because site groundwater does not meet New Jersey groundwater quality standards, a New Jersey Classification Exception Area (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 precluded until standards are achieved.

Long-Term Monitoring - Under Alternative 2, groundwater samples would be collected on a biennial basis (i.e., once every two years) from five existing monitoring wells and one new downgradient well (see Figure ES-3). A total of nine groundwater samples, including quality assurance/quality control (QA/QC) samples, would be collected along with measurement of groundwater levels to determine potentiometric conditions. All 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. Long-term monitoring would be conducted in accordance with CEA requirements. After New Jersey GWQS are achieved, monitoring would then be conducted to provide information for the CERCLA five-year reviews or if site conditions changed.

Five-Year Reviews - Because contaminants would remain in Site 7 groundwater, a review of site conditions and risks would be conducted every five years, as required by CERCLA.

Alternative 3: Soil Cover, Land Use Controls, and Long-Term Monitoring

Alternative 3 would include the addition of soil and reshaping the landfill cover to manage precipitation infiltration and surface runoff. The landfill would require revegetation to minimize erosion and to promote evapotranspiration of precipitation, thus reducing infiltration. The soil cap would not meet NJDEP Solid Waste Regulations (N.J.A.C.) 7:26) for final cover systems, but would reduce the amount of infiltration entering the landfill and would prevent exposure to any landfilled materials.

Alternative 3 relies on LUCs to limit potential exposure to contaminated groundwater and landfill contents. This alternative does not employ engineered treatment or containment to address groundwater contamination.

Land use restrictions placed in the Base Master Plan would be enacted to prohibit use of impacted groundwater and prevent intrusive activities within the landfill boundaries. Long-term periodic monitoring would be conducted to assess the alternative's effectiveness and potential threats to human health and the environment. Site conditions and risks would be reviewed every five years because contaminants (waste materials) would be left in place. Key components of Alternative 3 are identified on Table ES-1 and described below.

Existing Features - Currently, Site 7 features offer some limited protection of human health and the environment. However, only a thin sandy soil cover is present. Vegetative covering ranges from short grasses to trees 20 to 30 feet in height.

Groundwater underlying Site 7 is not used as a potable water supply. As a result, there is currently no pathway for human exposure to contaminated groundwater.

Although active treatment of groundwater would not be conducted, gradual natural reduction in concentrations of groundwater contaminants by dispersion, dilution, and degradation should occur.

Security Fencing - Security fencing and signage consistent with other NWS Earle landfill sites would be installed to deter human entry into the landfill area to protect the integrity of the existing cover. The fence will be a post and cable fence with treated wood posts and a strung cable. The fence will follow the same specifications as the fences installed at other landfill sites at NWS Earle (e.g., Sites 4 and 5).

Land Use Controls - Under Alternative 3, land use restrictions would be incorporated into the Base Master Plan to restrict the future use of Site 7 groundwater until natural processes have reduced contaminant concentrations to acceptable levels (GWQSs). Use of untreated, contaminated Site 7 groundwater for drinking water would be prohibited. Restrictions on future development of the site would also be placed in the Base Master Plan unless landfilled waste materials were removed or disposed of properly.

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 precluded until standards are achieved.

Long-Term Monitoring - Under Alternative 3, groundwater samples would be collected on a biennial basis (i.e., once every two years) from five existing monitoring wells and one new downgradient well (See Figure ES-3). A total of nine groundwater samples, including QA/QC samples, would be collected along with measurement of groundwater levels to determine potentiometric conditions. All 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. Long-term monitoring would be conducted in accordance with CEA requirements. After New Jersey GWQS are achieved, monitoring would then be conducted to provide information for the CERCLA five-year reviews or if site conditions changed.

Five-Year Reviews - Because waste materials would remain at the site, a review of site conditions and risks would be conducted every five years, as required by CERCLA.

Alternative 4: Single Barrier Cap, Land Use Controls, and Long-Term Monitoring

Under Alternative 4, a single barrier cap consisting of a 40-mil thickness Linear Low Density Polyethylene (LLDPE) membrane would be placed over the buried waste materials to prevent precipitation infiltration and reduce exposure to any of the landfilled materials. Prior to placement of the membrane, all trees and heavy vegetation would be removed and the landfill will be covered with a six-inch layer of common fill to protect the membrane from any protruding waste or debris. A drainage layer and/or drainage material would be placed on top of the membrane to direct precipitation off the capping membrane. The drainage

layer would be covered with a minimum of 18 inches of vegetative bearing clean fill and 6 inches of topsoil, graded, fertilized and seeded. A passive gas venting system would be installed to minimize methane gas entrapment beneath the impermeable liner. Due to the age of the landfill a passive system is expected to be adequate.

The current landfill cover material does not meet state requirements for final cover. Alternative 4, if implemented, would comply with New Jersey Solid Waste Regulations (N.J.A.C. 7:26) for final cover system design and construction.

Potential exposure to contaminated groundwater would be minimized through establishment of land use restrictions placed in the Base Master Plan. Long-term periodic monitoring would be conducted to assess the alternative's effectiveness and potential threats to human health and the environment. Site conditions and risks would be reviewed every five years. Key components of Alternative 4 are identified in Table ES-1 and described below.

Existing Features - Currently, Site 7 features offer some limited protection of human health and the environment. However, only a thin sandy soil cover is present. Vegetative covering ranges from short grasses to trees 20 to 30 feet in height.

Groundwater underlying Site 7 is not used as a potable water supply. As a result, there is currently no pathway for human exposure to contaminated groundwater.

The placement of an impermeable single barrier cap would significantly reduce the amount of precipitation entering the landfilled waste materials. Based on visual evidence from several test pits conducted in January 1991, none of the landfilled materials appeared to be in contact with groundwater. Thus, although active treatment of groundwater would not be conducted, gradual natural reduction in concentrations of groundwater contaminants by dispersion, dilution, and degradation should occur.

Security Fencing - Security fencing and signage consistent with other NWS Earle landfill sites would be installed to deter human entry into the landfill area to protect the integrity of the cover system. The fence will be a post and cable fence with treated wood posts and a strung cable. The fence will follow the same specifications as the fences installed at other landfill sites at NWS Earle (e.g., Sites 4 and 5).

Land Use Controls - Under Alternative 4, land use restrictions would be incorporated into the Base Master Plan to restrict the future use of Site 7 groundwater until natural processes have reduced contaminant concentrations to acceptable levels (GWQSs). Use of untreated, contaminated Site 7 groundwater for drinking water would be prohibited. Restrictions on future development of the site would also be placed in

the Base Master Plan unless landfilled waste materials were removed or disposed of properly.

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 precluded until standards are achieved.

Long-Term Monitoring - Under Alternative 4, groundwater samples would be collected on a biennial basis (i.e., once every two years) from five existing monitoring wells and one new downgradient well (See Figure ES-3). A total of nine groundwater samples, including QA/QC samples, would be collected along with measurement of groundwater levels to determine potentiometric conditions. All 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. Long-term monitoring would be conducted in accordance with CEA requirements. After New Jersey GWQS are achieved, monitoring would then be conducted to provide information for the CERCLA five-year reviews or if site conditions changed.

Five-Year Reviews - Because waste materials would remain at the site, a review of site conditions and risks would be conducted every five years, as required by CERCLA.

Alternative 5: Removal and Off-Site Disposal

Under Alternative 5 landfilled waste materials and contaminated soils would be excavated and disposed at appropriate off-site Resource Conservation and Recovery Act (RCRA) Subtitle C or Subtitle D landfills or permitted municipal landfills. Wastes suitable for recycling would be segregated and sent to appropriate recycling facilities. Incineration will also be evaluated as a disposal option for any materials with a positive combustion (British thermal unit (BTU) value.

Excavation and Disposal - Prior to the mobilization of the excavation activities, several test pits would be constructed and wastes would be inspected and sampled for additional characterization for disposal purposes. This would enable immediate transportation off site once excavations operations begin. All visible waste material would be excavated and loaded onto trucks for transport to approved disposal facilities.

During excavation activities, samples would be collected from the floor and sidewalls prior to backfilling and regarding. Verification sampling and analysis would be conducted to ensure that the remaining soils do not exceed New Jersey soil remediation levels.

After completion of excavation activities, sand or other clean fill material obtained from on-base would be used to regrade the site. A layer of topsoil, minimum thickness 6 inches, would be placed on the disturbed surfaces. This soil would be fertilized, conditioned, and vegetated for land use and erosion considerations.

Individual and Comparative Analysis of Alternatives

Detailed evaluations of remedial alternatives were performed in accordance with the requirements of the National Contingency Plan (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 ROD following the receipt of comments during the public comment period, after the PRAP has been presented to the public.

COMPARISON OF ALTERNATIVES

Based on comparison of each alternative, Alternative 1 would offer the least protection of all alternatives since no actions would be taken to reduce exposure to landfilled waste materials and site groundwater. In general, Alternatives 3 and 4 would offer comparable protection though Alternative 4 would be more effective at preventing the release of waste constituents into underlying groundwater. Alternative 5 would offer the greatest protection because the landfilled waste materials would be removed from the site.

Overall Protection of Human Health and the Environment: Alternative 1 would not be protective of human health and the environment since no actions would be taken to prevent exposure to landfilled waste materials or contaminated groundwater. Alternative 2 would be slightly more protective of human

health and the environment since restrictions on the current and future use of the site would be placed in the Base Master Plan. In addition, a CEA would be established to prevent use of the site groundwater until GWQS are achieved for several metals including aluminum and iron. Biennial groundwater monitoring would be conducted until GWQS are achieved and CERCLA five-year reviews would identify if site risks have changed and/or if additional remedial actions are needed.

Alternatives 3 and 4 would provide somewhat similar overall protection of human health and the environment though Alternative 4 would be more effective at preventing precipitation infiltration into the landfilled materials. Under Alternative 3 the vegetated soil cover would eliminate the presence of any waste materials on the landfill surface. Alternative 4 would also eliminate the presence of any waste materials on the landfill surface and would significantly reduce the infiltration of precipitation into the landfill. Installation of the low-permeability barrier would significantly reduce the amount of potential leachate generation and movement of waste contaminants into the underlying groundwater since the waste materials are not in contact with groundwater; movement of contaminants is due to precipitation flowing through the thin soil cover and waste materials. Both alternatives would also employ land use controls that would maintain the current site status and prevent intrusive activities or future development. Biennial groundwater monitoring would be conducted until GWQS are achieved and CERCLA five-year reviews would identify if site risks have changed or if additional remedial actions are needed.

Alternative 5 would provide the most overall protection of human health and the environment because all of the waste materials would be excavated and disposed in a secure permitted facility, recycled or incinerated, if appropriate. Levels of metals in groundwater attributable to the landfilled materials would decrease and GWQS would be archived.

Compliance with ARARs: Alternative 1 would not comply with chemical-specific ARARs. No action-specific ARARs apply to this alternative because no actions would be implemented. Alternative 1 would not meet any components of the EPA presumptive remedy for military landfills.

Alternative 2 would eventually comply with chemical-specific groundwater ARARs if GWQS are achieved. None of the location-specific or action-specific ARARs would be achieved because some waste materials would remain present on the landfill surface and the landfill would not comply with NJDEP Solid Waste Regulations and would not meet components of the EPA presumptive remedy for military landfills.

Alternative 3 should eventually comply with chemical-specific groundwater ARARs if GWQS are achieved. Implementation of land use controls and groundwater monitoring should be effective in providing notification if future use of the site is changed or if groundwater quality is negatively impacted. The vegetated soil cover would meet NJDEP soil remediation guidelines but would not meet the ARAR

for sanitary landfill final cover system design and construction. However, erosion and surface runoff would be controlled with placement of the vegetated soil cover and yearly O&M checks would insure that the soil cover and vegetation system is maintained. Alternative 3 would not meet all of the components of the containment presumptive remedy which are applicable to Site 7. However, due to the low level of groundwater contaminants and the length of time the landfill has been in place, plume containment and/or treatment and controlling and treating landfill gas are probably not needed at Site 7.

Alternative 4 would comply with applicable location-specific and action-specific ARARs. NJDEP guidelines for placement of an impermeable barrier to reduce surface infiltration prevent direct contact, limit gas emissions, and control erosion of landfilled material would be met. Chemical-specific groundwater ARARs would eventually be met because leachate generation should be significantly reduced or eliminated and wastes are not in contact with groundwater.

Alternative 5 would comply with all action-specific ARARs for the handling, transport and disposal of the landfilled materials. Any materials that are characterized as RCRA hazardous wastes would be handled, transported and disposed in accordance with applicable portions of RCRA requirements (40 CFR Parts 262 and 263) and applicable transportation requirements (49 CFR 107, 171-179).

Long-Term Effectiveness and Permanence: Alternative 1 would not provide any long-term protection of human health since no actions would be taken to prevent exposure to landfilled materials or contaminated groundwater. Alternative 2 would provide limited long-term effectiveness and permanence because restrictions on the use of the site and any intrusive activities would be outlined in the Base Master Plan. Under Alternative 2, a CEA would be established and sampling would be conducted on a routine basis to monitor groundwater quality.

Alternatives 3 and 4 would provide more long-term effectiveness and permanence because the landfill would be capped and annual operations and maintenance (O&M) inspections would provide notification if erosion and/or intrusive vegetation/animals were resulting in exposure of waste materials. Land use restrictions and the establishment of a CEA are both part of Alternatives 3 and 4 and would provide the same level of effectiveness and permanence in restricting use of the site and monitoring groundwater quality. The synthetic membrane cap included in Alternative 4 would provide substantially more effectiveness and permanence in reducing the amount of infiltration and leachate generation than the soil cover included in Alternative 3.

Alternative 5 would provide the most long-term effectiveness and permanence because all the landfilled materials would be excavated and disposed of in secure facilities, recycled, or incinerated. If implemented, Alternative 5 would eliminate the source of contamination at the site, thereby eliminating

any further degradation of groundwater quality. Post-removal groundwater sampling would be conducted to determine if additional measures (i.e., CEA) are needed to achieve the RAOs.

Reduction of Toxicity, Mobility, of Volume through Treatment: Alternative 1 would not satisfy the statutory preference for treatment since no remedial activities would be performed. No treatment of waste materials or groundwater is proposed under Alternative 2 so there would be no reduction in the toxicity, mobility, or volume of contaminants through treatment. Over time, it is expected that groundwater quality would meet New Jersey GWQS as the wastes have been in place for a number of years and exposed to numerous precipitation events, and impact to groundwater appears to have decreased.

Alternatives 3 and 4 would not reduce the volume of landfilled waste materials but should reduce the mobility and leachability of contaminants contained in the landfilled materials. Alternative 4 would be significantly more effective than Alternative 3 in reducing contaminant mobility and leachate generation. Neither alternative would result in treatment of waste and/or groundwater.

Alternative 5 would not necessarily reduce the volume of waste materials but would reduce the mobility and leachability of any contaminants contained in the buried waste. The source of elevated metals in the underlying groundwater would be completely removed from the site. Excavated materials would be disposed utilizing best practices, including secure landfills, recycling, and/or incineration depending upon the type and volume of materials encountered.

Short-Term Effectiveness: Because no active response actions would be implemented under Alternative 1, no additional short-term impacts at the site would be anticipated for this option. Under Alternative 2 the only short-term impact might be due to additional worker exposure and traffic during the installation of the proposed downgradient monitoring well and the CEA biennial sampling events. The potential impact from monitoring well installation and biennial groundwater sampling is minimal because experienced personnel trained in effective health and safety procedures are readily available for those tasks. Installation of the well should take only two days and groundwater sampling should take no more than two days per year for a 1 to 2 person crew. Documentation of the land use restrictions and CEA certification would not have any site-related impacts.

Field construction of Alternative 3 is expected to be completed within 1 month during which there will be increased traffic related to hauling of the cover materials and construction equipment. Following placement of the soil cover and site fencing, the only short-term impacts at the site would be related to the biennial CEA groundwater sampling events. Landfill capping is a common type of construction with ample availability of contractors proficient in the appropriate environmental, health, and safety controls.

Implementation of Alternative 4 is estimated to have a longer period of short-term impact at the site than the implementation of Alternative 5. For both alternatives there would be additional traffic due to the movement of cover or waste materials. Additional impact would result from grading and/or excavation activities and dust releases. However, Site 7 is located in a remote area of the Waterfront with no adjacent Naval, commercial or residential developments in immediate proximity. Site-specific health and safety procedures and PPE would be implemented to protect workers. Standard engineering controls and other precautionary measures would be taken to ensure worker safety and impact to the environment.

Implementability: Since no active remediation or response activities would occur, Alternative 1 is the most readily implementable. Alternative 2 is slightly more implementable than Alternative 3 because the only field activity associated with Alternative 2 is the installation of an additional downgradient monitoring well. However, Alternative 3 is easily implementable and involves standard construction techniques and equipment. Experienced and OSHA-certified workers and companies are readily available to implement construction of the soil cover. The optimal time for implementation of Alternative 3 would be late spring through early fall.

Implementation of Alternative 4 involves the placement of both a single membrane cap and associated drainage layer, but is implementable as standard construction techniques, equipment, and materials would be employed. Experienced and OSHA-certified workers and companies are readily available to implement construction of the cap system. The optimal time for implementation of Alternative 4 would be late spring through early fall.

For Alternative 5 the site is easily accessible through existing roads that are capable of handling heavy truck traffic. The work would be most implementable from late spring through early fall when precipitation and snowfall amounts are at a minimum. There are several off-site nonhazardous and construction debris landfills within a reasonable distance from the site. Wastes identified as hazardous and requiring disposal in RCRA Subtitle C landfills would require transport to New York State. Some landfills may be limited in their capacity to accept a certain volume of material on a daily basis which may impact the duration of the field activities. The excavation of the waste materials should be readily implementable because the wastes are generally at the surface or within several inches and do not appear to extend to the depth of the normal water table. Experienced and OSHA-certified workers and companies are readily available to implement excavation and transporting of the landfilled wastes.

Costs: Table ES-2, Comparative Analysis of Remedial Action Alternatives, provides a summary of the estimated capital and O&M costs for each alternative. Alternative 1 would cost the least to implement since there would be no active remediation and only 5-year reviews would be performed.

The estimated capital costs of Alternatives 2, 3, 4, and 5 range from $117,000 to $4,478,000 with Alternative 5 being the most expensive alternative to implement. Biennial O&M costs, including groundwater monitoring, for Alternatives 2 and 3 are estimated to be about $11,000. An additional $1,000 per year for site inspections and cap maintenance are estimated for Alternative 3. The annual O&M cost associated with Alternative 4 is estimated to be $1,000. The biennial O&M cost for Alternative 4 is estimated to be $13,000. Additional costs for Alternatives 2, 3, and 4 are those associated with the CEA Biennial Recertification (estimated at $10,000 every 2 years) and CERCLA 5-year reviews (estimated at $23,000 every 5 years).

1.0 INTRODUCTION AND BACKGROUND INFORMATION

This FS for NWS Earle Site 7 has been prepared in response to a request from the Navy for Contract Task Order No. 29 under Contract N62472-03-D-0057, Comprehensive Long-Term Environmental Action Navy (CLEAN). This FS has been prepared in accordance with the requirements of CERCLA and Navy IR guidance.

Site 7 (Landfill South of "P" Barricades) is designated OU 10 and is a former landfill disposal site. This FS and the remedial alternatives herein focus on landfill contents still in place and groundwater contamination above New Jersey Groundwater Quality Standards (GWQS), considered secondary drinking water standards, for metals (aluminum, iron and manganese). The FS report is presented in five sections (1.0 through 5.0).

Section 1.0 presents an overview of NWS Earle operations and regional environmental conditions. A summary of previous investigative activities and results and a discussion of HHRA methods and ecological risks for the site are also included. For a full understanding of site conditions, the Final RI Report by Brown & Root Environmental (B&R Environmental, 1996) should be reviewed. The RI report is an essential companion document to this FS because it was 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 ARARs and other guidance to be considered (TBCs). This section also addresses RAOs, PRGs, and general response actions. RAOs and PRGs are addressed for the identification, screening, and evaluation of remedial technologies and process options. Selected remedial options are also presented.

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

Section 4.0 provides a detailed analysis of each alternative and a final comparison of the alternatives is discussed in Section 5.0.

1.1 SITE DESCRIPTION AND SETTING

NWS Earle is located in Monmouth County in east-central New Jersey. It is situated on approximately 11,000 acres and includes a Mainside area, approximately 10 miles inland from the Atlantic Ocean at Sandy Hook Bay, and a Waterfront Area, that 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. This FS report includes a discussion of remedial alternatives for OU 10, which includes Site 7 (Landfill South of “P” Barricades). The OU 10 site is located within the Waterfront Area of NWS Earle.

Figures 1-1, 1-2, and 1-3 show the orientation of NWS Earle in Monmouth County and details of the Waterfront and Mainside areas. Figure 1-4 shows the Waterfront Area IR program sites, including Site 7.

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

An estimated 2,500 people reside and/or work at NWS Earle. Middletown Township, which is the location of the Waterfront Area, has a total population of approximately 68,200 people. Colts Neck Township, which is the location of the Mainside facility, has a total population of approximately 12,500 people. The total population of Monmouth County is approximately 550,000.

Land use at the Waterfront facility includes residences, office buildings, recreational areas, open space, and undeveloped land. Approximately 20 percent of the Waterfront Area is considered marshland. The area around the Waterfront includes commercial and single-family residential land.

NWS Earle is located in the coastal lowlands of Monmouth County, New Jersey, within the Atlantic Coastal Plain Physiographic Province. The Waterfront Area lies on the southern coast of Sandy Hook Bay on New Jersey's Atlantic shoreline, in an area known as the Bayshore Lowlands. The property and associated piers occupy a narrow strip of land running roughly perpendicular to the shoreline that serves as access from the ammunition depot (located one mile inland). This thin strip of land consists primarily of tidal marsh and swamp with areas of fill and has an average elevation of approximately 10 feet above msl.

The rivers and streams draining NWS Earle ultimately discharge to the Atlantic Ocean. Surface water drainage from the Waterfront Area enters Sandy Hook Bay. Much of this area is under tidal influence. Most of the surface drainage from the Chapel Hill area flows northward to Sandy Hook Bay via Compton, Ware, and Wagner Creeks. A very small area at the topographically high southern end of the Chapel Hill area drains southward through McClees Creek to the Navesink River. Surface runoff follows topographic gradients to storm drains and drainage ditches or occurs as overland flow that discharges to local surface water bodies.

As shown on Figure 1-4, Site 7 borders an unpaved road within the Waterfront Area. The ground surface within the vicinity of the site slopes downward to the north from an approximate elevation of 160 feet mean sea level (msl). The closest surface water body is located approximately 1,500 feet west of the site; as

shown on Figure 1-4 there are no surface water bodies located downstream of the site.

Site geology and hydrogeology at Site 7 based on a 1995 field investigation places Site 7 within the outcrop area of the Red Bank Sand and Navesink aquifer. Based on groundwater elevation surveys performed in 1995 and 2005 the direction of shallow groundwater flow in the aquifer at Site 7 is toward the north to Sandy Hook Bay.

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 sub crop 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 are discussed in Section 1.3.

Groundwater classification areas are established in New Jersey under NJDEP Water Technical Programs Groundwater Quality Standards in New Jersey Administrative Code (N.J.A.C.) 7:9C. The Waterfront 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 New Jersey coastal Waterfront 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 Waterfront is situated in the recharge area of the Wenonah-Mount Laurel aquifer system, the Englishtown aquifer, and the Red Bank Sand aquifer. The Red Bank Sand aquifer is developed in the Red Bank Sand. This aquifer is underlain by confining beds of the Navesink Formation. The Waterfront site OU 10 (Site 7) is located in the recharge area of the Red Bank Sand aquifer.

All facilities located in the Waterfront 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 the public water supply from the New Jersey American Water Company serves businesses and residences in areas surrounding the Waterfront facilities. There are private wells located within a 1-mile radius of NWS Earle and several within the NWS Earle boundaries. On-base wells (located at remote building locations) are not used for potable water supply.

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. The Waterfront Area borders a tidal wetland, some of which has been filled in by the Navy, and a neighboring (non-Navy) landfill. This marsh is a productive and environmentally useful resource that serves as a nursery for many marine and shore animals (Fred C. Hart Associates, Inc., 1983).

Resources and habitats of the drainage area potentially impacted by NWS Earle 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.

  - Migration of fish may have been impacted by the construction of a reservoir located on a tributary that also takes water from the Manasquan River. Although suspected, impacts of the reservoir have not been studied.

- Swimming River - Pine Brook and Hockhockson Brook.

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

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

- Navesink River.

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

- McClees Creek.

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

An ecological risk assessment was performed for the site; results are discussed in Section 1.9.

Aquifer Thickness

As noted in the preceding paragraphs, the site is underlain by the Red Bank and Navesink formations. According to the USGS (1984), both of these relatively low-permeability formations are part of the regional "composite Confining Bed" that is underlain by the Wenonah-Mount Laurel aquifer, which is a major regional source of groundwater.

The combined thickness of the Red Bank and Navesink formations locally ranges between 35 and 135 feet. Although the USGS regional structure contour map for the top of the Mount Laurel Formation (= base of the Navesink Formation) doesn't extend to the site location, projecting these interpretations along strike indicates that the base of the Navesink Formation occurs at an elevation of approximately 50 feet above mean sea level (AMSL). Using an average site elevation of about 140 feet AMSL, therefore, yields an approximate thickness of 90 feet for the combined Red Bank and Navesink formations.

The static water level beneath the site varies to some extent with the seasons and local precipitation patterns. Assuming a typical depth to water of about 20 feet, the saturated thickness of the Red Bank/Navesink hydrogeologic unit is about 70 feet.

Groundwater Flow Direction

Groundwater beneath OU10 (Site 7) site occurs under unconfined conditions. In an unconfined aquifer, the slope of the water table is typically a subdued reflection of the surface topography, and groundwater flow directions typically mimic the surface water flow directions.

Multiple rounds of groundwater elevation measurements collected in 1995 and 2005 indicate that the groundwater beneath the site consistently flows in a northward direction. This interpreted direction of flow is consistent with the surface typography, which slopes downward to the north from an elevation of approximately 160 feet near MW7-03 to an elevation of approximately 125 feet near MW7-02. Table 1-1 details recorded water level measurements from three dates, August 7, 1995, October 17, 1995 and April 12, 2005. Figures 1-5, 1-6, and 1-7 are groundwater contour maps developed for the three dates.

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 anti-submarine 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 Explosive Safety Quality Distance (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 7 is not within the Waterfront Administration area and is encumbered by ESQD arcs. Future land use is not expected to vary significantly from current land use unless a major base realignment was 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 7, Landfill South of “P” Barricades, is an approximately 5-acre site located in the Waterfront Area. About 3.6 acres of the site contains landfilled waste materials as determined by a 1974 EPA Environmental Photographic Interpretation Center (EPIC) photo (Figure 1-8). From 1965 to 1977, the site was used to dispose of municipal-type solid waste and waste from Waterfront industrial operations. Wastes reportedly consisted of munitions shipping wastes (dunnage, packing), shop wastes from the Waterfront Public Works Shop and the Munitions Handling Laboratory (glass, wood, and small quantities of waste paint, thinners, and solvents), and domestic refuse. The landfilled materials were covered with a thin layer of loose sand quarried from the surrounding area.

An unpaved road borders the site to the north, west and south. The ground surface slopes downward to the north from approximately 160 feet msl near MW7-03 to approximately 125 feet msl near MW7-02. A site visit was performed by Tetra Tech NUS, Inc. (TtNUS) personnel in January 2005 to assess current site appearance. During the site visit it was noted that there were large white pine trees (up to 20-30 feet in height) growing within the landfill area as well as heavy vegetation. A small wetland area, formed in a

depression on top of the landfill, was evident with heavy grasses and tall reeds.

1.3 PREVIOUS ENVIRONMENTAL INVESTIGATIONS

Site investigation activities related to areas of potential environmental concern at NWS Earle have been undertaken by the Navy since approximately 1982. The following reports include Site 7 and have been submitted for IRP work at NWS Earle.

- Initial Assessment Study (Fred C. Hart and Associates; February 1983);
- Interim Report for a Confirmation Study to Determine Existence and Possible Migration of Specific Chemicals in Situ (Roy F. Weston (Weston), December 1986);
- Current Situation and Draft Plan of Action (Weston, December 1988);
- Remedial Investigation/Feasibility Study for 11 Sites, Volumes 1-3 (Weston, September 1993).
- Remedial Investigation Report for Naval Weapons Station Earle, Volumes 1A, 1B and II (Brown & Root Environmental, July 1996).

Results from the previous investigations at Site 7 and the 1995/1996 RI are discussed below.

1.3.1 Initial Assessment and Site Investigation Studies

The Initial Assessment Study (Fred C. Hart and Associates; February 1983) was a document prepared for the Navy that identified 29 areas of concern at NWS Earle based on employee interviews, record searches, and site tours.

The 1983 Initial Assessment Study confirmation study consisted of interviews and on-site observations and did not recommend Site 7 for a confirmation study.

As part of a base-wide site investigation (SI) conducted in 1986 (Weston, December 1986), three monitoring wells, MW07-01, MW07-02 and MW07-03, were installed around the perimeter of Site 7 (Figure 1-9). Groundwater samples were found to contain acetone and phthalate however, the results were not included in the 1996 RI risk assessment.

1.3.2 1991-1992 Remedial Investigation

As part of a 1991-1992 remedial investigation at NWS Earle (Weston, September 1993), seven test pits were excavated and two monitoring wells were installed at Site 7 (Figure 1-9). A layer of trash, ranging in thickness from 2.5 to 6 feet, was encountered in five of the seven test pits. The encountered waste consisted of glass, paper, plastic, cans, and other types of household or shipboard-generated waste. Metal scrap, lumber, concrete, bricks, and other construction debris were also encountered. The cover material was thin to nonexistent. No sustained organic vapor readings were detected in any of the test pits. Two soil samples were collected from soil test pits for full target compound list (TCL)/target analyte list (TAL) and total petroleum hydrocarbon (TPH) analysis. Ethylhexylphthalate was found in soil samples taken at test pits TP-01 and TP-07. In summary, the RI test pits found mostly trash and construction debris and a thin landfill cover, ranging in thickness from 0 to 0.5 feet.

Groundwater samples were obtained from the three existing monitoring wells (MW07-01 through MW07-03) and two new wells (MW07-04 and MW07-05) during three different sampling events, March 1991, October 1991 and November 1991 (Figure 1-9). Samples were submitted for full TCL/TAL, VOCs, drinking water metals analysis, and landfill indicator parameters. Several VOCs were detected in wells MW07-02 and MW07-05, including several chemicals often associated with laboratory contamination (methylene chloride and acetone). Elevated levels of metals including chromium, arsenic, and lead were detected in wells at the site. Results of the landfill indicator parameter analysis indicated elevated levels of chemical oxygen demand (COD), chlorides, and sulfates in the downgradient wells relative to the upgradient well, MW07-03.

1.3.3 1995 Remedial Investigation

As part of the Navy's Installation Restoration Program (IRP) a remedial investigation of 27 sites, including Site 7, at NWS Earle was conducted in 1995. A complete discussion of the 1995 RI, including sampling methodology and results, is presented in the July 1996 "Remedial Investigation Report for Naval Weapons Station Earle" prepared by Brown & Root Environmental (now TtNUS).

Between July and October 1995, B&R Environmental conducted the following field investigation activities at Site 7:

- Sampling and analysis of one sediment sample (07 SD WET 7-B2)
- Sampling and analysis of one surface water sample (WSSW30)

- Sampling and analysis of groundwater from the five existing monitoring wells (MW07-01 through MW07-05)

- Measurement of static water levels in the five monitoring wells

Sample SD WET7-B2 was collected just north of the landfill boundary at a depth of 0 to 6 inches. The RI Report conservatively compared the sample to sediment concentrations and ecological screening criteria. For purposes of this FS, the sample has been compared to background surface soil concentrations (see Table 1-2). Based on this comparison only two inorganics, calcium and zinc, were detected in SD WET7-B2 at concentrations higher than the range of background surface soil concentrations. Calcium was detected at 568 mg/kg and zinc at 33.7 mg/kg. Calcium was detected at a maximum concentration of 519 mg/kg and zinc at a maximum concentration of 27.6 mg/kg in the surface soil background samples. No organic compounds were detected in sample SD WET7-B2

Five groundwater monitoring wells (07 GW 01 through 07 GW 05) were sampled at Site 7 during the 1995 RI including upgradient well 07 GW 03. Table 1-3 presents the groundwater analytical results and compares them to the range of results obtained for groundwater samples collected as background. Section 1.4 of this report presents information regarding the background environmental sampling conducted during the 1995 RI. Concentrations of most metals in Site 7 groundwater as determined during the 1995 RI were within the range of background results except for cadmium which was not detected. Thallium was detected at a concentration of 3.54 ug/l in one groundwater sample, MW07-01, but was not detected in background samples.

No organic compounds were detected in the groundwater samples collected from monitoring well MW07-01 and background monitoring well MW07-03. Benzene and chlorobenzene were detected at 1 ug/L and 11 ug/L, respectively in the MW07-02 sample. Chloroform was detected in sample MW07-04 at a concentration of 2 ug/L. 1,1,2-TCE and 1,2-DCE were detected in the groundwater samples collected from well MW07-05 at levels of 1.0 ug/L and 4.0 ug/L, respectively.

A watershed sample, WSSW30, was collected north of Site 7. This surface water sample is most closely related to potential runoff and stream recharge originating from Site 7 as outlined in the July 1996 RI Report. No organic compounds were found in the sample and all other parameters were found in the range of background. Table 1-4 presents the surface water analytical results and compares them to the range of results obtained for surface water samples collected as background. Section 1.4 of this report presents information regarding the background environmental sampling conducted during the 1995 RI.

A survey was conducted to establish the horizontal locations and vertical elevations of the sediment sample

location and the existing five monitoring wells. The 1995 RI results are further discussed in Section 1.5, Nature and Extent of Contamination.

1.3.4 April 2005 Groundwater Sampling

In April 2005, TtNUS collected groundwater samples from five existing monitoring wells (MW7-01 through MW7-05), including upgradient well MW7-03. The analytical results showed that VOCs have decreased since the previous sampling round conducted in 1995. One well (MW7-02) had a detection of chlorobenzene at a concentration of 4.4 ug/L much less than the New Jersey GWQS of 50 ug/L. All other VOCs were not detected or had an estimated value below the analytical method detection limit. Aluminum and iron were detected above GWQS. Manganese was detected at 914 ug/L in upgradient well MW7-03 and at 118 ug/L in downgradient well MW7-02. The GWQS for manganese is 50 ug/L. These metals are considered secondary drinking water standards and are within the range of background. Table 1-5 summarizes the analytical results from the April 2005 groundwater sampling event. Appendix A contains the analytical results and data validation reports for the April 2005 sampling event.

1.4 BACKGROUND ENVIRONMENTAL SAMPLING

As part of the 1995 RI, sampling was conducted in order to determine the background level of chemicals present in and around NWS Earle. B&R Environmental collected samples from media at locations throughout the Base 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 these areas. The samples were collected in areas hydraulically upgradient and, where possible, upwind of Base 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 (BG) 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 unimpacted surface water and sediment were not available near 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). Figure 1-10 shows the Mainside Area background sample locations. Background sample locations within the Waterfront Area are shown in Figure 1-11.

1.4.1. Background Sample Location 1

Background Sample Location 1, BG-1, is situated in the northeastern portion of the Mainside upgradient of operations areas 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) were collected at this location.

1.4.2 Background Sample Location 2

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

1.4.3 Background Sample Location 3

Background Sample Location 3, BG-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 at this location.

1.4.4 Background Sample Location 4

Background Sample Location 4, BG-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 BG-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 unimpacted surface water/sediment sample locations at the Waterfront Area.

1.4.5 Background Well Geology

Table 1-6 provides a summary of the characteristics of each background well, and Table 1-7 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.

Regional mapping places BGMW-01 within the outcrop of the Kirkwood Formation. The Kirkwood

Formation ranges from 60 and 100 feet in thickness, and the monitoring well installation 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 ground surface (bgs) and is assumed to be screened in the Kirkwood Formation.

Regional mapping places BGMW-02 within the outcrop area of the Cohansey Sand; Quaternary surficial deposits may also be present at this location. Quaternary surficial deposits in this area generally are 10 feet or less in thickness, and the Cohansey Sand ranges from 0 to 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 from 67 to 77 feet bgs 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 from 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 from 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 bgs and is assumed to be screened in the Englishtown Formation.

1.4.6 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 gave comments and revisions, a list of additional monitoring wells to be used for background statistical comparisons was agreed to. Table 1-8 shows the chosen background and upgradient wells grouped by interpreted aquifer. Geologic units were grouped according to similarity and association across NWS Earle.

Table 1-9 presents a summary of the statistical evaluation of background metals data for the two monitoring wells (BGMW-03 and MW7-03) completed in the Red Bank Sand and Navesink Formations. Site 7 is

located within the outcrop area of the Red Bank Sand and Navesink aquifer formations. The 95 percent upper tolerance limits (UTLs) presented in this table were compared to the individual maximum site-related results for corresponding wells grouped in the same interpreted aquifer. The estimation of 95 percent UTLs was conducted in accordance with EPA guidance for groundwater statistical evaluation (EPA, 1989 and 1992).

1.5 NATURE AND EXTENT OF CONTAMINATION

This section details the nature and extent of contamination at Site 7 based on sampling data obtained from the 1995 RI (B&R Environmental, 1996) and groundwater sampling conducted in April 2005. None of the analytical sampling results obtained during investigations conducted prior to the 1995 RI have been included because of data quality issues. Physical observations and/or measurements from the pre-1995 RI studies have been included as needed.

Tables 1-10 and 1-11 compare the results of background samples (Section 1.4) to samples collected at Site 7 during the 1995 and 2005 sampling investigations. Figure 1-10 shows the 1995 RI sediment and groundwater sample locations and concentrations of compounds that exceeded screening levels.

Figure 1-11 shows the April 2005 groundwater sample locations and concentrations that exceeded GWQS and EPA Maximum Contaminant Level (MCL) screening levels.

Surface water and sediment sample analysis results were compared to NWS Earle site-wide background samples. Groundwater at Site 7, found in the Red Bank Sand and Navesink Formation, was compared to samples taken from the Red Bank Sand and Navesink Formation grouping of background groundwater samples taken at NWS Earle.

1.5.1 Sediment

One sediment soil sample (07WET 07-B2) was collected north of the landfill edge to determine potential impacts to downgradient surface soils (Figure 1-9). The sample was taken in the broad drainageway of runoff from Site 7 and, as part of the 1995 RI was considered a "sediment" sample rather than a "surface soil" sample. The sample was submitted to Lancaster Laboratories for TCL VOC, TAL metals, ammonia, COD, chloride, moisture, nitrite, nitrate, sulfate, total organic compounds (TOC), and phosphates analyses.

The sample was collected from 0 to 6 inches (bgs) using a stainless-steel trowel and placed directly into the appropriate bottleware. The surface vegetation was removed before sampling.

NJDEP Geographic Information System data originally indicated the presence of wetlands to the east and

northeast of site, but on-site inspection revealed that no wetlands were present in these areas. Surface drainage on the former landfill appears to be toward the north, therefore no sediment samples were taken east of the site.

Table 1-10 presents the occurrence and distribution of inorganic chemicals detected in site-related sediment samples and compares them to background as presented in Section 31 of the 1996 RI Report (B&R Environmental, 1996). No organic chemicals were detected in site-related sediment samples collected at Site 7. Figure 1-12 shows sample locations and concentrations of compounds which exceed ARARs and TBCs.

Concentrations of most metals were within similar ranges in the site-related sediment sample. Manganese was detected in the site-related sample at a concentration slightly greater than background (38.1 mg/kg).

Miscellaneous parameter analyses for the Site 7 sediment sample consisted of COD, chlorides, moisture, sulfates, TOC, and phosphates. The sample did not reveal concentrations greater than background.

1.5.2 Groundwater

As part of the 1995 RI five site-related groundwater samples (07GW01 through 07GW05) were collected from the monitoring well network at Site 7 (Figure 1-9). A second round of sampling was conducted in April 2005. Table 1-11 presents the occurrence and distribution of inorganic and organic chemicals detected in site-related groundwater samples and compares them to background. Both the 1995 RI and April 2005 sampling results are included in the occurrence and distribution analysis. Figures 1-12 and 1-13 show groundwater sample locations and concentrations of compounds which exceed screening values (i.e., MCLS and GWQS).

In 1995, concentrations of most metals in Site 7 groundwater were within the range of background results except for aluminum, chromium, copper, lead, mercury, and thallium. Chromium, copper, lead, and thallium were detected in two or less groundwater samples, but were not detected in background samples.

The 2005 sampling results indicated that only aluminum and iron exceeded the normal range of background results. Manganese was present in upgradient well MW07-03 and two downgradient wells (07GW02 and 07GW05) at concentrations that exceeded the New Jersey GWQS at 50 ug/L.

1,1,2-TCA (1 ug/L), 1,2-Dichloroethene (1,2-DCE) (4 ug/L), benzene (1 ug/L), chlorobenzene (11 ug/L), and chloroform (2 ug/L) were each detected in one groundwater sample collected at Site 7 during the 1995 RI. Only chlorobenzene at 11 ug/L, exceeded applicable Federal and/or state ARARs and/or TBCs. None of these compounds were detected in background groundwater samples. During the April 2005 sampling

event, only one well had a detection of chlorobenzene at a concentration of 4.4 ug/L, significantly below the GWQS of 50 ug/L. All other VOCs were not detected in April 2005 or exhibited an estimated concentration below the analytical method detection limit.

Miscellaneous parameter analyses of five groundwater samples at Site 7 consisted of ammonia, biological oxygen demand (BOD), COD, chlorides, nitrates, sulfates, TOC, phosphates, and turbidity. Most indicator parameters revealed lower concentrations in upgradient well MW7-03 than in all downgradient wells. Downgradient concentrations were greater than background ranges for ammonia, COD, and TOC in MW7-02, for COD in MW7-04, and for sulfate and TOC in MW7-05. None of the indicator parameters in upgradient or downgradient wells were high enough to be within a range typically associated with concentrated landfill leachate (Chian and DeWalle, 1976; ASCE, 1976; Brunner and Keller, 1972). The wells containing maximum detected concentrations were generally consistent with the results of the 1993 RI.

1.5.3 Surface Water

A watershed sample, WSSW30, was taken north of Site 7. This surface water sample is most closely related to potential runoff and stream recharge originating from Site 7. No organic compounds were found in the sample and all other parameters were found in the range of background. The results for this sample are fully discussed in Section 30 of the 1996 RI report.

1.6 CONTAMINANT FATE AND TRANSPORT

The behavior of contaminants in the environment at Site 7 is described in this subsection. Various chemicals detected and their transport potential in the environment are also discussed in this section. Persistence of detected chemicals in the environment are discussed in this section as well as a brief discussion of contaminant trends.

1.6.1 Detected Chemicals and Transport Potential

Analytical results for the media sampled at Site 7 indicate halogenated and aromatic volatiles were present in groundwater in 1995. VOCs were not detected in sediment. Inorganics were detected in groundwater and sediment samples, but most element concentrations were within the ranges found in background samples. No surface soil or subsurface soil samples were collected at Site 7 in 1995.

Chlorinated aliphatics (1,1,2-TCA and 1,2-DCE), benzene, chlorobenzene, and chloroform were detected at low levels in groundwater downgradient of the landfill in 1995. All detected volatile organic groundwater

contaminants exhibit relatively high solubilities, vapor pressure, and air-water partition coefficients (Henry's law constant). These compounds are characteristically mobile in the environment (either through soil gas migration or groundwater transport).

No chlorinated aliphatics were detected above the detection limit in groundwater except chlorobenzene in April 2005. Chlorobenzene was detected at a low level in one well located downgradient of the landfill. Inorganics were detected in groundwater however they were all within the ranges found in background samples.

1.6.2 Contaminant Persistence

For the classes of detected chemicals, environmental persistence varies widely. Transformation of a chemical to degradation by-product(s) can be the result of numerous processes including biotransformation and uptake, photolysis, acid- or base-catalyzed reaction, or hydrolysis. The by-product chemical(s) may or may not be significantly different toxicologically or from a physical transport perspective. If the transformational process is known or suspected, product chemicals can be predicted and extent of transformation can be determined from chemical reaction rate data. Other transformational processes may be identified empirically from analytical data.

Although most chemicals are resistant to chemical change because of their stability and/or lack of reaction sites, many of the more mobile species are subjected to at least limited transformation. Because of more frequent contact with reactive dissolved species and catalysts when compared to unsaturated conditions, the contaminants found in saturated media (groundwater, saturated zone soils, surface water, and sediment) are most likely to be transformed in the environment. Higher molecular weight contaminants tend to be less mobile and less prone to chemical transformation.

1,2-DCE is associated with degradation of tetrachloroethene (PCE) and trichloroethene (TCE) (Cline and Viste, 1983). 1,1,2-TCA may also be involved with biodegradation processes that remove chlorine from the parent species. Concentrations of the parent compounds (TCE, PCE, or 1,1,2,2-tetrachloroethane) may diminish over time, depending upon the presence of contaminated source materials that could continue to leach new product into groundwater. Benzene and chlorobenzene are also considered susceptible to biodegradation in the environment. The rate of degradation depends on several factors including nutrients, oxygen, moisture, carbon source, pH, and the presence of appropriate acclimatized microorganisms.

1.6.3 Observed Chemical Contaminant Trends

Groundwater analytical data from the 1995 RI were compared to data from the April 2005 sampling event.

Benzene was detected at a trace level (1.0J ug/L) in monitoring well MW7-02 in 1995, but was not detected in the 2005 investigation. Chlorobenzene was detected at 11.0E ug/L in well MW7-02 during the 1995 investigation; in 2005 chlorobenzene was detected in the same well at a concentration of 4.4 ug/L. Chloroform was detected at an estimated concentration of 2.0J ug/L in well MW7-04 in 1995. During the 2005 sampling event, chloroform was detected in the same well at an estimated concentration of 0.72J ug/L. Both 1,2-dichloroethene (1,2-DCE) and 1,1,2-trichloroethane (1,1,2-TCA) were detected in well 07GW-05 during the 1995 investigation at estimated concentrations of 4.0J ug/L and 1.0J ug/L, respectively, but were not detected during the 2005 sampling event. Thus, VOCs, if present in groundwater, were detected at very low levels and/or have decreased to levels below analytical detection.

In 1995, four inorganic compounds were detected in one or more wells at concentrations that exceeded New Jersey GWQS. The inorganics were aluminum, iron, manganese and thallium. Aluminum and manganese were also detected above New Jersey GWQS in upgradient well 07GW-03. The April 2005 sampling event identified only three inorganics, aluminum, iron and manganese that exceeded GWQS. However, manganese was detected above GWQS in upgradient well 07GW-03. Thallium was not detected in any well in April 2005.

1.7 HUMAN HEALTH RISK ASSESSMENT

The methodologies used for the human health risk assessments were considered sufficient to adequately characterize potential risks based on regulatory review and guidance available at the time and are presented in detail in Section 2 of the RI Report (July 1996). This section provides a summary description of the HHRA methods used to evaluate the NWS Earle RI data. The objectives of the risk assessment were to estimate the actual or potential risks to human health resulting from the presence of contamination in surface soil, subsurface soil, sediment, groundwater, and surface water and to provide the basis for determining the need for remedial measures for these media in the FS.

Three major aspects of chemical contamination must be considered when assessing public health risks: contaminants with toxic characteristics must be found in environmental media and must be released by either natural processes or by human action; potential exposure points must exist either at the source or via migration pathways if exposure occurs at a location other than the source; and human or environmental receptors must be present at the point of exposure. Risk is a function of both toxicity and exposure; without any one of the three factors listed above, there will be no risk.

The risk assessment estimated the potential for human health risk attributable to Site 7. Information regarding the toxicity of the compounds detected in the various media, the distribution of contamination, potential migration pathways, and a site-specific estimate of chemical intake via assumed exposure routes

were combined to estimate potential risks. The risk assessment processes used at NWS Earle were in accordance with current (at the time - 1996) EPA risk assessment guidance (EPA, 1989a; EPA, 1991a).

The HHRA consists of four sections: Data Evaluation, Toxicity Assessment, Exposure Assessment, and Risk Characterization. Each section is briefly discussed below.

- Data Evaluation (Section 2.4.1 of the 1996 RI) is primarily concerned with the Identification of Chemicals of Potential Concern (COPCs, Section 2.4.1.1 of the 1996 RI), Distributional Analysis of the data (Section 2.4.1.2 of the 1996 RI), and Representative Concentrations for the COPCs (2.4.1.3 of the 1996 RI). COPCs selected in this section are representative of the type and magnitude expected for potential human health exposure. Distributional analysis of the data, contaminant concentrations relative to background levels, contaminant release and environmental transport mechanisms, exposure routes, and toxicity are all considered in order to develop a list of COPCs used to define the site-associated risks.
- The Toxicity Assessment (Section 2.4.2 of the 1996 RI) presents available Health Effects for all COPCs. Quantitative toxicity indices, where available, are presented in this section. Dose-response parameters, such as reference doses (RfDs) and cancer slope factors (SFs) are presented in this section for each COPC. Carcinogenic chemicals are classified by EPA as Group A (human), B (probable human), or C (possible human) carcinogens. A special discussion of lead is included because of the lack of quantitative dose-response parameters for this analyte.

- The Exposure Assessment (Section 2.4.3 of the 1996 RI) identifies potential human health exposure including the presentation of a Site-Conceptual Model (Section 2.4.3.1 of the 1996 RI), selection of Potential Receptors (Section 2.4.3.2 of the 1996 RI), and Exposure Routes (Section 2.4.3.3 of the 1996 RI) either at the source area or off site. This section generally identifies potential pathways of COPC migration, selected potential receptors, and the estimated intakes of COPCs for the identified receptors.

- Risk Characterization (Section 2.4.4 of the 1996 RI) presents the risks for a site including a Determination of Risks (2.4.4.1), the estimated Receptor Risks (2.4.4.2), and a presentation of Uncertainty Analysis (Section 2.4.4.3). This section estimates the risks associated with noncarcinogenic and carcinogenic effects of COPCs (established in Section 2.4.1 of the 1996 RI) via estimated intakes in exposure routes (established in Section 2.4.3 of the 1996 RI) compared to appropriate toxicity values (established in Section 2.4.2 of the 1996 RI). A discussion of the uncertainties associated with the risk assessment is also presented in this section.

After the conservative HHRA was completed, additional procedures were applied in accordance with EPA Region II recommendations to refine the calculated results. This process eliminated additional COPCs from

consideration and generally reduced the calculated risks using revised methods for dermal exposure to soil/sediment, grouping of chemicals by target organ, and/or use of central tendency calculations. The Amended Risk Assessment (Section 2.4.6 of the 1996 RI) presents the amended risk assessment procedures applied to a site.

At the direction of EPA Region II, a central tendency risk calculation using central tendency exposure (CTE) assumptions (EPA, 1993a (see RI report 1996)) was performed if the cancer risk for a receptor pathway was within the borderline range of 1×10^{-4} to 4×10^{-4} or the noncancer risk (HI) was greater than one. This step was not necessary to apply in general, since calculated risks at NWS Earle sites were often below this range. The central tendency approach uses exposure input parameters associated with average or 50th percentile behavior patterns rather than upper 90th percentile values, so that a more realistic expectation of risk can be generated. In contrast, the high end risks that were calculated using RME assumptions in the initial risk assessment may be overestimated to an extent. The central tendency estimate provides additional information, but the RME risk estimate is used in the decision-making process.

1.7.1 Baseline Human Health Risk Assessment

Sediment and groundwater were used in assessing risks at Site 7. Surface soil was sampled for the 1993 RI/FS from two test pit soil samples. The soil contained only slightly elevated levels of a phthalate compound, but phthalates are ubiquitous in the environment. Due to data quality issues the soil data was not used in the risk assessment. One surface water sample, sampled in 1995, was not used in the human health risk assessment for the following reasons: the sample did not detect any contaminants potentially related to Site 7, it was not in the direction of groundwater flow, and this sample would not be enough to show no human health risk. Surface water is not present near the site in the direction of groundwater flow, and hence, groundwater-to-surface water contaminant migration is not of concern. The potential receptors considered for this site were future industrial, residential, and recreational receptors. Appendix B contains summary tables of the estimated human health risks for Site 7.

The RME cancer risks associated with future residential groundwater exposure (5.3E-06) are within the 1E-04 to 1E-06 EPA target acceptable risk range. 1,1,2-TCA and benzene via ingestion and chloroform via inhalation during showering are the principal COPCs that contributed to the cancer risks for these exposure scenarios. The RME cancer risks associated with the future recreational sediment exposure (2.0E-07) are below the 1E-04 to 1E-06 target acceptable risk range. The RME cancer risks associated with future industrial groundwater exposure (1.1E-05) are within the 1E-04 to 1E-06 target acceptable risk range. Beryllium via ingestion is the principal COPC that contributed to the cancer risks for these exposure scenarios.

RME estimates for non-carcinogenic HI risk (3.1) associated with the future residential groundwater ingestion exposure scenario exceeded 1.0. Thallium was the principal COPC responsible for HIs in the range of 2.8 to 3.0 for the target organs skin, kidney, liver, and central nervous system (ingestion exposures contributed the significant portion of the risk). Adverse noncarcinogenic effects cannot be ruled out when the HI is greater than 1.0. The RME estimates for non-carcinogenic HI risk associated with the future recreational sediment exposure (7.5E-03) and the future industrial groundwater exposure (4.7E-01) are below the HI risk (1.0). Adverse noncarcinogenic effects are not expected when the HIs are below 1.0.

Lead was found at concentrations exceeding the EPA action level (15 ug/L) in groundwater samples taken in previous investigations, but not in groundwater samples collected using low flow techniques during the 1995 RI. Lead was not found at levels exceeding 400 mg/kg in subsurface soil from previous investigations or in the 1995 RI sediment sample.

1.8 ECOLOGICAL RISK ASSESSMENT

Site 7 and adjacent areas contain excellent terrestrial habitats. In addition, the small wetland on the site provides excellent wetland habitat, albeit limited. Most terrestrial ecological receptors found on the base are expected to utilize these areas. Although a few small bare areas are present, the majority of the site has been covered with sand quarried from the surrounding areas and primary and early secondary succession has occurred on the landfill. Hence, exposure to contaminants in surface soils is limited. Runoff from the landfill exits the site to the forested area to the north, although no significant drainageways are present and most precipitation on the site infiltrates site soils.

During 1993 RI/FS activities at the site, seven test pits were excavated and two of these samples were analyzed for TCL organics, TAL inorganics, and TPH. One of these samples was taken near the northwest corner of the landfill, where any potential off-site runoff would occur. Only slightly elevated levels of Bis(2-ethylhexyl)phthalate were detected in these samples. Some slightly elevated concentrations of metals and VOCs were detected in 1993 RI/FS groundwater samples. Nonetheless, the study concluded that the concentrations were not high enough to indicate that the landfill is generating a significant amount of leachate. RI groundwater samples taken in 1995 indicated the presence of some chlorinated aliphatics and benzene derivatives in groundwater. Chloroform and thallium were also detected in elevated levels in groundwater, but in only one sample.

A sediment (soil) sample was taken in the forested area near the north edge of the landfill where any off-site overland runoff from the landfill would likely occur. Since the soils were moist, due to recent rainfall, the sample was conservatively treated as a sediment sample. Arsenic was the only contaminant detected in this sample that exceeded the ecological screening value (ESV), but the hazard quotient (HQ) was

indicative of low potential risk. No organics were detected. Aluminum and vanadium were conservatively retained as final COPCs since no suitable ESV values were available, but both of these metals were present in concentrations lower than background.

The results of the 1995 RI sampling and 1993 RI/FS sampling suggest that potential risks to ecological receptors at Site 7 are insignificant. Results of 1995 RI groundwater investigations indicate that groundwater has been impacted by some site-related contaminants and downgradient migration is possible. Surface water is not present near the site in the direction of groundwater flow, and hence, groundwater-to-surface water contaminant migration is not of concern. The nearest surface water north of the site was sampled (WS SW 30) as part of the Watershed sampling and was found to contain nothing potentially related to Site 7. The only compound found in WS SW 30 at a concentration above any conservative ARAR or TBC was 0.069 ug/L of mercury. Although loose sand has been placed on the landfill, some runoff of contaminants from site soils to adjacent surface soils is possible, mainly to the north, since the site slopes heavily in that direction. However, no organics were detected and no inorganics exceeded the ESV in sediments (moist soils) collected just north of the site, suggesting no significant overland migration. This also suggests that contaminant concentrations in surface soils on the landfill are most likely insignificant. The results of the 1993 RI/FS investigation also suggest minimal surface soil contamination at the site. The two test pit soil samples contained only slightly elevated levels of a phthalate compound, but phthalates are ubiquitous in the environment and phthalate toxicosis is rare in fish and wildlife. Organic vapor readings in soils taken as part of 1993 RI/FS activities also indicated no anomalous results. Significant overland migration of contaminants does not appear to be occurring, no waterways exit the area, and groundwater is not expected to migrate the extensive distances to the nearest surface water. For these reasons, contaminant inputs to the watershed do not appear to be possible. Some watershed samples were taken several hundred yards away, but again, no drainageways connect Site 7 and those waterways.

During the site inspection by TtNUS personnel in January 2005, the wetland was inspected. The small, marginal wetland is located within the landfill, due to a depression. This is not believed to be a significant wetland and would not be a significant impact if the site was regarded for surface controls. Site pictures taken during the site visit in January 2005 are included in Appendix B.

1.8.1 Ecological Screening - Surface Soil

Potential risks to plants, soil invertebrates, mammals, and birds resulting from exposure to chemicals in the surface soil were evaluated by comparing chemical concentrations to Ecological Soil Screening Levels (Eco-SSLs) developed by USEPA (USEPA, 2005a and supporting documents). Table 1-12 presents the detected concentration of each chemical in sample 07SDWET7-B2 compared to Eco-SSLs for plants, soil invertebrates, and wildlife (when available). As presented on the table, only two metals (lead and vanadium

were detected at concentrations that slightly exceeded their respective avian Eco-SSLs. However, the detected concentrations of lead (19.6 mg/kg) and vanadium (19.3 mg/kg) were less than the maximum detected concentrations of these metals in the background samples (39.4 mg/kg and 64.0 mg/kg respectively). In fact, all of the metals in sample 07SDWET7-B2 were detected at greater concentrations in the background samples except zinc, which was not detected at a concentration that exceeded any of the Eco-SSLs. Therefore, any potential risks from thee metals are within background risks.

1.9 QUALITATIVE EVALUATION OF HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT RESULTS

This section considers potential impacts of new or changed (since 1995) ARARs on potential risk posed to human health. The chemical-specific ARARs used in the RI identified for Site 7 were reviewed, as were changes to Federal or state regulations and guidelines that have been issued in the intervening years. The result of this analysis determined that recalculation of risk to determine whether a remedy continues to protect human health or the environment as concluded by the RI/FS process (using the 1996 RI risk assessment estimations) is not necessary for this site.

The procedures used for this evaluation follow the guidance from EPA for performing a CERCLA Five-Year review and are provided in Appendix D, along with a complete summary of guidance documents. The conclusions from this review follow.

The evaluation of the HHRA methods, guidance, and toxicity factors for Site 7 groundwater and sediment has found several minor changes that would impact the Site 7 RI report's risk calculations, but none of the major conclusions of the HHRA would be affected. Some of the cancer SFs and noncancer RfDs have been changed, withdrawn, or added. Estimated risks would be slightly different if the HHR were to be recalculated at present. In addition, some of the dermal exposure parameters have been changed slightly with the issuance of the 2004 final EPA dermal exposure guidance; however, the underlying methods for dermal exposure assessment were not changed, and the recommended dermal exposure factors and chemical-specific constants were only slightly altered due to re-evaluation of the same data sources by an EPA workgroup. Overall, the decision to remediate or not remediate based on risk assessments results would not be affected, and the regulatory criteria selected for monitoring would still be the MCLs and GWQS.

<u>Conclusions</u>

Low-level release of chlorinated aliphatics and benzene derivatives from the landfill to the groundwater has occurred. Detected chemicals in the groundwater are expected to be transported downgradient. Based on the 2005 sampling round, VOCs have decreased in concentration over time and only a trace level of

chlorobenzene is still present in a downgradient well (MW7-02). Inorganics, specifically aluminum, iron and manganese, are detected at levels above GWQS; however, they are still within ranges of background samples.

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 RAOs that are protective of human health and the environment with regard to the contaminants and media of concern, exposure pathways and the PRGs 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 ARARs and TBCs in the development of RAOs for the NWS Earle OU 10 site. Section 2.2 briefly presents the overall approach used to develop RAOs. Section 2.3 summarizes the overall approach used in the 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, general response actions, and screening of remedial technologies and process options for Site 7 are presented in Section 2.6. Section 2.7 presents the estimated volume of contaminated media at the site.

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 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 ARAR, "applicable, 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 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 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 sites 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 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 the OU 10 site is not currently used for drinking water, and potable water is not supplied at the site. Federal chemical-specific ARARs such as the SDWA MCLs [40 Code of Federal Regulations (CFR) 141] and the RCRA MCLs and alternate concentration limits (ACLs) (40 CFR 264.94) may be relevant and appropriate requirements in establishing groundwater clean-up 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 Site include the GWQSs that regulate groundwater quality and the SWQSs 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 site 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.

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

contaminated materials is anticipated).

The Federal Fish and Wildlife Coordination Act and the Endangered Species Act are potential ARARs that are promulgated 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 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 Federal and state ARARs and TBCs and their consideration in the FS are provided in Tables 2-5 and 2-6, respectively.

If site soils, sediments, or landfill materials are determined to be hazardous by characteristic or are listed wastes per RCRA Identification and Listing of Hazardous Waste (40 CFR 261), these action-specific ARARs may potentially be applicable to the how these materials are treated, stored, or disposed or as part of 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 post-closure 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 ARARs 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 (N.J.A.C. 7:26-9); closure and post-closure of sanitary landfills (N.J.A.C. 7:26-2A.9); thermal treatment (N.J.A.C. 7:26-11.6); and physical, chemical, and biological treatment (N.J.A.C. 7:26-11.7).

Because Site 7 is a military landfill, two OSWER directives are TBC guidance documents that may be considered in developing remedial alternatives that employ presumptive remedies. These guidance

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

2.2 METHOD USED FOR DEVELOPMENT OF REMEDIAL ACTION OBJECTIVES

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

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

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

RAO development for Site 7 is presented in Section 2.6.

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 was developed for groundwater contaminants of concern (COCs) based on the results of the RI and HHRA 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. A set of PRGs was developed and the basis for selection is presented.

Typically, a promulgated regulatory ARAR was selected as the proposed PRG unless background levels or the analytical detection limit is higher. If no ARAR was available, 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 are presented in Section 2.6.

2.3.1 ARAR/TBCs Basis

There are no promulgated chemical-specific Federal or state ARARs for soils. However, New Jersey 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 EPA screening level for soil lead under commercial/industrial (i.e. non-residential) scenarios is 800 parts per million (ppm) and 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 GWQSs are promulgated under the N.J.A.C. Title 7, Chapter 9-6 (N.J.A.C. 7:9-6) and establish allowable contaminant concentrations in groundwater. The 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

Risk-based concentrations PRGs will be developed in accordance with EPA guidance for any chemicals of concern that do not have chemical-specific ARARs as defined by CERCLA and its amendments. The development of risk-based PRGs will follow EPA guidance as outlined in Risk Assessment Guidance for Superfund Volume I - Human Health Evaluation Manual (Part B, Development of Risk-based Preliminary Remediation Goals) (EPA, 1991). For Site 7 groundwater risk-based PRGs , if needed, will be developed for the future residential exposure pathway. It should be noted that there are no plans to use the site for residential purposes. Risk-based concentrations for carcinogenic compounds will be based on achieving a cancer risk less than or equal to 1E-4. For non-carcinogenic compounds, the risk-based concentration will be based on not exceeding a hazard index (HI) of 1.0 for any target organ.

2.3.3 Ecological Risk Basis

ET values were used for screening potential risks to ecological receptors from contaminants detected in site-related samples. The ecological risk assessment endpoint was the protection of plants and animals inhabiting the wetland and marsh areas and the Ware and Wagner Creek Watersheds.

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 site) at concentrations higher than the risk-based or groundwater protection-based PRGs calculated for the site. 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. As part of the RI, eight representative background soil samples were collected, and the mean and 95 percent UTL values were calculated. These tables are included in section 31 of the 1996 RI. Representative background groundwater concentration values for the formation underlying Site 7 at NWS Earle is presented in Table 1-5. 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 site 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 contaminated soils and landfill materials at the sites include the following:

- No Action
- Limited Action (LUCs)
- Containment (surface controls or cap)
- Excavation and Treatment Actions
- Excavation, Treatment, and Disposal Actions

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

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

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

General response actions specific to the OU 10 site are presented in Section 2.6.

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 RAOs 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 COCs (metals), and conditions present at each of the sites, including heterogeneous soils, landfill materials, leaching of contaminants to underlying groundwater, erosion and runoff of contaminated materials, vertical hydraulic gradients, etc.

A detailed evaluation of technologies and process options retained in the preliminary screening step is conducted to further focus the alternatives development process. In this step, process options are evaluated with respect to other processes in the same technology category. One representative process option is selected, if possible, for each technology type, to simplify the subsequent development and evaluation of alternatives without limiting flexibility during remedy selection or remedial design. The evaluation of technologies and process options utilizes three criteria: effectiveness, implementability, and relative cost. The Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (Interim Final) (EPA, 1988) suggests that this evaluation focus on the effectiveness criterion, with less emphasis on the

implementability and relative cost criteria. Brief definitions of effectiveness, implementability, and relative cost, as they apply to the evaluation process are as 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 is also evaluated.
- 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.

2.6 SITE 7 TECHNOLOGY SCREENING

The selection of viable remedial technologies and process options for assemblage into remedial alternatives for Site 7 is presented in this section.

2.6.1 Site 7 Remedial Action Objectives

The results of the RI, other previous investigations, and the human health and ecological risk assessments for Site 7 were evaluated to determine the RAOs that may be needed to protect human health and the environment.

Human Health Protection Considerations

Soil, sediment, groundwater, and surface water were sampled at Site 7. Only sediment and groundwater

concentrations were used in the HHRA. See Section 1.8 for additional information. The potential receptors considered for this site were future industrial, residential, and recreational receptors.

The RME cancer risks associated with future residential groundwater exposure (5.3E-06) are within the 1E-04 to 1E-06 EPA target acceptable risk range. 1,1,2-TCA and benzene via ingestion and chloroform via inhalation during showering are the principal COPCs that contributed to the cancer risks for these exposure scenarios. The RME cancer risks associated with the future recreational sediment exposure (2.0E-07) are below the 1E-04 to 1E-06 target acceptable risk range. The RME cancer risks associated with future industrial groundwater exposure (1.1E-05) are within the 1E-04 to 1E-06 target acceptable risk range. Beryllium via ingestion is the principal COPC that contributed to the cancer risks for these exposure scenarios.

RME estimates for non-carcinogenic HI risk (3.1) associated with the future residential groundwater ingestion exposure scenario exceeded 1.0. Thallium was the principal COPC responsible for HIs in the range of 2.8 to 3.0 for the target organs skin, kidney, liver, and central nervous system (ingestion exposures contributed the significant portion of the risk). Adverse noncarcinogenic effects cannot be ruled out when the HI is greater than 1.0. The RME estimates for non-carcinogenic HI risk associated with the future recreational sediment exposure (7.5E-03) and the future industrial groundwater exposure (4.7E-01) are below the HI risk (1.0). Adverse noncarcinogenic effects are not expected when the HIs are below 1.0.

At Site 7, 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 7 being considered for future residential land use. Currently, there are no land use controls (i.e., institutional controls) in place that prevent use of groundwater or installation of drinking water wells.

Ecological Receptors Risk Considerations

Site 7 and adjacent areas contain excellent terrestrial habitats. In addition, the small wetland on the site provides excellent wetland habitat, albeit limited. Most terrestrial ecological receptors found on the base are expected to utilize these areas. Although a few small bare areas are present, the majority of the site has been covered with sand quarried from the surrounding areas and primary and early secondary succession has occurred on the landfill. Hence, exposure to contaminants in surface soils is limited. Runoff from the landfill exits the site to the forested area to the north, although no significant drainageways are present and most precipitation on the site infiltrates site soils. No surface water exists near the site, and the pocket wetland is quite small, precluding significant groundwater to surface water contaminant migration.

During 1993 RI/FS activities one test pit sample was taken near the northwest corner of the landfill, where

any potential off-site runoff would occur. Only slightly elevated levels of Bis(2-ethylhexyl)phthalate were detected in the test pit samples. Some slightly elevated concentrations of metals and VOCs were detected in 1993 RI/FS groundwater samples. Nonetheless, the study concluded that the concentrations were not high enough to indicate that the landfill is generating a significant amount of leachate. RI groundwater samples taken in 1995 indicated the presence of some chlorinated aliphatics and benzene derivatives in groundwater. Chloroform and thallium were also detected at elevated levels in groundwater, but in only one sample.

A sediment (soil) sample was taken in the forested area near the north edge of the landfill where any off-site overland runoff from the landfill would likely occur. Since the soils were moist, due to recent rainfall, the sample was conservatively treated as a sediment sample. Arsenic was the only contaminant detected in this sample that exceeded its ESV, but the HQ was indicative of low potential risk. No organics were detected. Aluminum and vanadium were conservatively retained as final COPCs since no ESV were available, but both of these metals were present in concentrations lower than background.

The results of the 1995 RI sampling and 1993 RI/FS sampling suggest that potential risks to ecological receptors at Site 7 are insignificant. Results of 1995 RI groundwater investigations indicate that groundwater has been impacted by some site-related contaminants and downgradient migration is possible. Surface water is not present near the site in the direction of groundwater flow, and hence, groundwater-to-surface water contaminant migration is not of concern. The nearest surface water north of the site was sampled (WS SW 30) as part of the Watershed sampling and was found to contain nothing potentially related to Site 7. The only compound found in WS SW 30 at a concentration above any conservative ARAR or TBC was 0.069 ug/L of mercury. Although loose sand has been placed on the landfill, some runoff of contaminants from site soils to adjacent surface soils is possible, mainly to the north, since the site slopes heavily in that direction. However, no organics were detected and no inorganics exceeded the ESV in sediments (moist soils) collected just north of the site, suggesting no significant overland migration. This also suggests that contaminant concentrations in surface soils on the landfill are most likely insignificant. The results of the 1993 RI/FS investigation also suggest minimal surface soil contamination at the site. The two test pit soil samples contained only slightly elevated levels of a phthalate compound, but phthalates are ubiquitous in the environment and phthalate toxicosis is rare in fish and wildlife. Organic vapor readings in soils taken as part of 1993 RI/FS activities also indicated no anomalous results.

Environmental Media Protection Considerations

Significant overland migration of contaminants does not appear to be occurring, no waterways exit the area, and groundwater is not expected to migrate the extensive distances to the nearest surface water. For these reasons, contaminant inputs to the watershed do not appear to be possible. Some watershed samples

were taken several hundred yards away, but again, no drainageways connect Site 7 and those waterways.

Remedial Action Objective Selection

Based on the information developed to date, limiting access to the site or removal of landfill contaminants are warranted for the further protection of human health. Also, there is one organic contaminant and four inorganic contaminants found in site groundwater at concentrations greater than background concentrations and GWQSs. Considering the presence of metals in groundwater, the establishment of a CEA according to state regulations would need to be considered. A CEA would include future monitoring of groundwater quality.

The Application of the CERCLA Municipal Landfill Presumptive Remedy to Military Landfills (Interim Guidance), Directive No. 9355.0-62FS, from the EPA Federal Facilities Restoration and Reuse Office may be applicable when considering disposition of the site.

For the reasons provided above, the following RAOs have been selected for Site 7:

Protection of Human Health RAO

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

Protection of the Environment RAO

- None.

2.6.2 Site 7 Preliminary Remediation Goals

Data from the RI HHRA, the 1995 and 2005 sampling events, and ARARs were reviewed to identify COCs for Site 7. Only those compounds detected in 1995 and ten years later, 2005 were considered as potential COCs. Table 2-7 presents the Site 7 groundwater contaminants of potential concern (COPCs) and screens them against frequency of detection (detected in 1995 and 2005), MCLs (Federal ARAR), NJDEP GWQSs (State ARAR), background levels, and EPA Region 3 risk-based screening criteria for water (TBC).

Table 2-8 presents potential PRGs based on ARARs/TBCs, maximum detected background concentrations and risk-based cleanup goals that were developed for each COPC so that cancer risks

would not exceed 1E-4 and non-cancer risks would not be greater than a HI of 1. Non-cancer risks were calculated for the future child resident, tap water ingestion scenario. Carcinogenic risk was calculated for the future adult resident, daily showering scenario. Appendix G provides supporting information for development of the groundwater risk-based cleanup goals. As detailed in the supporting calculations, target risk levels for non-carcinogens (aluminum, iron, manganese, and chlorobenzene) were adjusted for cumulative effects due to similar target organs for aluminum and manganese (central nervous system) and iron and chlorobenzene (liver).

The role of background will be reassessed using data collected over the next 5-year period of monitoring, which will be sufficient to calculate a 95 percent UTL on the background concentrations for individual COC metals. In Table 2-8, maximum background levels are presented to allow a qualitative comparison to site data.

Based on comparison of groundwater concentrations to the PRGs, no chemicals of concern (COCs) were identified for groundwater for Site 7. Chlorobenzene and chloroform were detected at concentrations significantly below their respective MCLs and NJDEP GWQSs. Manganese, while detected at a maximum concentration of 118 ug/L in well MW7-02 which is above the NJDEP GWQS, is present in Site 7 groundwater at concentrations significantly below background concentrations as identified in upgradient well MW7-03. As outlined in Section 104(3) (A) of CERCLA, a removal or remedial action does not need to be provided in response to a release of a naturally occurring substance. Aluminum and iron were detected at concentrations above background and NJDEP GWQSs, but significantly below their respective calculated risk-based concentrations for cleanup.

Per N.J.A.C. 7:26E-1.13, NJDEP GWQSs are the minimum remediation standards that apply to groundwater for purposes of remediation of a contaminated site pursuant to New Jersey Technical Requirements for Site Remediation (NJDEP, 2007). However, the GWQS for aluminum and iron are equivalent to the EPA Secondary Drinking Water Regulation concentrations which are non-enforceable Federal guidelines regarding cosmetic or aesthetic effects of drinking water (EPA, 2006). Furthermore, the maximum background concentrations detected for aluminum (393 ug/L) and iron (706 ug/L) for Site 7 groundwater, are above NJDEP GWQSs for each compound, but significantly below their respective calculated risk-based cleanup concentrations of 7,800 ug/L (aluminum) and 5,500 ug/L (iron). Therefore, remediation of groundwater at Site 7 is not required based on potential risks to human health. Residential scenarios were evaluated to be conservative; site use is currently non-residential. Should future use of the site change, groundwater concentrations are within EPA's target acceptable risk levels for residential exposure.

2.6.3 Site 7 General Response Actions

General response actions were selected based on the RAO for Site 7 and the consideration that the site is an inactive military landfill, therefore incorporating the application of a presumptive remedy. Treatment of groundwater in the vicinity is considered technically impracticable because of the relatively low concentrations of metals exceeding PRGs. The general response actions for Site 7 that address potential human exposures to landfill contents presented here to comply with the presumptive remedy include:

- No action
- LUCs (limited action)
- Containment (surface controls or cap)
- Removal and disposal

General response actions that address potential human exposure to groundwater contaminants include:

- No action
- LUCs (limited action)
- Collection and discharge (clean groundwater only)
- Collection, treatment, and discharge actions
- In-situ treatment

2.6.4 Identification, Screening, and Evaluation of Technologies and Process Options for Site 7

Table 2-9 presents a summary of potential remedial technologies and process options that apply to the Site 7 RAOs and general response actions. Screening of the remedial technologies considered their overall applicability to the media of concern (landfill materials and groundwater), primary contaminant (metals), and current site conditions. During the screening step, process options and entire technology types were eliminated from further consideration on the basis of technical implementability.

Site conditions considered included fill materials consisting of heterogeneous municipal-type waste, the location of a depression within the landfill, referred to as a wetland, large white pine trees growing within the landfill area as well as heavy vegetation and relatively sparse top cover of the landfilled materials.

The preliminary screening of soils and landfill material remedial technologies is presented and summarized in Table 2-10 and the screening of groundwater response remedial technologies is summarized in Table 2-11. Detailed evaluations of the remedial technologies and process options for contaminated soils/landfill materials and groundwater are presented in Tables 2-12 and 2-13, respectively.

2.6.5 Summary of Site 7 Selected Remedial Technologies and Process Options

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

For the contaminated soils and landfill materials options, local ordinances were eliminated from further consideration because this action may be difficult to implement and would not offer any greater protection over LUCs. The composite cap was eliminated because it did not offer substantially greater protectiveness than the single barrier cap, and the current leaching of landfill contaminants does not appear to constitute a significant problem. Surface controls for site soils and soil cover options were retained since the soil cover was observed to be thin during the 1993 RI investigation.

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

2.7 VOLUME OF CONTAMINATED MEDIA

2.7.1 Landfill Wastes

Materials deposited at the site include municipal-type solid waste and waste from NWS Earle Waterfront industrial operations. Wastes reportedly consisted of munitions shipping wastes (dunnage packing), shop wastes (dunnage packing), shop wastes from the Waterfront Public Works Shop and the Munitions Handling Laboratory (glass, wood, and small quantities of waste paint, thinners and solvents) and domestic refuse. Test pits logs from the 1991-1992 RI (Appendix E) describe the encountered waste as consisting of household type trash, plastic, wood, cans, paper, glass, and cardboard (Weston, 1993). Based on the extent of disturbance depicted in a 1974 EPIC photo (approximately 3.6 acres) and the average thickness of waste encountered during the 1991 test pit investigation (3.4 feet), approximately 19,800 cubic yards of waste are present at the site.

For purposes of this FS, it was assumed that about 90% (about 17,820 cubic yards) of the total volume of landfilled material would be characterized as a non-hazardous solid waste. The remaining materials or about 10% (1,980 cubic yards) of the total waste volume would be characterized as a RCRA hazardous solid waste.

2.7.2 Groundwater

Groundwater within the Waterfront Area, including Site 7, is classified as a Class II-A: Groundwater Supporting Potable Water Supply area. Beneath Site 7, the average depth to groundwater is about 20 feet and the saturated thickness of the Red Bank/Navesink formation is approximately 70 feet.

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 Site 7. In this process, technically feasible technologies retained for further evaluation in Section 2 are combined to form remedial alternatives that provide varying levels of risk reduction.

3.1 SITE 7 - DEVELOPMENT AND SCREENING OF ALTERNATIVES

Section 3.1.1 presents the rationale for development of remedial action alternatives for Site 7, Section 3.1.2 describes the assembled alternatives, and Section 3.1.3 presents the screening of alternatives. Detailed evaluations and costing of the retained alternatives are presented in Section 4.0.

3.1.1 Site 7 - Rationale for Development of Alternatives

Factors considered in formulating the remedial alternatives to address the RAOs for Site 7 are discussed below:

Protection of Human Health Considerations - The RAO for protection of human health specifies preventing human exposure to metals in groundwater and potential human exposure to landfill contents. This objective has been addressed in the formulation of remedial alternatives.

Protection of the Environment Considerations - No further action deemed necessary.

Navy/Marine Corps policy as stated in the IR Manual dictates that the procedures outlined in the NCP, (40 CFR 300.430) be followed for all sites. In accordance with this policy, alternatives development for Site 7 was conducted in compliance with statutory requirements of the NCP and in consideration of the Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (Interim Final), (EPA, 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 treatment alternative, including one or more engineering control alternatives (such as containment), one or more innovative treatment alternatives, and the baseline no-action alternative. Treatment technologies are favored to address principal threats, and engineering controls are favored to address relatively low long-term threats.

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

EPA established containment as the presumptive remedy for CERCLA municipal landfills based on the expectation that containment would generally be appropriate for municipal landfill waste because the volume and heterogeneity of the waste generally make treatment impracticable (OSWER Directive No. 9355.0-49FS). Further, EPA established that the CERCLA municipal landfill presumptive remedy should also be applied to all appropriate military sites (OSWER Directive No. 9355.0-62FS). Based on the criteria presented in that directive, the Site 7 landfill is an appropriate site for the application of the presumptive remedy for CERCLA municipal landfills.

3.1.2 Site 7 - Remedial Alternatives Descriptions

This section presents detailed descriptions of the remedial alternatives for Site 7. The key components of each remedial alternative are identified on Table 3-1.

3.1.2.1 Alternative 1: No Action

The no action alternative is developed as a baseline scenario to which the other alternatives may be compared, as required by the NCP. The only activity that would occur under the no action alternative is a review of site conditions and risks every five years.

The purpose of the no action alternative is to evaluate the overall human health and environmental protection provided by the site in its present state. Under this alternative, no remedial actions would be taken to protect human health or the environment. No measures would be implemented to prevent potential human exposure to site groundwater or contact with landfill materials. Key components of Alternative 1 are identified on Table 3-1 and described below.

Existing Features - Currently, the site is located in a wooded area within the NWS Earle Waterfront Area. There are no buildings at Site 7 or in the immediate vicinity. There are no potable water supplies at or around Site 7. All facilities located in the Waterfront 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. The primary protective feature is that groundwater underlying Site 7 is not used as

a potable water supply. There is currently no pathway for human exposure to metals-contaminated groundwater.

As outlined under CERCLA, every five years available site data would be reviewed to assess the status of the site, its condition, status of groundwater contamination, changes in potential risks, and whether site contaminants pose an imminent hazard. Site use and development would also be considered.

3.1.2.2 Alternative 2: Land Use Controls and Long-Term Monitoring

Alternative 2 relies on land use controls to limit potential exposure to contaminated groundwater and landfill contents. This alternative does not employ engineered treatment or containment to address groundwater contamination. Since no engineered treatment or containment to address groundwater contamination would be implemented under Alternative 2, waste constituents would continue to be exposed to infiltration.

LUCs such as use restrictions placed in the Base Master Plan would be enacted to prohibit use of impacted groundwater and preclude contact with landfill contents. Long-term periodic monitoring would be conducted to assess the alternative's effectiveness and potential threats to human health and the environment. Site conditions and risks would be reviewed every five years because contaminants would be left in place. Key components of Alternative 2 are identified on Table 3-1 and described below.

Existing Features - Currently, Site 7 features offer some limited protection of human health and the environment. Groundwater underlying Site 7 is not used as a potable water supply. As a result, there is currently no pathway for human exposure to contaminated groundwater.

Security Fencing - Security fencing and signage consistent with other NWS Earle landfill sites would be installed to deter human entry into the landfill area to protect the integrity of the existing cover. The fence will be a post and cable fence with treated wood posts and a strung cable. The fence will follow the same specifications as the fences installed at other landfill sites at NWS Earle (e.g., Sites 4 and 5).

Land Use Controls - Under Alternative 2, land use restrictions would be incorporated into the Base Master Plan to restrict the future use of Site 7 groundwater until natural processes have reduced contaminant concentrations to acceptable levels (GWQSs). Use of untreated, contaminated Site 7 groundwater for drinking water would be prohibited. Restrictions on future development of the site would also be placed in the Base Master Plan unless landfilled waste materials were removed and/or disposed of properly.

Because site groundwater does not meet New Jersey groundwater quality standards, a New Jersey 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 precluded until standards are achieved. Figure 3-1 details the proposed boundaries of the CEA, including the installation of an additional downgradient groundwater monitoring well. The exact boundaries will be determined per NJDEP "Final Guidance on Designation of Classification Exception Area" to be conducted as part of the CEA documentation submission.

Long-Term Monitoring - Under Alternative 2, groundwater samples would be collected on a biennial basis (i.e., once every two years) from five existing monitoring wells and one new downgradient well. A total of nine groundwater samples, including QA/QC samples, would be collected along with measurement of groundwater levels to determine potentiometric conditions. All 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. Long-term monitoring would be conducted in accordance with CEA requirements. After New Jersey GWQS are achieved, groundwater monitoring would then be conducted every five years to provide information for the CERCLA five-year reviews (see below) or if site conditions changed.

Five-Year Reviews - Because waste materials would remain at 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 and assessing whether contaminant migration has increased to determine whether human receptors or natural resources are at risk.

3.1.2.3 Alternative 3: Soil Cover, Land Use Controls, and Long-Term Monitoring

Alternative 3 would include the removal of trees and other heavy vegetation from the site, and the addition of soil and reshaping the landfill cover to manage precipitation infiltration and surface runoff. The landfill would require revegetation to minimize erosion and to promote evapotranspiration of precipitation, thus reducing infiltration. The soil cap would not meet NJDEP Solid Waste Regulations (N.J.A.C. 7:26) for final cover systems, but would reduce the amount of infiltration entering the landfill and would prevent exposure to landfilled materials. As part of a pre-design investigation, an assessment of the wetland area located on the landfill and any adjacent wetlands (if present) will be conducted to identify impacts from implementation of Alternative 3.

Alternative 3 relies on LUCs to limit potential exposure to contaminated groundwater and landfill contents. This alternative does not employ engineered treatment or containment to address groundwater contamination.

LUCs such as use restrictions placed in the Base Master Plan would be enacted to prohibit use of impacted groundwater and prevent intrusive activities within the landfill boundaries. Long-term periodic monitoring would be conducted to assess the alternative's effectiveness and potential threats to human health and the environment. Site conditions and risks would be reviewed every five years because contaminants would be left in place. Key components of Alternative 3 are identified on Table 3-1 and described below.

Existing Features - Currently, Site 7 features offer some limited protection of human health and the environment. However, only a thin sandy soil cover is present. Vegetative covering ranges from short grasses to trees 20 to 30 feet in height. Groundwater underlying Site 7 is not used as a potable water supply. As a result, there is currently no pathway for human exposure to contaminated groundwater.

The placement of a soil cap would reduce the amount of precipitation entering the landfilled waste materials. Based on visual evidence from several test pits conducted in January 1991, none of the landfilled materials appear to be in contact with groundwater. Thus, although active treatment of groundwater would not be conducted, gradual natural reduction in concentrations of groundwater contaminants by dispersion, dilution, and degradation should occur.

Security Fencing - Security fencing and signage consistent with other NWS Earle landfill sites would be installed to deter human entry into the landfill area to protect the integrity of the existing cover. The fence will be a post and cable fence with treated wood posts and a strung cable. The fence will follow the same specifications as the fences installed at other landfill sites at NWS Earle (e.g., Sites 4 and 5).

Land Use Controls - Under Alternative 3, LUCs restrictions would be incorporated into the Base Master Plan to restrict the future use of Site 7 groundwater until natural processes have reduced contaminant concentrations to acceptable levels (GWQSs). Use of untreated, contaminated Site 7 groundwater for drinking water would be prohibited. Restrictions on future development of the site would also be prohibited unless landfilled waste materials were removed or disposed of properly.

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. Figure 3-1 shows the proposed CEA boundaries.

Long-Term Monitoring - Under Alternative 3, groundwater samples would be collected on a biennial basis (i.e., once every two years) from five existing monitoring wells and one new downgradient well. A total of nine groundwater samples, including QA/QC samples, would be collected along with measurement of

groundwater levels to determine potentiometric conditions. All 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. Long-term monitoring would be conducted in accordance with CEA requirements. After New Jersey GWQS are achieved, groundwater monitoring would then be conducted every five years to provide information for the CERCLA five-year reviews (see below) of if site conditions changed.

Five-Year Reviews - Because waste materials would remain at 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 to evaluate the extent of contamination and if potential site risks have been impacted. Site use and future development, if any, would also be reviewed.

3.1.2.4 Alternative 4: Single Barrier Cap, Land Use Controls, and Long-Term Monitoring

Under Alternative 4 a single barrier cap would be placed over the landfilled waste materials to reduce surface infiltration, prevent direct contact, and control erosion. A protective and vegetative layer of soil, 18 to 24 inches thick including 6 inches of topsoil, and vegetation establishment would eliminate potential exposure to the buried landfill wastes. As part of the Alternative 4 construction activities all trees and other heavy vegetation would also be removed from the site. A pre-design assessment of the wetland area located on the landfill and any adjacent wetlands (if present) would be conducted to identify impacts from implementation of Alternative 4.

Potential exposure to contaminated groundwater would be minimized through establishment of LUCs, such as use restrictions placed in the Base Master Plan. Long-term periodic monitoring would be conducted to assess the alternative's effectiveness and potential threats to human health and the environments. Site conditions and risks would be reviewed every five-years because contaminants would be left in place. Key components of Alternative 3 are identified in Table 3-1 and described below.

Existing Features - Currently, Site 7 features offer some limited protection of human health and the environment. However, only a thin sandy soil cover is present. Vegetative covering ranges from short grasses to trees 20 to 30 feet in height. Groundwater underlying Site 7 is not used as a potable water supply. As a result, there is currently no pathway for human exposure to contaminated groundwater.

The placement of an impermeable single barrier cap would significantly reduce the amount of precipitation entering the landfill waste materials. Based on visual evidence from several test pits conducted in January 1991, none of the landfilled materials appears to be in contact with groundwater. Thus, although active treatment of groundwater would not be conducted, gradual natural reduction in

concentrations of groundwater contaminants by dispersion, dilution, and degradation should occur.

Security Fencing - Security fencing and signage consistent with other NWS Earle landfill sites would be installed to deter human entry into the landfill area to protect the integrity of the single barrier cap. The fence will be a post and cable fence with treated wood posts and a strung cable. The fence will follow the same specifications as the fences installed at other landfill sites at NWS Earle (e.g., Sites 4 and 5).

Land Use Controls - Under Alternative 4, land use restrictions would be incorporated into the Base Master Plan to restrict the future use of Site 7 groundwater until natural processes have reduced contaminant concentrations to acceptable levels (GWQSs). Use of untreated, contaminated Site 7 groundwater would be prohibited. Restrictions on future development of the site would also be prohibited unless landfilled waste materials were removed or disposed of properly.

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 achieve. Figure 3-1 shows the proposed CEA boundaries.

Long-Term Monitoring - Under Alternative 4, groundwater samples would be collected on a biennial basis (i.e., once every two years) from five existing monitoring wells and one new downgradient well. A total of nine groundwater samples, including QA/QC samples, would be collected along with measurement of groundwater levels to determine potentiometric conditions. All 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. Long-term monitoring would be conducted in accordance with CEA requirements. After New Jersey GWQS are achieved, groundwater monitoring would then be conducted every five years to provide information for the CERCLA five-year reviews (see below) or if site conditions changed.

Five-Year Reviews - Because waste materials would remain at 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 to evaluate the extent of contamination and if potential site risks have been impacted. Site use and future development, if any, would also be reviewed.

3.1.2.5 Alternative 5: Removal and Off-Site Disposal

Under Alternative 5 landfilled waste materials and contaminated soils would be excavated and disposed at appropriate off-site RCRA Subtitle C or Subtitle D landfills or permitted municipal landfills (if allowable).

Materials deposited at the site include municipal-type solid waste and waste from Waterfront industrial operations. Wastes reportedly consisted of munitions shipping wastes (dunnage, packing), shop wastes from the Waterfront Public Works Shop and the Munitions Handling Laboratory (glass, wood and small quantities of waste paint, thinners and solvents) and domestic refuse. Test pit logs from 1991 describe the encountered waste as consisting of household type trash, plastic, wood, cans, paper, glass, and cardboard. Based on the extent of disturbance depicted in a 1974 EPIC photo (approximately 3.6 acres) and the average thickness of waste encountered during the 1991 test pit investigation (3.4 feet), approximately 19,800 cubic yards of waste are present at the site. The excavated materials would be transported to either a RCRA permitted Subtitle C (hazardous), Subtitle D (non-hazardous) landfill or municipal solid waste landfill for final disposal. For purposes of this FS, it was assumed that about 90 percent (about 17,820 cubic yards) of the total volume of landfilled material (19,800 cubic yards) would be sent to a non-hazardous waste landfill. The remaining materials or about 10 percent (1,980 cubic yards) of the total waste volume would be sent to a hazardous waste landfill. Because no waste materials would be left at the site, no long-term monitoring or five-year reviews would be required.

A pre-design assessment of the wetland area located on the landfill and any adjacent wetlands (if present) would be conducted to identify impacts from implementation of Alternative 5.

Excavation and Disposal - Prior to the mobilization of the excavation activities, several test pits would be constructed and wastes would be inspected and sampled for additional characterization for disposal purposes. This would enable immediate transportation off site once excavation operations begin. All visible waste material would be excavated and loaded onto trucks for transport to approved disposal facilities. As part of the Alternative 5 construction activities, all trees and other heavy vegetation would also be removed from the site.

During excavation activities, samples would be collected from the floor and sidewalls prior to backfilling and regrading. Verification sampling and analysis would be conducted to ensure that the remaining soils do not exceed New Jersey soil remediation levels.

It is anticipated that the majority of excavated materials would not be classified as a hazardous waste as defined by RCRA. These non-hazardous wastes would be transported to a permitted solid waste disposal facility, such as a RCRA Subtitle D landfill or a municipal solid waste landfill.

After completion of excavation activities, sand or other clean fill material obtained from on-base would be used to regrade the site. A layer of topsoil, minimum thickness 6 inches, would be placed on the disturbed surfaces. This soil would be fertilized, conditioned, and vegetated for land use and erosion considerations.

Within 12 months of the excavation of the waste materials and restoration of the site, groundwater samples would be collected from the five existing monitoring wells and analyzed for the site contaminants of concern (metals). Based on review of the post-removal groundwater results a determination would be made if additional measures (i.e., CEA) are needed to meet the RAOs. For purposes of this FS, no CEA has been included for Alternative 5.

3.1.3 Site 7 - 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 7. The screening is presented in Table 3-2.

4.0 DETAILED ANALYSIS OF REMEDIAL ACTION ALTERNATIVES

4.1 INTRODUCTION

In this section, each remedial alternative developed in Section 3.0 is described and analyzed in detail in accordance with the "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA" (EPA, 1988) and the NCP (40CFR300). The detailed analysis of remedial alternatives provides information needed for the comparison of alternatives, as well as, for the final selection of alternative(s).

4.2 CRITERIA FOR DETAILED ANALYSIS

The following nine criteria were used for the detailed analysis for each remedial alternative:

1. Overall Protection of Human Health and the Environment
2. Compliance with ARARs and TBCs
3. Long-Term Effectiveness and Permanence
4. Reduction of Toxicity, Mobility, and Volume through Treatment
5. Short-Term Effectiveness
6. Implementability
7. Cost
8. State Acceptance
9. Community Acceptance

The first seven criteria are specifically addressed in this FS. State acceptance will be evaluated after PADEP has reviewed and commented on the draft FS report. Community acceptance will be addressed in the ROD that will be finalized after the public comment period for the Proposed Plan. State and community acceptance must be considered during remedy selection. The following contains a description of each of the nine evaluation criteria.

1. Overall Protection of Human Health and the Environment. The primary requirement for CERCLA remedial actions is that they are protective of human health and the environment. A remedy is protective if it adequately eliminates, reduces, or controls all current and potential health risks. All pathways of exposure must be considered when evaluating the remedial alternative. After the remedy is implemented, if hazardous substances remain without engineering or institutional controls, then the evaluation must consider unrestricted use and unlimited exposure for human and environmental receptors.

For those sites where hazardous substances remain and unrestricted use and unlimited exposure are not allowable, engineering controls, institutional controls, or some combination of the two must be implemented to control exposure and thereby ensure reliable protection over time. In addition, implementation of a remedy cannot result in unacceptable short-term risks or cross-media impacts with regard to human health and the environment.

2. Compliance with ARARs and TBCs. Compliance with ARARs and TBCs is one of the statutory requirements for remedy selection. Alternatives are developed and refined throughout the FS process to ensure that they will meet all of their respective ARARs or that there is good rationale for obtaining a variance or exemption. During the detailed analysis, information on Federal and state action-specific ARARs will be assembled along with previously identified chemical-specific and location-specific ARARs. Alternatives will be refined to ensure compliance with these requirements.

3. Long-Term Effectiveness and Permanence. This criterion reflects CERCLA's emphasis on implementing remedies that will ensure protection of human health and the environment in the future. In evaluating alternatives for their long-term effectiveness and the degree of permanence they afford, the analysis should focus on the residual risks that will remain at the site after the completion of the remedial action. This analysis should include consideration of the following:

   - Degree of threat posed by the hazardous substances remaining at the site.

   - Adequacy of any controls (e.g., engineering and institutional controls) used to manage the hazardous substances remaining at the site.

   - Reliability of those controls.

   - Potential impacts on human health and the environment, should the remedy fail, based on assumptions included in the reasonable maximum exposure scenario.

4. Reduction of Toxicity, Mobility, and Volume through Treatment. This criterion addresses the statutory preference for remedies that employ treatment as a principal element by ensuring that the relative performance of the various treatment alternatives in reducing toxicity, mobility, or volume will be assessed. Specifically, the analysis should examine the magnitude, significance, and irreversibility of reductions.

5. Short-Term Effectiveness. This criterion examines the short-term impacts of the alternatives (i.e., impacts of the implementation) on the neighboring community, the workers, or the surrounding

environment, including the potential threat to human health and the environment associated with excavation, treatment, and transportation of hazardous substances. The potential cross-media impacts of the remedy and the time to achieve protection of human health and the environment are also evaluated.

6. Implementability. Implementability considerations include the technical and administrative feasibility of the alternatives, as well as the availability of the goods and services (e.g., treatment, storage, or disposal capacity) on which the viability of the alternative depends. Implementability considerations often affect the timing of various remedial alternatives (e.g., limitations on the season in which the remedy can be implemented, the number and complexity of materials-handling steps that must be followed, the need to obtain permits for offsite activities, and the need to secure technical services such as well drilling and excavation).

7. Cost. Cost encompasses all capital costs and operation and maintenance costs incurred over the life of the project. The focus during the detailed analysis is on the net present value of these costs. Costs were used to select the least expensive (or most cost-effective) alternative that will achieve the remedial action objectives. For purposes of calculating the present worth for the operating and maintenance costs, a 30-year maintenance life and a 7 percent annual discount factor are used.

8. State Acceptance. This criterion, which is an ongoing concern throughout the remediation process, reflects the statutory requirement to provide for substantial and meaningful state involvement.

9. Community Acceptance. This criterion refers to the community's comments on the remedial alternatives under consideration, where "community" is broadly defined to include all interested parties. These comments are taken into account throughout the FS process. However, only preliminary assessment of community acceptance can be conducted during the development of the FS, since formal public comment will not be received until after the public comment period for the preferred alternative is held.

4.3 INDIVIDUAL ANALYSIS OF SITE 7 ALTERNATIVES

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

4.3.1 Alternative 1: No Action

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

Overall Protection of Human Health and the Environment

The no action alternative would not provide protection of human health or the environment. No response actions would be taken to contain or treat contaminated groundwater and no additional measures would be implemented to prevent potential human contact with landfill materials. Contaminated groundwater would continue to exceed state GWQS and pose a potential health risk until contaminant concentrations naturally reduce to guideline levels.

Under Alternative 1 no actions would be taken to remove or cover waste materials present on the landfill surface. Precipitation would continue to infiltrate the wastes potentially releasing constituents into groundwater.

Compliance with ARARs

Because groundwater beneath Site 7 exceeds GWQSs (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. Alternative 1 would not comply with New Jersey Sold Waste Regulations (N.J.A.C. 7:26) for final cover system design and construction. In addition, Alternative 1 would not meet any of the components of the CERCLA municipal landfill presumptive remedy which is appropriate for Site 7 (i.e., source containment).

Long-Term Effectiveness and Permanence

Because no remedial actions would occur under Alternative 1, potential threats to human health would remain.

Landfilled waste materials would remain at or near the site surface. The potential for additional waste to be exposed would remain as no erosion controls or control of burrowing animals would be implemented. No controls regarding future use of the site or intrusive activities would be implemented. No security fencing or signage would be implemented.

The risk assessment concluded that, under a future residential land use scenario, exposure to contaminated groundwater beneath the site would result in a potential RME non-carcinogenic risk (HI) greater than 1.0, mainly based on ingestion of groundwater. Because Alternative 1 would not include any remedial actions or LUCs to reduce contaminant concentrations in groundwater or prohibit use of untreated contaminated groundwater, the risk to potential future users of the groundwater would remain unchanged.

The groundwater underlying Site 7 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/or groundwater usage change in the future, potential residential and industrial users of groundwater would not be protected.

Under ambient conditions, a gradual reduction of the contaminants in site groundwater would likely occur through physical, biological, and chemical mechanisms; however, the process is likely to take a number of years.

No controls would be used to manage site contaminants 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, because no treatment would be used to address the contaminated media. Some reduction of contaminant toxicity or volume (groundwater and/or waste materials) might occur through natural dispersion, dilution, or other physical, biological, or chemical mechanisms.

Short-Term Effectiveness

Because no response actions would occur, implementation of the no action alternative would not pose additional short-term risks to Base personnel or the local community. Current risks would remain unabated. None of the RAOs would be achieved. Landfilled waste materials would remain at or near the site surface.

Implementability

Because no response activities would occur, the no action alternative is readily implementable. The technical feasibility criteria including constructability, 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. No coordination with other agencies would be required.

Cost

No capital costs are associated with the no action alternative. Over a 30-year period, the net present-worth cost is $49,600 at an annual 7 percent discount rate (Appendix F). The average O&M cost for five-year

reviews is $23,000 per event.

4.3.2 Alternative 2: Land Use Controls and Long-Term Monitoring

Alternative 2 relies on LUCs to achieve RAOs. A fence would limit human access to the landfill area. Restrictions on site use would be placed in the Base Master Plan to limit future contact with landfill contents and uses of the site that may result in direct contact with, or use of, untreated groundwater as drinking water. Over time, groundwater contamination is expected to gradually decrease by physical, biological, and chemical mechanisms. Long-term periodic 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 provide protection of human health by instituting restrictions on use of site groundwater and potential exposure to landfill contents.

Groundwater contaminant concentrations should eventually decrease to acceptable levels (GWQSs), reducing the long-term risk posed by future use of site groundwater. Implementing access restrictions and establishing a groundwater CEA at the site would provide interim protection by prohibiting use of the aquifer until GWQSs are achieved.

Fencing and access restrictions would provide long-term protection by limiting access to the landfill area and restricting activities that could damage or intrude into the existing cover and potentially the shallow groundwater.

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

Compliance with ARARs

Implementation of Alternative 2 would comply with some of the ARARs identified in Tables 2-1 through 2-6. Because Alternative 2 does not include active treatment of groundwater, the groundwater beneath Site 7, would not initially meet the New Jersey GWQSs (N.J.A.C. 7:9-6). However, contaminants in the groundwater should gradually decrease to GWQS. Alternative 2 includes a provision to seek a CEA until the GWQSs are achieved. The CEA would be established to provide the state official notice that the constituent standards

would not be met for a specified duration and to provide legal documentation to ensure that consumption of the untreated groundwater is prohibited.

Alternative 2 would not comply with New Jersey Solid Waste Regulations (N.J.A.C. 7:26) for final cover system design and construction. Source containment has been identified by EPA as the presumptive remedy for military landfills like Site 7. Alternative 2 would not meet all of the components of the presumptive remedy.

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 HI of 3.1 for a potential non-carcinogenic risk. This risk estimate exceeds EPA's guideline risk of 1.0. Implementing institutional controls to prohibit use of untreated contaminated groundwater would reduce this risk and provide long-term protection of human health. A gradual reduction of groundwater contamination should occur that would ultimately result in reduced risk as groundwater contaminant concentrations decrease to acceptable levels (GWQSs) through physical, biological, and chemical mechanisms.

The groundwater underlying Site 7 is not currently used as a potable water supply and there are no existing plans for its use; however, public non-community wells and domestic wells are situated elsewhere on or near NWS Earle, indicating that future use of groundwater is conceivable. If site land and groundwater usage change in the future, potential residential users of groundwater would be protected by access restrictions and the CEA until GWQSs are achieved.

Periodic 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 lowlands and downgradient receptors, and determine whether additional remedial actions are necessary. The groundwater sampling program should be effective in monitoring the risks to downgradient receptors and the environment.

Under ambient conditions, a gradual reduction of the contaminants in site groundwater would likely occur through physical, biological, and chemical mechanisms; however, the process is likely to take a number of years. Five-year reviews would assess whether human health risks are increasing or abating with time in light of future land use or changes in the conditions at the site. These reviews would be based in large part on analytical data collected during monitoring events. Review of the effectiveness of the CEA in preventing exposure to site contaminants would also be required.

No difficulties or uncertainties are anticipated in performing the long-term maintenance or monitoring. All materials used in construction of the fencing and one new monitoring well are readily available. In the event of damage to the fencing, repairs would likely be performed without difficulty. Groundwater monitoring wells may require replacement if sedimentation or vandalism occurs; 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 because no treatment is used to address the metals found in groundwater.

Short-Term Effectiveness

Implementation of Alternative 2 is not expected to pose any significant risks to Base personnel or the local community. Minimal increased truck traffic would occur as the result of site preparation and the placement of fencing and an additional downgradient monitoring well. Workers who implement Alternative 2 would be adequately safeguarded by using appropriate personal protective equipment (PPE) to prevent exposure to groundwater, contaminant-laden dusts, or landfilled waste materials. Occupational Safety and Health Administration (OSHA) standards would be followed and, proper PPE would be used during any intrusive remedial activities. A site-specific health and safety plan (HASP) would be developed and implemented as part of the Site 2 activities.

Alternative 2 should achieve the RAO for protection of human health by preventing exposure to contaminants in groundwater. Implementing access restrictions and establishing the groundwater CEA may take about one year. Landfilled waste materials would remain at or near the site surface.

Implementability

Alternative 2 is implementable. No anticipated difficulties or uncertainties exist because common construction techniques are required and are readily available from several vendors. Long-term monitoring (sampling and analyses) requires trained and experienced personnel, equipment, and materials which are available. Land use restrictions should not be difficult to implement and enforce because the site is part of an active Navy base, and coordination with other agencies and property owners is not necessary.

Because 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 groundwater quality that may potentially impact downgradient receptors.

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

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

Cost

Capital costs associated with Alternative 2 are estimated at $117,000. The average O&M cost for long-term monitoring is $11,100, and five-year reviews are $23,000 per event. Every two years until GWQS are achieved, the CEA would require recertification which is estimated to be $10,000 per event. Over a 30-year period, the net present-worth cost is $266,900 (at a 7 percent discount rate).

4.3.3 Alternative 3: Soil Cover, Land Use Controls and Long-Term Monitoring

Under Alternative 3 the landfill would be covered with a minimum thickness of 18 inches of clean fill plus 6 inches of topsoil. The site would be graded to control surface water runoff, prevent ponding, and minimum erosion. A perennial grass would be established as a final vegetative cover. Alternative 3 also relies on LUCs to achieve groundwater RAOs. Construction of a soil cover cap and a fence would limit access to landfill contents and the landfill area, thereby achieving the RAO for eliminating exposure to landfilled wastes. Access restrictions would be placed in the Base Master Plan to limit future uses of the site that may result in direct contact with groundwater and landfill contents, use of untreated groundwater as drinking water, or disturbance to the integrity of the soil cover. Prior to placement of the soil cover, all trees and heavy vegetation would be removed. Over time, groundwater contamination is expected to gradually decrease through natural dispersion or dilution or by other physical, biological, and chemical mechanisms. A CEA would be established for site groundwater until groundwater constituents decrease to acceptable levels (GWQS). Long-term periodic monitoring and five-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 by instituting restrictions on potential contact with landfill contents and use of site groundwater.

Groundwater contaminant concentrations should eventually decrease to acceptable levels (GWQSs),

reducing the long-term risk posed by future use of site groundwater. Implementing access restrictions and establishing a groundwater CEA at the site would provide interim protection by prohibiting use of the aquifer until GWQSs are achieved.

Placement of the soil cover, including permanent vegetation to control erosion and infiltration, fencing and access restrictions would provide long-term protection by limiting access to the landfilled area and restricting activities that could damage or intrude into the soil cover and potentially groundwater.

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

Compliance with ARARs

Implementation of Alternative 3 would comply with some of the ARARs identified in Tables 2-1 through 2-6. Because Alternative 3 does not include active treatment of groundwater, the groundwater beneath Site 7 would not initially meet the state GWQSs. However, contaminants in the groundwater should gradually decrease to GWQS. Alternative 3 includes a CEA until the GWQSs are achieved. The CEA would be established to provide the state official notice that the constituent standards would not be met for a specified duration and to provide documentation to ensure that consumption of the untreated groundwater is prohibited.

Based on the description of waste types disposed at Site 7, the landfill would not be a Class II or Class III sanitary landfill per N.J.A.C. 7:26. Thus, Alternative 3 is not expected to meet the ARAR for sanitary landfill final cover system design and construction. Alternative 3 would not meet all of the components of the containment presumptive remedy which are applicable to Site 7. However, due to the low level of groundwater contaminants and the length of time the landfill has been in place, plume containment and/or treatment and controlling and treating landfill gas are probably not needed at Site 7.

Long-Term Effectiveness and Permanence

Placement of additional soil on the landfill surface and establishment of a permanent vegetative cover would eliminate the presence of any waste materials on the landfill surface. Annual site inspections would ensure the integrity of the cover soil and vegetation. Periodic maintenance activities would result in the control of burrowing animals and prevent the establishment of deep-rooting vegetation. Any subsidence and/or erosion of the cap would be identified during the annual inspections and would be addressed.

The risk assessment concluded that, under a future residential land use scenario, exposure to contaminated groundwater beneath the site would result in a HI of 3.1 for a potential non-carcinogenic risk. This risk estimate exceeds EPA's guideline risk of 1.0. Implementing LUCs to prohibit use of untreated contaminated groundwater would reduce this risk and provide long-term protection of human health. A gradual reduction of groundwater contamination should occur that would ultimately result in reduced risk as groundwater contaminant concentrations decrease to acceptable levels (GWQSs) through physical, biological, and chemical mechanisms.

The groundwater underlying Site 7 is not currently used as a potable water supply and there are no existing plans for its use; however, public non-community wells and domestic wells are situated elsewhere on or near NWS Earle, indicating that future use of groundwater may be conceivable. If site land and groundwater usage change in the future, potential residential users of groundwater would be protected by institutional controls (access restrictions and CEA) until GWQSs are achieved.

Periodic monitoring would allow the responsible agency to monitor the quality of groundwater beneath and leaving the site, assess potential impacts to the adjacent lowlands and downgradient receptors, and determine whether additional remedial actions are necessary. The groundwater sampling program should be effective in monitoring the risks, if any, to downgradient receptors and the environment.

Under ambient conditions, a gradual reduction of the contaminants in site groundwater would likely occur through physical, biological, and chemical mechanisms; however, the process is likely to take a number of years. Five-year reviews would assess whether human health risks are increasing or abating with time in light of future land use or changes in the conditions at the site. These reviews would be based in large part on analytical data collected during monitoring events. Review of the effectiveness of the CEA in preventing exposure to site contaminants would also be required.

No difficulties or uncertainties are anticipated in performing the long-term maintenance or monitoring. All materials used in placement of the soil and establishment of permanent vegetative covers, fencing construction, and monitoring well installation are readily available.

Reduction of Toxicity, Mobility, or Volume through Treatment

Alternative 3 would not reduce the toxicity, mobility, or volume of contamination through treatment because no treatment is used to address the landfill contents or metals found in groundwater.

Short-Term Effectiveness

Implementation of Alternative 3 is not expected to pose any significant risks to base personnel or the local community. Some increased truck traffic would occur during installation of the site fencing and an additional monitoring well. Workers who implement Alternative 3 would be adequately safeguarded by using appropriate PPE to prevent exposure to landfilled waste materials. OSHA standards would be followed, and proper PPE would be used during any grading and/or intrusive remedial activities. A site-specific HASP would be developed and followed during the construction activities.

Upon completion of the soil covering, Alternative 3 would achieve the RAO for protection of human health by preventing exposure to landfill contents. Implementing access restrictions and establishing the groundwater CEA will take approximately 6 to 12 months.

Implementability

Alternative 3 is implementable. No anticipated difficulties or uncertainties exist because common construction techniques are required and are available from several vendors. Long-term monitoring (sampling and analyses) requires only readily available resources. Access restrictions should not be difficult to implement and enforce because the site is part of an active Navy base.

Because 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 groundwater quality that may potentially impact downgradient receptors.

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

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

Cost

Capital costs associated with Alternative 2 are $230,000. The annual cost for site inspections and cap maintenance is $1,000. The average biennial O&M cost for long-term monitoring is $11,100, and five-year reviews are $23,000 per event. Every two years until GWQS are achieved, the CEA would require

recertification which is estimated to be $10,000 per event. Over a 30-year period, the net present-worth cost is $392,400 at a 7 percent discount rate.

4.3.4 Alternative 4: Single Barrier Cap, Land Use Controls, and Long-Term Monitoring

Under Alternative 4, a single barrier cap consisting of a 40 mil thickness Linear Low Density Polyethylene (LLDPE) membrane would be placed over the buried waste materials to prevent precipitation infiltration and reduce exposure to any of the landfilled materials. Prior to placement of the membrane, all trees and heavy vegetation would be removed and the landfill will be covered with a six-inch layer of common fill to protect the membrane from any protruding waste or debris. A drainage layer and/or drainage material would be placed on top of the membrane to direct precipitation off of the capping membrane. The drainage layer would be covered with 18 inches of vegetative bearing clean fill and 6 inches of topsoil, graded, fertilized, and seeded. A passive gas venting system would be installed to minimize methane gas entrapment beneath the impermeable liner. Due to the age of the landfill a passive system is expected to be adequate. Because waste materials would remain at the site, groundwater monitoring and CERCLA five-year reviews would be conducted. Access restrictions would be placed in the Base Master Plan to limit future uses of the site that may result in direct contact with groundwater and landfill contents, disturbance to the integrity of the soil cover, and use of untreated groundwater as drinking water. A CEA would be established for site groundwater until groundwater constituents decrease to acceptable levels (GWQS).

Overall Protection of Human Health and the Environment

Alternative 4 would provide protection of human health by preventing any direct contact with waste materials present at or near the landfill surface and by instituting restrictions via the Base Master Plan regarding the use of the capped area and site groundwater.

Groundwater contaminant concentrations should eventually decrease to acceptable levels (GWQS), reducing the long-term risk posed by future use of site groundwater. Implementing access restrictions and establishing a groundwater CEA at the site would provide interim protection by prohibiting use of the aquifer until GWQS are achieved.

Placement of the single membrane cap system, including permanent vegetation to control erosion and prevent infiltration, fencing, and access restrictions would provide long-term protection by limiting access to the landfilled area and restricting activities that could damage the membrane.

The long-term periodic monitoring program would allow the responsible agency to monitor the quality of groundwater leaving the site.

Compliance with ARARs

Implementation of Alternative 4 would comply with a number of the ARARs identified in Tables 2-1 through 2-6. Because Alternative 4 does not include active treatment of groundwater, the groundwater beneath Site 7 would not initially meet the state GWQS. However, contaminants in the groundwater should gradually decrease to GWQS. A CEA would be established to provide the state official notice that the constituent standards would not be met for a specified duration and to provide documentation to ensure that consumption of the untreated groundwater is prohibited.

Alternative 4 would comply with New Jersey Solid Waste Regulations (N.J.A.C. 7:26) for final cover system design and construction. The 40 mil LLDPE membrane would achieve the 1×10^{-5} centimeter per second (cm/sec) permeability requirement. Alternative 4 would meet most of the key components of the containment presumptive remedy. Due to the low levels of groundwater contaminants and the lack of potential receptors, plume containment and treatment is not needed at Site 7. Following construction of the single barrier cap system, the potential for leachate generation is expected to be minimal because the waste materials are not in contact with groundwater and infiltration of precipitation should be virtually eliminated.

Long-Term Effectiveness and Permanence

Placement of the single membrane cover and establishment of a permanent vegetative cover would eliminate the presence of any waste materials on the landfill surface. Annual site inspections would ensure the integrity of the cap system by controlling burrowing animals and the establishment of deep-rooted vegetation.

The risk assessment concluded that under a future residential land use scenario, exposure to contaminated groundwater beneath the site would result in a HI of 3.1 for a potential non-carcinogenic risk. Implementing LUCs to prohibit use of untreated contaminated groundwater would reduce this risk and provide long-term protection of human health. A gradual reduction of groundwater contamination should occur that would ultimately result in reduced risk as groundwater contaminant concentrations decrease to acceptable levels (GWQS) through physical, biological, and chemical mechanisms.

The groundwater underlying Site 7 is not currently used as a potable water supply and there are no existing plans for its use; however, public non-community wells and domestic wells are situated elsewhere on or near NWS Earle, indicating that future use of groundwater may be conceivable. If site land and groundwater usage change in the future, potential residential users of groundwater would be protected by access restrictions and a CEA until GWQSs are achieved.

Periodic monitoring would allow the responsible agency to monitor the quality of groundwater beneath and

leaving the site. The groundwater sampling program should be effective in monitoring the risks, if any, to downgradient receptors and the environment.

Under ambient conditions, a gradual reduction of the contaminants in site groundwater would likely occur through physical, biological, and chemical mechanisms; however the process is likely to take a number of years. Five-year reviews would assess whether human health risks are increasing or abating with time, in light of future land use or changes in the conditions at the site. These reviews would be based, in large part, on analytical data collected during monitoring events. Review of the effectiveness of the CEA in preventing exposure to site contaminants would also be required.

No difficulties or uncertainties are anticipated in performing the long–term maintenance or monitoring. All materials used in the construction of the single membrane cap system, fencing construction, and monitoring well installation are readily available.

Reduction of Toxicity, Mobility, or Volume through Treatment

Alternative 4 would not reduce the toxicity, mobility, or volume of contamination through treatment, because no treatment is used to address the landfill contents or metals found in groundwater. However, there may be some reduction in the mobility of waste constituents because the single membrane cap would essentially eliminate precipitation infiltration into and through the waste.

Short-Term Effectiveness

Implementation of Alternative 4 is not expected to pose any significant risks to base personnel or the local community. Some increased truck traffic would occur due to the transport of cover materials and equipment. Workers who implement Alternative 4 would be adequately safeguarded by using appropriate PPE to prevent exposure to landfilled waste materials. OSHA standards would be followed and proper PPE would be used during any grading and/or intrusive remedial activities. A site-specific HASP would be developed and followed during the construction activities.

Upon completion of the capping, Alternative 4 would achieve the RAO for protection of human health by preventing exposure to landfill contents and groundwater. Implementing access restrictions and establishing the groundwater CEA would take approximately 6 to 12 months. The groundwater RAO would be met when groundwater concentrations achieve state GWQSs.

Implementability

Alternative 4 is implementable. No anticipated difficulties or uncertainties exist because common construction techniques are required and are available from several vendors. Long-term monitoring (sampling and analysis) requires only readily available resources. Access restrictions should not be difficult to implement and enforce because the site is part of an active Navy base.

Because long-term monitoring is included under Alternative 4, contaminant presence and migration can be assessed. Monitoring of groundwater would be effective for detecting changes in groundwater quality that may potentially impart downgradient receptors.

Permits would not be required under Alternative 4 because all activities would be conducted on the base, however the substantive requirements of most ARARs would be met as described previously.

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

Cost

Alternative 4 capital costs are estimated at $2,031,300. The annual cost for site inspections and cap maintenance is $1,000. The average biennial O&M cost for long term monitoring is $12,900 and five-year reviews are $23,000 per event. Every two years until GWQSs are achieved, the CEA would require recertification which is estimated to be $10,000 per event. Over a 30-year period, the net present-worth cost is $2,204,500 at a 7 percent discount rate.

4.3.5 Alternative 5: Removal and Off-Site Disposal

Under Alternative 5, all landfilled waste materials would be excavated and transported to an appropriate permitted off-site landfill for disposal, recycled, or incinerated (if appropriate). This alternative would constitute closure of Site 7 and would eliminate any current or future exposure to the waste materials. Metals present in the groundwater would decrease through dispersion or dilution, or by other physical, biological, and chemical mechanisms. Post-removal groundwater sampling would be conducted within 12 months of the completion of waste removal and site restoration to determine if additional measures (i.e., CEA) are needed to achieve the RAOs. For purposes of this FS, no CEA has been included for Alternative 5.

Overall Protection of Human Health and the Environment

Alternative 5 would provide overall protection of human health and the environment by eliminating the potential for direct exposure to landfilled waste materials and preventing contaminant migration from waste materials into groundwater.

Compliance with ARARS

Implementation of Alternative 5 would comply with the ARARs identified in Tables 2-1 through 2-6. Because active treatment of groundwater would not be conducted, initially, the groundwater beneath Site 7 might not meet the constituent concentrations specified in the GWQS. However, excavation and removal of the landfilled materials would prevent further migration of contaminants into groundwater.

If any of the excavated materials are determined to be hazardous wastes, their handling, management, and off-site transport would be conducted in accordance with RCRA hazardous waste generator and transporter requirements (40 CFR parts 262 and 263) and New Jersey labeling, records, and transportation requirements. Non-hazardous wastes would be handled, managed, and transported in accordance with Federal and New Jersey solid and/or municipal waste requirements.

If implemented, Alternative 5 would meet or exceed the presumptive remedy for military landfills like Site 7 because the landfilled materials would be removed and disposed in state-of-the art permitted facilities. Materials that can be recycled or incinerated would be handled accordingly.

Long-Term Effectiveness and Permanence

Alternative 5 would provide long-term protection of human health and the environment, and would result in permanent reduction of all potential health risks. A reduction of groundwater contamination would occur that would ultimately result in reduced risk as groundwater contaminant concentrations decrease to acceptable levels (GWQS) through physical, biological, and chemical mechanisms.

Reduction of Toxicity, Mobility, or Volume through Treatment

Alternative 5 would not reduce the toxicity, mobility, or volume of landfilled waste materials or groundwater through treatment since no treatment would be conducted. The mobility of contaminants in the environment would be reduced by placement of waste materials in a permitted and engineered landfill or through recycling or incineration. The actual volume of waste material may decrease due to compaction as part of the waste handling, recycling, or incinerations. Groundwater contaminant's toxicity, mobility, and volume would be

reduced as the source of metals would be removed from the site.

Short-Term Effectiveness

Implementation of Alternative 5 is not expected to pose any significant risks to Base personnel, the local community, workers, or the environment. During excavation of the waste materials, short-term risks posed to Base personnel, site workers, and the environment would be mitigated through use of engineering controls and appropriate PPE. Workers who implement Alternative 5 would be adequately safeguarded by implementation of a site-specific HASP and the use of PPE. OSHA standards would be followed during all remedial activities.

Somewhat increased truck and heavy equipment vehicular traffic would occur for a short time as the result of excavation and off-site transport of waste materials. Equipment such as covered trucks would be used for transport to minimize spills and migration of contaminants during transport.

Alternative 5 would require approximately 12 months to implement, including testing and analysis of the waste materials to determine the appropriate disposal facility. Following excavation, the site would be backfilled with clean soil obtained from on-base and graded to reflect the natural topography. Alternative 5 would achieve the RAOs for both landfilled waste materials and groundwater.

Implementability

Alternative 5 is readily implementable. There are a number of firms with trained personnel and equipment to handle the removal, transport, and disposal of the Site 7 waste materials and site restoration activities. Alternative 5 is estimated to be completed in 12 months, including design, mobilization and demobilization, implementation, and site restoration.

Cost

The estimated capital cost for implementation of Alternative 5 is $4,478,000. For purposes of this FS, there are no O&M costs associated with this alternative.

5.0 COMPARISON OF ALTERNATIVES

This section presents a comparative analysis of the alternatives relative to the specific evaluation criteria. The comparison identifies the advantages and disadvantages of each alternative relative to one another. Table 5-1 presents the summary of the evaluation for each alternative and comparison with the other alternatives.

5.1 OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

Alternative 1 would not be protective of human health and the environment since no actions would be taken to prevent exposure to landfilled waste materials or contaminated groundwater. The small quantity of waste present on the landfill surface would continue to be exposed to Base personnel and the environment. No risk reduction is anticipated under the No Action alternative.

Alternative 2 would be slightly more protective of human health and the environment since restrictions on the current and future use of the site would be placed in the Base Master Plan. In addition, a CEA would be established to prevent use of the site groundwater until GWQS are achieved for several metals including aluminum and iron. Biennial (i.e., once every two years) groundwater monitoring would be conducted until GWQS are achieved and CERCLA five-year reviews would identify if site risks have changed or if additional remedial actions are needed.

Alternatives 3 and 4 would provide somewhat similar overall protection of human health and the environment though Alternative 4 would be more effective at preventing precipitation infiltration into the landfilled materials. Under Alternative 3 the vegetated soil cover would eliminate the presence of any waste materials on the landfill surface. Alternative 4 would also eliminate the presence of any waste materials on the landfill surface and would virtually eliminate the infiltration of precipitation into the landfill. This would significantly impact the amount of potential leachate generation and movement of waste contaminants into the underlying groundwater since the waste materials are not in contact with groundwater; movement of contaminants is due to precipitation flowing through the thin soil cover and waste materials. Both alternatives would also employ land use restrictions which would maintain the current site status and prevent intrusive activities or future development. Biennial (i.e., once every two years) groundwater monitoring would be conducted until GWQS are achieved and CERCLA five-year reviews would identify if site risks have changed or if additional remedial actions are needed.

Alternative 5 would provide the most overall protection of human health and the environment because all of the waste materials would be excavated and disposed in a secure permitted facility, recycled or incinerated, if appropriate. Levels of metals in groundwater attributable to the landfilled materials would decrease and GWQS would be achieved.

5.2 COMPLIANCE WITH ARARS

Alternative 1 would not comply with chemical-specific ARARs. No action-specific ARARs apply to this alternative because no actions would be implemented. Alternative 1 would not meet any components of the EPA presumptive remedy for military landfills.

Alternative 2 would comply with chemical-specific groundwater ARARs if GWQS are achieved. None of the location-specific or action-specific ARARs would be achieved because some waste materials would remain present on the landfill surface and the landfill final cover would not comply with NJDEP Solid Waste Regulations, and would not meet components of the EPA presumptive remedy for military landfills.

Alternative 3 should eventually comply with chemical-specific groundwater ARARs if GWQS are achieved. Implementation of land use controls and groundwater monitoring should be effective in providing notification if future use of the site is changed or if groundwater quality is negatively impacted. The vegetated soil cover would meet NJDEP soil remediation guidelines but would not meet the ARAR for sanitary landfill final cover system design and construction. Erosion and surface runoff would be controlled with placement of the vegetated soil cover and yearly inspections would ensure that the soil cover and vegetation is maintained.

Alternative 4 would comply with applicable location-specific and action-specific ARARs. NJDEP guidelines for placement of an impermeable barrier to reduce surface infiltration, prevent direct contact, limit gas emissions, and control erosion of landfilled material would be met. Chemical-specific groundwater ARARs would eventually be met because leachate generation should be significantly reduced or eliminated and wastes are not in contact with groundwater.

Alternative 5 would comply with all action-specific ARARs for the handling, transport and disposal of the landfilled materials. Any materials that are characterized as RCRA hazardous wastes would be handled, transported and disposed in accordance with applicable portions of RCRA requirements (40 CFR Parts 262 and 263) and applicable transportation requirements (49 CFR 107, 171-179).

5.3 LONG-TERM EFFECTIVENESS AND PERMANENCE

Alternative 1 would not provide any long-term protection of human health since no actions would be taken to prevent exposure to landfilled materials or contaminated groundwater. Current risks would remain unmitigated.

Alternative 2 would provide limited long-term effectiveness and permanence because restrictions on the use of the site and any intrusive activities would be outlined in the Base Master Plan. A CEA would be established and sampling would be conducted on a routine basis to monitor groundwater quality.

Alternatives 3 and 4 would provide more long-term effectiveness and permanence because the landfill would be capped and annual O&M inspections would provide notification if erosion and/or intrusive vegetation/animals were resulting in exposure of waste materials. Land use restrictions and the establishment of a CEA are both part of Alternatives 3 and 4 and would provide the same level of effectiveness and permanence in restricting use of the site and monitoring groundwater quality. The synthetic membrane cap included in Alternative 4 would provide substantially more effectiveness and permanence in reducing the amount of infiltration and leachate generation than the soil cover included in Alternative 3.

Alternative 5 would provide the most long-term effectiveness and permanence because all the landfilled materials would be excavated and disposed of in secure facilities, recycled, or incinerated. If implemented, Alternative 5 would eliminate the source of contamination at the site, thereby eliminating any further degradation of groundwater quality. Post-removal groundwater sampling would be conducted to determine if additional measures (i.e., CEA) are needed to achieve the RAOs.

5.4 REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT

Alternative 1 would not satisfy the statutory preference for treatment since no remedial activities would be performed. This alternative is not considered a treatment remedy.

No treatment of waste materials or groundwater is proposed under Alternative 2 so there would be no reduction in the toxicity, mobility, or volume of contaminants. Over time, it is expected that groundwater quality would meet New Jersey GWQS as the wastes have been in place for a number of years and exposed to numerous precipitation events, and impact to groundwater appears to have decreased.

Alternatives 3 and 4 would not reduce the volume of landfilled waste materials but should reduce the mobility and leachability of contaminants contained in the landfilled materials. Alternative 4 would be significantly more effective than Alternative 3 in reducing contaminant mobility and leachate generation. Neither alternative would result in treatment of waste and/or groundwater.

Alternative 5 would not necessarily reduce the volume of waste materials but would reduce the mobility and leachability of any contaminants contained in the buried waste. The source of elevated metals in the underlying groundwater would be completely removed from the site. Excavated materials would be

disposed utilizing best practices, including secure landfills, recycling, and/or incineration depending upon the type and volume of materials encountered.

5.5 SHORT-TERM EFFECTIVENESS

Because no active response actions would be implemented under Alternative 1, no additional short-term impacts at the site would be anticipated for this option. Under Alternative 2 the only short-term impact might be due to some additional traffic during the installation of the proposed downgradient monitoring well and the CEA biennial sampling events, however this impact is most likely negligible as the well installation and groundwater sampling are expected to be only one or two days in duration. Documentation of the land use restrictions and CEA certification would not have any site-related impacts.

Field construction of Alternative 3 is expected to be completed within 1 month during which there will be increased traffic related to hauling of the cover materials and construction equipment. Following placement of the soil cover and site fencing, the only short-term impacts at the site would be related to the biennial CEA sampling events. Landfill capping is a common type of construction with ample availability of contractors proficient in the appropriate environmental, health, and safety controls.

Implementation of Alternative 4 is estimated to have a longer period of short-term impact at the site than the implementation of Alternative 5. For both alternatives there would be additional traffic due to the movement of cover or waste materials. Additional impact would result from grading and/or excavation activities and dust releases. However, Site 7 is located in a remote area of the Waterfront with no adjacent Naval, commercial or residential developments in immediate proximity. Site-specific health and safety procedures and PPE would be implemented to protect workers. Standard engineering controls and other precautionary measures would be taken to ensure worker safety and impact to the environment.

5.6 IMPLEMENTABILITY

Since no active remediation or response activities would occur, Alternative 1 is the most readily implementable. The implementation of Alternative 2 is slightly more implementable than the implementation of Alternative 3 because the only field activity associated with Alternative 2 is the installation of an additional downgradient monitoring well. However, the implementation of Alternative 3 is easily implementable and involves standard construction techniques and equipment. Experienced and OSHA-certified workers and companies are readily available to implement construction of the soil cover. The optimal time for implementation of Alternative 3 would be late spring through early fall.

Implementation of Alternative 4 involves the placement of both a single membrane cap and associated drainage layer but is implementable as standard construction techniques, equipment, and materials would be employed. Experienced and OSHA-certified workers and companies are readily available to implement construction of the cap system. The optimal time for implementation of Alternative 4 would be late spring through early fall.

For Alternative 5 the site is easily accessible through existing roads that are capable of handling heavy truck traffic. The work would be most implementable from late spring through early fall when precipitation and snowfall amounts are at a minimum. There are several off-site nonhazardous and construction debris landfills within a reasonable distance from the site. Wastes identified as hazardous and requiring disposal in RCRA Subtitle C landfills would require transport to New York State. Some landfills may be limited in their capacity to accept a certain volume of material on a daily basis which may impact the duration of the field activities. The excavation of the waste materials should be readily implementable because the wastes are generally at the surface or within several inches and do not appear to extend to the depth of the normal water table. Experienced and OSHA-certified workers and companies are readily available to implement excavation and transporting of the landfilled wastes.

5.7 COSTS

The estimated capital and O&M costs associated with each alternative are provided in Table 5-1. Alternative 1 would cost the least to implement since there would be no active remediation and only 5-year reviews would be performed.

The estimated capital costs of Alternatives 2, 3, 4, and 5 range from $117,000 to $4,478,000 with Alternative 5 being the most expensive alternative to implement. Biennial O&M costs, including groundwater monitoring, for Alternatives 2 and 3 are estimated to be about $11,000. An additional $1,000 per year for site inspections and cap maintenance are estimated for Alternative 3. The annual O&M cost associated with Alternative 4 is estimated to be $1,000. The biennial O&M cost for Alternative 4 is estimated to be $13,000. Additional costs for Alternatives 2, 3, and 4 are those associated with the CEA Biennial Recertification (estimated at $10,000 every 2 years) and CERCLA 5-year reviews (estimated at $23,000 every five years).

REFERENCES

B&RE (Brown and Root Environmental), 1996. Remedial Investigation Report for Naval Weapons Station Earle, Colts Neck, New Jersey. Wayne, Pennsylvania. July.

B&RE, 1998. Remedial Investigation Addendum Report for Naval Weapons Station Earle, colts Neck, New Jersey. Wayne, Pennsylvania. January.

Hart (Fred C. Hart and Associates, Inc.). 1983. Initial Assessment Study, Naval Weapons Station Earle, Colts Neck, New Jersey. New York, New York. February.

NJDEP (New Jersey Department of Environmental Protection), 1998. Soil Cleanup Criteria. Accessed from the Internet at http://www.state.nj.us/dep/srp/reqs/scc/scc_0599.pdf. May 12.

NJDEP, 2005. Groundwater Quality Standards, New Jersey Administrative Code 7:9C. Accessed from the Internet at http://www.state.nj.us/dep/wms/bwqsa/docs/njac79C.pdf. November 7.

NEESA (Naval Energy and Environmental Support Activity), 1992. Addendum to the Preliminary Assessment (Initial Assessment Study) of Naval Weapons Station Earle, Colts Neck, New Jersey. NEESA 13-020A. Port Hueneme, California. July 31.

USEPA (United States Environmental Protection Agency).1988. Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA, Interim Final. October.

USEPA, 1989a. Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A). EPA 540/1-89/002. Office of Emergency and Remedial Response. Washington, DC.

USEPA, 1989b. Risk Assessment Guidance for Superfund, Volume II – Environmental Evaluation Manual. Office of Solid Waste and Emergency and Remedial Response. EPA 540/1-89/001.

USEPA, 1992a. Framework for Ecological Risk Assessment. EPA/630/R-92/001. February.

USEPA, 1992b. Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities; Addendum to Interim Final Guidance. Office of solid Waste Permits and State Programs Division. Washington, DC. July.

USEPA, 1996. Application of the CERCLA Municipal Landfill Presumptive Remedy to Military Landfills. Office of Solid Waste and Emergency Response, Directive No. 9355.0-67FS. EPA/540/F-96/020. December.

USEPA, 2003. Recommendations of the Technical Review workgroup for Lead for an Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil. EPA-540-R-03-001. January.

Weston (Roy F. Weston, Inc.), 1986. Interim Report for a Confirmation Study to Determine Existence and Possible Migration of specific Chemicals in Situ. West Chester, Pennsylvania. December.

Weston, 1988. Report of Current Situation and Draft Plan of Action, Naval Weapons Station Earle, Colts Neck, New Jersey. West Chester, Pennsylvania. December.

Weston, 1993. Installation Restoration Program Remedial Investigation/Feasibility Study for 11 sites at NWS Earle, Colts Neck, New Jersey. West Chester, Pennsylvania. September.

TABLES

TABLE ES-1
SITE 7 - REMEDIAL ALTERNATIVE COMPONENTS
OPERABLE UNIT 10 FEASIBILITY STUDY
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

	ALTERNATIVE	KEY COMPONENTS OF ALTERNATIVE
1	No Action	• No actions would be taken • Five-year reviews
2	Limited Action	• Fencing • Land Use Controls (LUCs) (Base Master Plan site use restrictions, CEA*) • Long-term groundwater monitoring • Five-year reviews
3	Surface Controls	• Soil cover, grading and revegetation • Fencing • LUCs (Base Master Plan site use restrictions, CEA*) • Long-term groundwater monitoring • Five-year reviews
4	Single Barrier Cap	• Single barrier synthetic cap • Grading and vegetation establishment • Fencing • LUCs (Base Master Plan site use restrictions, CEA*) • Long-term groundwater monitoring • Five-year reviews
5	Removal and Off-site Disposal	• Excavation of waste materials and contaminated soil • Disposal in permitted facility • Site restoration

Notes:

* 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 GQS.

TABLE ES-2
SITE 7 - COMPARATIVE ANALYSIS OF REMEDIAL ACTION ALTERNATIVES
OPERABLE UNIT 10 FEASIBILITY STUDY
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

CRITERION:	ALTERNATIVE 1: NO ACTION	ALTERNATIVE 2: INSTITUTIONAL CONTROLS AND LONG-TERM MONITORING	ALTERNATIVE 3: SOIL COVER, INSTITUTIONAL CONTROLS, AND LONG-TERM MONITORING	ALTERNATIVE 4: SINGLE BARRIER CAP, INSTITUTIONAL CONTROLS AND LONG-TERM MONITORING	ALTERNATIVE 5: REMOVAL AND OFF-SITE DISPOSAL
OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT					
Prevent Human Exposure to Metal Contaminants in Groundwater	No action taken to prevent human exposure to contaminated groundwater. No institutional controls implemented to prohibit use of untreated groundwater.	Institutional controls would minimize potential exposure to landfill contents and site groundwater by prohibiting its use. In time, contaminants expected to decrease until reaching levels that would not pose excess risk. Land use controls would restrict site access.	Same as Alternative 2.	Cap system would prevent exposure to landfill contents and would significantly reduce impact of waste constituents on groundwater quality. Establishment of CEA would minimize potential exposure to groundwater by prohibiting its use. Land use controls would restrict site access.	Landfill contents would be removed from site and disposed in appropriate and permitted manner. Most protective of human health and environment as source of elevated metals in groundwater would be eliminated.
COMPLIANCE WITH ARARs					
Chemical-Specific ARARs	Would not comply with state groundwater quality standards.	A CEA would be established to provide the state official notification that standards would not be met for a specified duration.	Same as Alternative 2.	Same as Alternatives 2 and 3.	Source of elevated metals in groundwater would be eliminated.
Location-Specific ARARs	Not applicable.	Would comply with Federal and state ARARs for wetlands, floodplains, and other sensitive receptors.	Same as Alternative 2.	Same as Alternatives 2 and 3.	Landfill would no longer exist.
Action-Specific ARARs	Would not comply with state final cover system design. Would not meet any components of EPA presumptive remedy for military landfills.	Would not comply with state final cover system design. Long-term monitoring would provide data for five-year reviews and evaluation of risk.	Would not comply with state final cover system design; however soil cap would meet NJDEP soil remediation guidelines. Would not meet any components of EPA presumptive remedy for military landfills. Long-term monitoring would provide data for five-year reviews and evaluation of risk.	Would comply with NJDEP final cover system design. Would meet several components of EPA presumptive remedy for military landfills,	Landfill would no longer exist.
LONG-TERM EFFECTIVENESS AND PERMANENCE					
Magnitude of Residual Risk	Existing risks would remain: HI > 1 non-carcinogenic risk from exposure to site groundwater assuming future residential land use and consumption of contaminated groundwater.	Existing risks would remain: HI > 1 non-carcinogenic risk from exposure to site groundwater assuming future residential land use. Implementation and enforcement of institutional controls would block exposure to site groundwater. Fencing would reduce potential contact with landfill contents and shallow groundwater.	Same as Alternative 2. Additional cover would reduce potential contact with landfill materials, which may be close to the surface (thin cover), during site access (O&M).	Same as Alternative 2 and 3 except synthetic membrane more effective at reducing potential contact with landfill materials and eliminating infiltration and leachate generation.	Most effective and permanent.

TABLE ES-2
SITE 7 - COMPARATIVE ANALYSIS OF REMEDIAL ACTION ALTERNATIVES
OPERABLE UNIT 10 FEASIBILITY STUDY
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

CRITERION:	ALTERNATIVE 1: NO ACTION	ALTERNATIVE 2: INSTITUTIONAL CONTROLS AND LONG-TERM MONITORING	ALTERNATIVE 3: SOIL COVER, INSTITUTIONAL CONTROLS, AND LONG-TERM MONITORING	ALTERNATIVE 4: SINGLE BARRIER CAP, INSTITUTIONAL CONTROLS AND LONG-TERM MONITORING	ALTERNATIVE 5: REMOVAL AND OFF-SITE DISPOSAL
LONG-TERM EFFECTIVENESS AND PERMANENCE (Continued)					
Adequacy and Reliability of Controls	No new controls implemented. Existing site features provide limited controls.	If implemented and enforced, institutional controls could prevent contact with groundwater and landfill contents and the use of contaminated groundwater.	Same as Alternative 2.	Same as Alternatives 2 and 3.	No controls needed.
Need for Five-Year Review	Not applicable.	Review would be required because groundwater contaminants would be left in place.	Same as Alternative 2.	Same as Alternatives 2 and 3.	No review required.
REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT					
Reduction of Toxicity, Mobility, or Volume Through Treatment	No reduction, because no treatment would be employed.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1, though elimination of infiltration would decrease mobility of waste constituents.	No treatment would be employed however wastes would be recycled, placed in secure landfill, or incinerated (if appropriate).
SHORT-TERM EFFECTIVENESS					
Community Protection	No additional risk to community anticipated.	No significant risk to community anticipated. Engineering controls would be used during implementation to mitigate risks.	Same as Alternative 2.	Same as Alternatives 2 and 3.	Some short-term risk to community due to waste excavation and transport. Risks would be minimized through engineering controls and use of experienced firms and personnel.
Worker Protection	No risk to workers anticipated.	No significant risk to workers anticipated if proper PPE is used during well and fence installation and long-term monitoring.	Same as Alternative 2. PPE would also need to be used during surface control improvements.	Same as Alternative 3.	PPE and engineering controls would be used during waste excavation activities.
Environmental Impacts	No adverse impacts to the environment anticipated.	No adverse impacts to the environment anticipated.	Same as Alternative 2.	Same as Alternatives 2 and 3.	Same as Alternatives 2, 3, and 4.
Time Until Action is Complete	Not applicable.	Approximately 1 year to institute CEA.	Same as Alternative 2.	Approximately 18 months to design and implement cap construction and institute CEA.	Approximately 1 year to implement.
IMPLEMENTABILITY					
Ability to Construct and Operate	No construction or operation involved.	No difficulties anticipated. Monitoring well and fencing installation are readily implementable technologies.	No difficulties anticipated. Grading, revegetation, monitoring well, and fencing installation are readily implementable technologies.	No difficulties anticipated. Grading, revegetation, monitoring well, and fencing installation are readily implementable technologies.	No difficulties anticipated. Equipment and personnel readily available. Landfills available to accept waste quantity.

TABLE ES-2
SITE 7 - COMPARATIVE ANALYSIS OF REMEDIAL ACTION ALTERNATIVES
OPERABLE UNIT 10 FEASIBILITY STUDY
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

CRITERION:	ALTERNATIVE 1: NO ACTION	ALTERNATIVE 2: INSTITUTIONAL CONTROLS AND LONG-TERM MONITORING	ALTERNATIVE 3: SOIL COVER, INSTITUTIONAL CONTROLS, AND LONG-TERM MONITORING	ALTERNATIVE 4: SINGLE BARRIER CAP, INSTITUTIONAL CONTROLS AND LONG-TERM MONITORING	ALTERNATIVE 5: REMOVAL AND OFF-SITE DISPOSAL
IMPLEMENTABILITY (Continued)					
Ease of Doing More Action if Needed	Additional actions would be easily implemented if required.	Additional actions would be easily implemented if required.	Same as Alternative 2.	Same as Alternatives 2 and 3.	No additional actions would be needed.
Ability to Monitor Effectiveness	Not applicable.	Monitoring would provide assessment of potential exposures, contaminant presence, and migration, or changes in site conditions.	Same as Alternative 2.	Same as Alternatives 2 and 3.	Monitoring would not be required because source eliminated.
Ability to Obtain Approvals and Coordinate with Other Agencies	Not applicable.	Coordination for five-year reviews may be required and would be obtainable. Coordination with the state would be required to establish a CEA and would be obtainable.	Same as Alternative 2.	Same as Alternatives 2 and 3.	No five-year reviews would be required; CEA would not be required.
Availability of Treatment, Storage Capacities, and Disposal Services	None required.	None required.	None required.	None required.	Landfill contents would be landfilled, recycled, and/or incinerated (if appropriate). Sufficient capacity exists.
Availability of Equipment, Specialists, and Materials	Not applicable.	Ample availability of equipment and personnel to install monitoring well/fencing and perform long-term maintenance, monitoring, and five-year reviews.	Ample availability of equipment and personnel to perform surface control improvements, install monitoring well/fencing, and perform long-term maintenance, monitoring, and five-year reviews.	Ample availability of equipment and personnel to perform cap improvements, install monitoring well/fencing, and perform long-term maintenance, monitoring, and five-year reviews.	Ample availability of equipment and personnel to perform excavation and transport.
Availability of Technology	Not required.	Common construction techniques and materials required for construction.	Common construction techniques and materials required for construction.	Common construction techniques and materials required for construction.	Common construction techniques and materials required for construction.
COST					
Capital Cost	$0	$117,000	$230,000	$2,031,300	$4,478,000
Annual O&M Cost	$0	$0	$1,000	$1,000	$0
Biennial O&M Cost	$0	$11,100	$11,100	$12,900	$0
CEA Recertification (Every 2 Years)	$0	$10,000	$10,000	$10,000	$0
Five-Year Reviews	$23,000	$23,000	$23,000	$23,000	$0
Present Worth Cost*	$49,600	$266,900	$392,400	$2,204,500	$4,478,000

* Present worth cost is based on discount rate of 7 percent

TABLE 1-1
SITE 7 STATIC WATER-LEVEL MEASUREMENT SUMMARY
OU 10 FEASIBILITY STUDY
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

Monitoring Well Number	August 7, 1995			October 17, 1995			April 12, 2005		
	Depth to Water Table(1) (feet)	Top of PVC Riser(2)	Elevation of Water Table(2)	Depth to Water Table(1)	Top of PVC Riser(2)	Elevation of Water Table(2)	Depth to Water Table(1) (feet)	Top of PVC Riser	Elevation of Water Table(2)
MW7-01	18.75	148.61	129.86	21.31	148.61	127.30	12.76	148.61	135.85
MW7-02	9.88	126.94	117.06	11.81	126.94	115.13	2.16	126.94	124.78
MW7-03	23.31	163.01	139.70	25.57	163.01	137.44	17.98	163.01	145.03
MW7-04	17.77	132.77	115.00	20.74	132.77	112.03	8.65	132.77	124.12
MW7-05	14.81	136.10	121.29	16.93	136.10	119.17	7.69	136.10	128.41

(1) In feet below top of riser.
(2) In feet above mean sea level.

TABLE 1-2
OCCURRENCE AND DISTRIBUTION OF INORGANICS IN SURFACE SOIL
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE		BACKGROUND[1]		SITE-RELATED	
		FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	FREQUENCY OF DETECTION	07 SD WET 7-B2
INORGANICS					
aluminum	mg/kg	5 / 5	1710 - 5310	1 / 1	2770
arsenic	mg/kg	5 / 5	1.3 - 14.4	1 / 1	11.7
barium	mg/kg	5 / 5	1.6 - 31.0	1 / 1	8.6
calcium	mg/kg	5 / 5	39.3 - 519	1 / 1	568
chromium	mg/kg	5 / 5	7.4 - 59.5	1 / 1	13.2
copper	mg/kg	5 / 5	1.0 - 8.4	1 / 1	3.6
iron	mg/kg	5 / 5	3700 - 62500	1 / 1	10000
lead	mg/kg	5 / 5	1.8 - 39.4	1 / 1	19.6
magnesium	mg/kg	5 / 5	64.4 - 619	1 / 1	243
mangenese	mg/kg	5 / 5	3.1 - 214	1 / 1	38.1
potassium	mg/kg	5 / 5	69.0 - 792	1 / 1	332
sodium	mg/kg	5 / 5	17.1 - 86.2	1 / 1	28.7
vanadium	mg/kg	5 / 5	10.6 - 64.0	1 / 1	19.3
zinc	mg/kg	5 / 5	1.1 - 27.6	1 / 1	33.7

Notes:

Compound exceeds background concentration.

1 Background samples from BG SB 01-00, BG SG 02-00, BG SB 03-00, and BG SB 04-00. A duplicate sample was taken from BG SG 02-00.

J The identification of the analyte is acceptable; the reported value is an estimate.

NA Not analyzed.

TABLE 1-3
SUMMARY OF 1996 RI DETECTED COMPOUNDS IN GROUNDWATER COMPARED TO BACKGROUND AT SITE 7
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE		BACKGROUND[1]			SITE-RELATED			
		FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	07 GW 03	07 GW 01	07 GW 02	07 GW 04	07 GW 05
INORGANICS								
aluminum	ug/L	2 / 2	242 - 393	393	174	557 J	320	1850
barium	ug/L	2 / 2	42.2 - 50.2	42.2	11.9	24.2	26.8	112
beryllium	ug/L	1 / 2	0.40	0.40	0.11 U	0.11 U	0.11 U	0.66
calcium	ug/L	2 / 2	1460 - 5870	1460	916	1480	1050	1330
chromium, total	ug/L	1 / 2	14.8 - 14.8	1.0 U	1.0 U	1.0 U	1.9	1.0 U
cobalt	ug/L	2 / 2	8.4 - 28.2	28.2	1.6	0.85	1.0	6.9
copper	ug/L	NOT DETECTED	-	0.77 U	0.77 U	1.8	1.7	0.77 U
iron	ug/L	2 / 2	298 - 706	298	913	145	561	63.7
lead	ug/L	NOT DETECTED	-	1.5 UJ	2.3	1.5 U	1.5 U	1.5 UJ
magnesium	ug/L	2 / 2	1800 - 2120	2120	723	594	1990	6920
mangenese	ug/L	2 / 2	192 - 246	246	19.0	48.9	15.2	63.7
mercury	ug/L	1 / 2	0.047	0.0040 UJ	0.0050	0.033	0.017	0.34 J
nickel	ug/L	2 / 2	3.4 - 11.3	3.4	4.2	1.2	3.1	4.8
potassium	ug/L	2 / 2	714 - 2110	714	941	1400	1140	1950
sodium	ug/L	2 / 2	4710 - 7760	4710	4240	20600	7040	17800
thallium	ug/L	NOT DETECTED	-	3.6 U	4.0	3.6 U	3.6 U	3.6 U
vanadium	ug/L	1 / 2	1.4	0.61 U	0.83	0.61 U	0.71	0.61 U
zinc	ug/L	2 / 2	5.0 - 8.8	8.8	1.6 U	1.6 U	1.6 U	13.4
ORGANICS								
1,1,2-trichloroethane	ug/L	NOT DETECTED	-	10.0 U	10.0 U	10.0 U	10.0 U	1.0 J
1,2-dichloroethene (total)	ug/L	NOT DETECTED	-	10.0 U	10.0 U	10.0 U	10.0 U	4.0 J
benzene	ug/L	NOT DETECTED	-	10.0 U	10.0 U	1.0 J	10.0 U	10.0 U
chlorobenzene	ug/L	NOT DETECTED	-	10.0 U	10.0 U	11.0	10.0 U	10.0 U
chloroform	ug/L	NOT DETECTED	-	10.0 U	10.0 U	10.0 U	2.0 J	10.0 U
MISCELLANEIOUS PARAMETERS								
ammonia nitrogen	mg/L	NOT DETECTED	-	1.0 U	1.0 U	0.90 J	1.0 U	1.0 U
biochemical oxygen demand	mg/L	2 / 2	0.80 - 1.9	0.80 J	1.3 J	2.0	0.70 J	0.90 J
chemical oxygen demand	mg/L	2 / 2	4.0 - 5.0	5.0 J	2.0 J	28.0	11.0	4.0 J
chloride	mg/L	2 / 2	8.0 - 10.0	8.0	9.0	27.0	13.0	25.0
nitrate nitrogen	mg/L	2 / 2	1.3 - 1.6	1.3	0.50 U	0.15 J	0.50 U	0.50 U
sulfate	mg/L	2 / 2	9.0 - 10.0	10.0	7.0	25.0	13.0	44.0
total organic carbon	mg/L	2 / 2	0.8 - 0.8	0.80 J	1.0 U	9.0	0.90 J	2.0

Notes:

Compound exceeds background concentration.

1 Background wells include BG GW 03 and 07 GW 03.

J The identification of the analyte is acceptable; the reported value is an estimate.

U Analyte included in the analysis, but not detected at or above the quantitation limit.

UJ The analyte was not detected at or above the quantitation limit. The quantitation limit is an estimate.

TABLE 1-4
SUMMARY OF 1996 RI DETECTED COMPOUNDS IN SURFACE WATER COMPARED TO BACKGROUND AT SITE 7
NWS EARLE, COLTS NECK, NEW JERSEY

SUBSTANCE		BACKGROUND[1]		SITE-RELATED	
		FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	WS SW 07	
INORGANICS					
aluminum	ug/L	3 / 3	265 - 384	516	J
barium	ug/L	3 / 3	16.3 - 34.0	25.4	
beryllium	ug/L	2 / 3	0.22 - 0.33	0.25	
calcium	ug/L	3 / 3	462 - 10100	1440	
cobalt	ug/L	3 / 3	0.81 - 1.9	1.1	
copper	ug/L	2 / 3	1.1 - 9.8	0.83	
iron	ug/L	3 / 3	160 - 702	815	
lead	ug/L	1 / 3	4.4	1.2	
magnesium	ug/L	3 / 3	369 - 2770	713	
manganese	ug/L	3 / 3	14.0 - 55.5	35.4	R
mercury	ug/L	2 / 3	0.023 - 0.028	0.030	
nickel	ug/L	3 / 3	2.1 - 7.1	1.8	
potassium	ug/L	2 / 3	251 - 1850	724	
sodium	ug/L	R		4870	J
zinc	ug/L	3 / 3	7.6 - 29.4	22.4	J
MISCELLANEIOUS PARAMETERS					
biochemical oxygen demand	mg/L	3 / 3	1.90 - 3.0	0.90	
chemical oxygen demand	mg/L	3 / 3	4.0 - 29.0	20.0	
total hardness	mg/L	3 / 3	4.0 - 38.0	10.0	
total organic carbon	mg/L	3 / 3	0.40 - 9	7.0	J
turbidity	ntu	3 / 3	0.70 1.8	0.90	

Notes:

Compound exceeds background concentration.

1 Background samples from BG SW 01, BG SW 02, and BG SW 04.

J The identification of the analyte is acceptable; the reported value is an estimate.

R Positive result is considered rejected based on exceedance of data validation quality control criteria.

TABLE 1-5
APRIL 2005 DATA SUMMARY OF INORGANIC AND ORGANIC ANALYTICAL RESULTS
NWS EARLE SITE 7 - GROUNDWATER SAMPLES
NWS EARLE, COLTS NECK, NEW JERSEY

Sample ID:	NJDEP GQS[1]	MCL[2]	MW7-01		DUP-01		MW7-02		MW7-03		MW7-04		MW7-05	
Sample Date:			04/12/05		04/12/05		04/12/05		04/12/05		04/12/05		04/12/05	
Duplicate:			DUP-01		MW7-01									
			RESULT		RESULT		RESULT		RESULT		RESULT		RESULT	
INORGANICS	ug/L	ug/L	ug/L		ug/L		ug/L		ug/L		ug/L		ug/L	
Aluminum	200	NA	105	U	121	U	503	U	302	U	114	U	1710	
Iron	300	NA	414	U	507	U	340	U	117	U	655		965	
Manganese	50	NA	16	U	17.4	U	118		914		12.3	U	38.8	L
Thallium	0.5	2	2	U	2	U	2	U	2	U	2	U	2	U
VOLATILES	ug/L	ug/L	ug/L		ug/L		ug/L		ug/L		ug/L		ug/L	
1,1,2-Trichloroethane	3	5	1	U	1	U	1	U	1	U	1	U	1	U
Benzene	0.2	5	1	U	1	U	1	U	1	U	1	U	1	U
Chlorobenzene	50	100	1	U	1	U	4.4		1	U	1	U	1	U
Chloroform	6	NA	1	U	1	U	1	U	1	U	0.72	J	1	U

Data Qualifiers:
J -- Value is considered estimated due to exceedance of technical quality control criteria or because result is less than the Contract Required Quantitation Limit (CRQL).
U -- Value is a non-detected result as reported by the laboratory.

[1] Values from the NJDEP Ground Water Quality Standards (GQS) Table 1 and Interim Specific Criteria.
[2] Values from the EPA List of Drinking Water Contaminants & Maximum Contaminant Levels (MCLs), July 2002.

Database source file: H:\EARLE\SITE 7\T2358\T2358\T2358.DBF data retrieved on: 05/12/05

Note: Shading denotes concentrations that exceed GQS or MCL.

TABLE 1-6
BACKGROUND MONITORING WELL CHARACTERISTICS SUMMARY
OPERABLE UNIT 10 FEASIBILITY STUDY
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

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

Note: All wells are constructed of 2 inch internal diameter Schedule 40 polyvinyl chloride (PVC) well casing.
bgs = below ground surface.
msl = mean sea level.

TABLE 1-7
BACKGROUND STATIC WATER LEVEL MEASUREMENT SUMMARY
OPERABLE UNIT 10 FEASIBILITY STUDY
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

Monitoring Well Number	August 7, 1995			October 17, 1995		
	Depth to Water Table(in feet below top of riser)	Top of PVC Riser (in feet above msl)	Elevation of Water Table (in feet above msl)	Depth to Water Table (in feet above msl)	Top of PVC Riser (in feet above msl)	Elevation of Water Table (in feet above msl)
BGMW-01	21.937	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

msl = mean sea level

TABLE 1-8

BACKGROUND WELLS AND UPGRADIENT WELLS GROUPED BY INTERPRETED AQUIFER
OU 10 FEASIBILITY STUDY
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

Geologic Unit of Screened Interval	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, (B&R Environmental, 1996)

TABLE 1-9
STATISTICAL EVALUATION OF BACKGROUND GROUNDWATER METALS DATA
RED BANK SAND AND NAVESINK FORMATIONS
OU 10 FEASIBILITY STUDY
NAVAL WEAPONS STATION 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 1-10
SITE 7 - OCCURRENCE AND DISTRIBUTION OF INORGANICS IN SEDIMENT
NWS EARLE, COLTS NECK, NEW JERSEY
(mg/kg)

	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	3 / 3	839 - 3940	5492.67	1 / 1	2770	2770.00	NO	2770
ARSENIC*	2 / 3	2.4 - 6.2	5.95	1 / 1	11.7	11.70	YES	11.7
BARIUM	3 / 3	3.9 - 10.6	14.07	1 / 1	8.6	8.60	NO	8.6
CALCIUM	3 / 3	179 - 518	685.33	1 / 1	568	568.00	NO	568
CHROMIUM	3 / 3	4.3 - 56	43.13	1 / 1	13.2	13.20	NO	13.2
COPPER	3 / 3	1.5 - 13	12.47	1 / 1	3.6	3.60	NO	3.6
IRON	3 / 3	228 - 7650	6578.67	1 / 1	9950	9950.00	YES	9950
LEAD	3 / 3	4.6 - 34.3	30.60	1 / 1	19.6	19.60	NO	19.6
MAGNESIUM	3 / 3	60.7 - 256	306.47	1 / 1	243	243.00	NO	243
MANGANESE*	3 / 3	4.6 - 9.2	13.80	1 / 1	38.1	38.10	YES	38.1
POTASSIUM	2 / 3	86.1 - 681	589.40	1 / 1	332	332.00	NO	332
SODIUM	3 / 3	26.6 - 116	115.27	1 / 1	28.7	28.70	NO	28.7
VANADIUM	3 / 3	5.9 - 42.7	36.93	1 / 1	19.3	19.30	NO	19.3
ZINC*	3 / 3	14.2 - 26.9	37.33	1 / 1	33.7	33.70	NO	33.7

Note:
* - Selected as a COPC

TABLE 1-11
SITE 7 - OCCURRENCE AND DISTRIBUTION OF SUBSTANCES IN GROUNDWATER
NWS EARLE, COLTS NECK, NEW JERSEY
(ug/L)

	BACKGROUND		SITE-RELATED		
SUBSTANCE	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	AVERAGE CONCENTRATION
INORGANICS					
ALUMINUM	2 / 3	242 - 393	5/8	174 - 1850	622
BARIUM	2 / 2	42.2 - 50.2	4/4	11.9 - 112	43.7
BERYLLIUM	1 / 2	0.4	1/4	0.66	0.206
CALCIUM	2 / 2	1460 - 5870	4/4	916 - 1480	1190
CHROMIUM	1 / 2	14.8	1/4	1.9	0.839
COBALT	2 / 2	8.4 - 28.2	4/4	0.85 - 6.9	2.59
COPPER	0 / 2	-	2/4	1.7 - 1.8	1.07
IRON	2 / 3	298 - 706	6/8	63.7 - 965	463
LEAD	0 / 2	-	1/4	2.3	1.14
MAGNESIUM	2 / 2	1800 - 2120	4/4	594 - 6920	2560
MANGANESE	3 / 3	192 - 914	6/8	15.2 - 118	39.8
MERCURY	1 / 2	0.047	4/4	0.005 - 0.34	0.0988
NICKEL	2 / 2	3.4 - 11.3	4/4	1.2 - 4.8	3.33
POTASSIUM	2 / 2	714 - 2110	4/4	941 - 1950	1360
SODIUM	2 / 2	4710 - 7760	4/4	4240 - 20600	12400
THALLIUM	0 / 3	-	1/8	4	1.6
VANADIUM	1 / 2	1.4	2/4	0.71 - 0.83	0.538
ZINC	2 / 2	5 - 8.8	1/4	13.4	3.95
ORGANICS					
1,1,2-TRICHLOROETHANE	0 / 3	-	1/8	1	1
1,2-DICHLOROETHENE (TOTAL)	0 / 2	-	1/4	4	4
BENZENE	0 / 3	-	1/8	1	1
CHLOROBENZENE	0 / 3	-	2/8	4.4 - 11	7.7
CHLOROFORM	0 / 3	-	2/8	0.72 - 2	1.36

TABLE 1-12

ECOLOGICAL SCREENING TABLE - SURFACE SOIL
NAVAL WEAPONS STATION EARLE, NEW JERSEY

Chemical	Sample ID # 07SDWET7-B2	Ecological Soil Screening Levels			
		Plants	Soil Invertebrates	Wildlife	
				Avian	Mammal
Aluminum	2770	NA(1)	NA(1)	NA(1)	NA(1)
Arsenic	11.7	18	NA	43	46
Barium	8.6	NA	330	NA	2,000
Chromium	13.2	NA	NA	III-26	III-34
				VI-NA	VI-81
Copper	3.6	70	80	28	49
Iron	10000	NA(2)	NA	NA	NA
Lead	19.6	120	1,700	11	56
Manganese	38.1	220	450	4300	4000
Vanadium	19.3	NA	NA	7.8	280
Zinc	33.7	160	120	46	79

Units are mg/kg
NA Not available; data were insufficient to derive an Eco-SSL.
(1) - Aluminum is considered a COPC only when the soil pH is less than 5.5.
(2) - Iron is not expected to be toxic to plants with a soil pH between 5 and 8.

Eco-SSL documents are available on-line at http://www.epa.gov/ecotox/ecossl/.
- cells are shaded if the screening criteria is exceeded

TABLE 2-1
POTENTIAL FEDERAL CHEMICAL-SPECIFIC ARARs AND TBCs
OPERABLE UNIT 10 FEASIBILITY STUDY
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION IN THE FS
Safe Drinking Water Act (SDWA) - Maximum Contaminant Levels (MCLs) [40 Code of Federal Regulations (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 10 site. MCLs can also be used to derive potential soil clean-up levels. Soil to groundwater screening levels (SSLs) provide a protective model for predicting the threshold soil concentrations that could leach to generate groundwater concentrations in excess of standards such as MCLs. A current SSL calculator based on MCLs is found on the EPA website: http://rais.ornl.gov/calc-start.shtml. SSLs require a site-specific or generic Dilution Attenuation Factor (DAF) which is estimated according to EPA guidance (EPA, 1996 and 2002).
Resource Conservation and Recovery Act (RCRA) - Groundwater Protection Standard (40 CFR 264.94)	Potentially Relevant and Appropriate	The RCRA Groundwater Protection Standard is established for groundwater monitoring of RCRA-permitted treatment, storage, or disposal facilities. The standard is set at either an existing or proposed RCRA MCL, background concentration, or an alternate concentration limit (ACL) protective of human health and the environment.	RCRA MCLs may be used or ACLs may be developed to identify levels of contamination in the aquifer above which human health and the environment are at risk and to provide an indicator when corrective action is necessary.
RCRA Land Disposal Restrictions (40 CFR 268)	Potentially Applicable	These regulations identify hazardous wastes that are restricted from land disposal and establish waste analysis and recordkeeping requirements and "treatment standards" (concentration levels or methods of treatment) that wastes must meet in order to be eligible for land disposal.	Contaminated soil must be analyzed and disposed in accordance with the requirements of these regulations. If necessary, soils will be treated to attain applicable "treatment standards" prior to placement in a landfill or other land disposal facility. This requirement would be considered for alternatives involving land disposal.
Clean Water Act - Aquatic 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.	AWQCs may be used to assess the need for remediation of discharges to surface water or to use as benchmarks during long-term monitoring.
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.

TABLE 2-1
POTENTIAL FEDERAL CHEMICAL-SPECIFIC ARARs AND TBCs
OPERABLE UNIT 10 FEASIBILITY STUDY
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION IN THE FS
Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities (OSWER Directive No. 9355.4-12) (July 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. For industrial land use, a soil lead screening value of 800 mg/kg is recommended by EPA, from the EPA website: http://www.epa.gov/superfund/lead/almfaq.htm. This value is based on a recent analysis of the National Health and Nutrition Examination Survey (NHANES III).	If the OU 10 site is to be considered for eventual residential use, then the screening value may be used to assess whether site-specific lead levels require further evaluation and possible remediation.
EPA Groundwater Protection Strategy	To Be Considered	Provides classification and restoration goals for groundwater based on its vulnerability, use, and value.	This strategy is considered in conjunction with the SDWA and GQS to determine groundwater clean-up levels.
EPA Risk 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 are 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 are used to assess health risks from carcinogens present at the site. These factors may also be used in the development of acceptable contaminant concentrations.
EPA Region 3 Risk-Based Concentrations (RBCs) (October 2007 revision)	To Be Considered	RBCs are screening levels calculated for a Target Hazard Index of 1.0 for noncarcinogenic effects and a Target Risk of 1E-6 for carcinogenic effects.	TBC for groundwater that may be used for selecting contaminants for risk assessment and/or fate and transport modeling.
EPA Drinking Water Standards and Health Advisories (Summer 2006)	To Be Considered	Intended for use in qualitative human health evaluation of remedial alternatives.	These advisories and health assessment documents are used in assessing health risks from contaminants present at the site.
Clean Air Act - Standards for Air Emissions from Municipal Solid Waste Landfills (40 CFR 60.752 and 60.753)	Potentially Relevant and Appropriate	Active landfills with design capacities equal to or greater than 2.5 million cubic meters are required to have landfill gas collection and control systems if greater than 50 megagrams of non-methane organic compounds are expected to be emitted. The collection system shall be operated so that the methane concentration is less than 500 ppm above background at the surface of the landfill.	The Site 7 landfill is estimated to be much less than 2 million cubic feet in capacity. However, soil gas studies and measurement of methane concentrations at the landfill surfaces need to be conducted during the pre-design phase to determine whether landfill gas controls need to be included as part of the control systems.

TABLE 2-2
POTENTIAL STATE CHEMICAL-SPECIFIC ARARs AND TBCs
OPERABLE UNIT 10 FEASIBILITY STUDY
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION IN THE FS
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 GQC [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 discharges to groundwater that subsequently discharges to surface water that do not comply with the New Jersey Surface Water Quality Standards (SWQSs).	Because contaminated groundwater is present underneath the OU 10 site in excess of GQSs, these regulations will be considered in determining groundwater action levels. Application for CEA may be required if GQSs 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.
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 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 SWQCs are attained in the long term. Remedial alternatives shall consider action to mitigate the continued contamination of surface waters.
New Jersey Safe Drinking Water SDWA (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. MCLs have been established to regulate the concentrations 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 10 site. MCLs can be used to derive potential soil clean-up levels.
New Jersey Soil Cleanup Criteria (1999)	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
OPERABLE UNIT 10 FEASIBILITY STUDY
NAVAL WEAPONS 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.	There are no significant wetlands within or adjacent to OU10. If the small, marginal wetland located at OU10 is considered valuable, wetlands protection 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.
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 United States (USC) 1531 et seq.]; (50 CFR Part 200)	Potentially Applicable, if present	Actions shall be taken to conserve endangered or threatened species or to protect critical habitats. Consultation with the Department of the Interior is required.	The RI determined that there were no sensitive habitats (except for marsh and wetlands) or endangered or threatened species present at the OU 10 site.
Fish and Wildlife Coordination Act Of 1958 (16 USC 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 Fish and Wildlife Service, NJDEP, and EPA will be consulted.
National Historic Preservation Act of 1966 Section 106 (16 USC 470 et. seq.)	Potentially Applicable, if present	Action will be taken to recover and 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). To date, no such artifacts have been encountered at OU 10.
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 archaeological 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). To date, no such artifacts have been encountered at OU 10.

TABLE 2-4
POTENTIAL STATE LOCATION-SPECIFIC ARARs AND TBCs
OPERABLE UNIT 10 FEASIBILITY STUDY
NAVAL WEAPONS 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 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.	There are no significant wetlands within or adjacent to OU10. If the small, marginal wetland located at OU10 is considered valuable, wetlands protection will be incorporated into the planning, decision making, and implementation of remedial alternatives.
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 the area or donations to the Mitigation Bank of equal ecological value.	There are no significant wetlands within or adjacent to OU10. If the small, marginal wetland located at OU10 is considered valuable, wetlands protection will be incorporated into the planning, decision making, and implementation of remedial alternatives.
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 alternatives that may adversely affect floodplains at NWS Earle. OU10 is located in a topographically elevated location, not within or adjacent to a floodplain.
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 OU 10. However, if remedial alternatives employ an on-site or on-base treatment scheme, remediation activities will need to be consistent with these requirements.

TABLE 2-5
POTENTIAL FEDERAL ACTION-SPECIFIC ARARs AND TBCs
OPERABLE UNIT 10 FEASIBILITY STUDY
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION IN THE FS
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, record keeping, 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), this regulation will be considered. This regulation specifies transportation, storage and disposal (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, 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, 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 record keeping and reporting requirements for RCRA facilities.	If the alternative includes treatment, storage, or disposal of hazardous wastes, records of facility activities will be developed and maintained during remedial actions.
RCRA - Closure and Post-Closure (40 CFR 258, Subpart F)	Potentially Relevant and Appropriate	Details specific requirements for closure and post-closure of municipal solid waste landfills. Final cover requirements that address minimizing infiltration and erosion are identified in this regulation. Following closure, post-closure requirements include preparing a post-closure plan, maintaining integrity and effectiveness of the final cover, groundwater monitoring, and maintaining and operating a gas collection system.	If an alternative includes closure of a solid waste landfill, then these requirements will be considered in formulating the alternative.

TABLE 2-5
POTENTIAL FEDERAL ACTION-SPECIFIC ARARs AND TBCs
OU 10 FEASIBILITY STUDY
NAVAL WEAPONS 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 off-gases 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 that have a total organics concentration of 10 ppm or greater.	These standards will be considered during the development and design of alternatives that include treatment of VOC-contaminated soils. Air emissions from treatment units will be monitored to ensure compliance with this ARAR.
OSWER Directive 9355.0-62FS Application of the CERCLA Municipal Landfill Presumptive Remedy to Military Landfills (Interim Guidance) (April 1996)	To Be Considered	This EPA directive provides guidance in evaluating military landfill sites and determining whether presumptive remedies can be applied.	The procedures and suggested remedial actions will be considered in formulating remedial alternatives for Site 7.
OSWER Directive 9355.0-49FS Presumptive Remedy for CERCLA Municipal Landfill Sites (September 1993)	To Be Considered	This EPA directive provides guidance in evaluating CERCLA municipal landfill sites and determining if presumptive remedies can be applied.	The procedures and suggested remedial actions will be considered in formulating remedial alternatives for Site 7.

TABLE 2-6
POTENTIAL STATE ACTION-SPECIFIC ARARs AND TBCs
OPERABLE UNIT 10 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, this regulation will be complied with during implementation.
New Jersey Closure and Post-Closure Care of Sanitary Landfills Regulations (N.J.A.C. 7:26-2A.9)	Potentially Relevant and Appropriate	Detail specific requirements for closure and post-closure of municipal solid waste landfills. Final cover requirements that address minimizing infiltration and erosion are identified in these regulations. Following closure, post-closure requirements include preparing a post-closure plan, maintaining integrity and effectiveness of final cover, groundwater monitoring, and maintaining and operating a gas collection system.	If an alternative includes closure of a solid waste landfill, these requirements will be considered in formulating the alternative.
New Jersey Thermal Treatment Regulations (N.J.A.C. 7:26-11.6)	Potentially Applicable	These regulations detail operating requirements, waste analyses and monitoring of treatment conditions, performance standards, and closure of existing facilities that thermally treat hazardous wastes.	Alternatives that include thermal treatment of contaminated soils, sediments, and materials would be designed and operated 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 soils, sediments, and materials would be designed and operated consistent with this regulation.
New Jersey Control and Prohibition of Air Pollution by Toxic Substances (N.J.A.C. 7:27-17)	Potentially Applicable if emissions greater than 45.4 g/hr(0.1 lb/hr)	These regulations govern the emission of Group I and Group II toxic volatile organic compounds (TXS) to the ambient air. Group I TXS would be addressed through adequate stack height or prevention of aerodynamic downwash. Group II TXS would be addressed through reasonably available control technology.	Alternatives that may result in the release of Group I or Group II TXS to the ambient air at concentrations exceeding 0.1 lb/hr would incorporate appropriate vapor control measures to comply with these requirements.

TABLE 2-7
SITE 7 GROUNDWATER CONTAMINANTS OF POTENTIAL CONCERN (COPCs)
OPERABLE UNIT 10 FEASIBILITY STUDY
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

Contaminant of Concern	Detected 1995 and 2005	Exceeds NJ GQS	Exceeds SDWA MCL	Exceeds Background Level
Aluminum	X	X	---(1)	X
Iron	X	X	---(1)	X
Manganese	X	X	---(1)	---
Chlorobenzene	X	---	---(1)	X
Chloroform	X	---	---(2)	X

Notes: GQS are ARARs.
MCLs regulate organic and inorganic constituents in public drinking water supplies and are included for comparison purposes.
X Indicates the basis for selection of the compound or element as a COC.
--- Indicates there was no exceedance or compound was not detected at a level exceeding EPA Region 3 Risk Based Concentration (RBC) for tap water (EPA, October 2007).
1. No MCL for this analyte.
2. 1998 Final Rule for Disinfectants and Disinfection By-products; the total for trihalomethanes (THM) is 0.08 mg/L.

TABLE 2-8
SITE 7 GROUNDWATER COPCs PRELIMINARY REMEDIATION GOALS (µg/L)
OPERABLE UNIT 10 FEASIBILITY STUDY
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

Contaminant of Potential Concern	Maximum Detected Site Concentration and Location	Maximum Background Concentration and Location	SDWA MCL	NJDEP GWQS	Risk-Based Concentration
Aluminum	1850 (MW7-05)	393 (MW7-03)	None	(1)	7800(2)
Iron	965 (MW7-05)	706 (BGGW03)	None	(1)	5500(2)
Manganese	118 (MW7-02)	914 (MW7-03)	None	(1)	160(2)
Chlorobenzene	11 (MW7-02)	ND	100	50	160(2)
Chloroform	2.0J (MW7-04)	ND	80(3)	70	190(4)

Notes:

SDWA MCLs are promulgated federal standards for public water supplies.

(1) NJDEP GWQS for Aluminum (200 ug/L), Iron (300 ug/L) and Manganese (50 ug/L) are not risk-based.

(2) Risk-based concentration for child resident – tap water ingestion exposure scenario based on noncarcinogenic risk HI<1.0 and carcinogenic risk less than or equal to $1X10^{-4}$ (See Appendix A for assumptions and calculations).

(3) 1998 Final Rule for Disinfectants and Disinfection By-products; the total for trihalomethanes (THM) is 0.08 mg/L.

(4) Risk-based concentration for adult resident – daily showering exposure scenario based on carcinogenic risk less than or equal to $1X10^{-4}$ (See Appendix A for assumptions and calculations).

TABLE 2-9
SITE 7 REMEDIAL ACTION OBJECTIVES, GENERAL RESPONSE ACTIONS, TECHNOLOGY TYPES, AND PROCESS OPTIONS
OPERABLE UNIT 10 FEASIBILITY STUDY
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

Environmental Medium	Remedial Action Objectives (from site characterization)	General Response Action (for all RAOs)	Remedial Technology Type (for general response actions)	Process Options
Landfill Materials	**Presumptive Remedy** Prevent human exposure to landfill materials.	No Action	No Action	- Not Applicable
		Limited Action	Institutional Controls	- Land use restrictions - Local ordinances
			Access Restrictions	- Fencing
			Monitoring	- Monitoring of groundwater to assess contaminant status
		Containment	Surface Controls	- Grading - Revegetation
			Cap	- Soil cover - Single barrier - Double barrier
		Removal and Disposal	Excavation	- Mechanical excavation
			Disposal On Site	- Consolidation into existing landfill - New landfill
			Disposal Off Site	- RCRA Landfill
Groundwater	**Protection of Human Health** Prevent human exposure to metal contaminants in groundwater.	No Action	No Action	- Not applicable
		Limited Action	Limited Action Technologies - LUCs - Long-Term Monitoring	- Groundwater monitoring - Implement classification exception area

TABLE 2-10
PRELIMINARY SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS FOR SITE 7 LANDFILL MATERIALS
OPERABLE UNIT 10 FEASIBILITY STUDY
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

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

TABLE 2-10
PRELIMINARY SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS FOR SITE 7 LANDFILL MATERIALS
OU 10 FEASIBILITY STUDY
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	DESCRIPTION	SCREENING COMMENTS
Containment (continued)	Cap	Soil (Permeable) Cover	Soil with a vegetative cover to prevent direct contact and minimize erosion and surface migration of contaminated soils. The soil cover was thin during the 1993 RI investigation.	Potentially viable if direct contact and erosion are the prime threats. Offers little additional groundwater protection. Retained.
		Single Barrier	Cap over the site constructed with one low-permeability layer (clay or synthetic membrane) to prevent direct contact, to minimize erosion, and to reduce leaching of contaminants from the landfill into groundwater. Additional layers would be required to protect the barrier.	Potentially viable to prevent direct contact and to reduce erosion and infiltration. Effective in eliminating leachate generation and impact to groundwater. Retained.
		Composite (Double) Barrier	Multi-media cap with two low-permeability layers (clay and/or synthetic membranes) constructed over the site to prevent direct contact and to reduce leaching of landfill contaminants into groundwater. Provides greater reduction in infiltration and better protection against failure than a single-barrier cap.	Potentially viable to prevent direct contact and to reduce erosion and infiltration. Offers little additional protection over single barrier cap. Eliminated.
Removal and Disposal	Excavation	Mechanical Excavation	Mechanical removal of solid materials using common construction equipment such as bulldozers, excavators, and front-end loaders.	Retained for combination with other technologies. Retained.
		Drum Removal	Removal of buried drums or containers using mechanical equipment such as a drum grappler, drum cradle, sling attached to a backhoe, or front-end loader.	Potentially viable if drums or containers are encountered during remediation; however, presence of drums at Site 7 has not been indicated. Eliminated.

TABLE 2-10
PRELIMINARY SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS FOR SITE 7 LANDFILL MATERIALS
OU 10 FEASIBILITY STUDY
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	DESCRIPTION	SCREENING COMMENTS
Removal and Disposal (continued)	Disposal Off Base	RCRA Subtitle C or Subtitle D Landfill	Transport and disposal of excavated materials in a RCRA-permitted landfill.	Somewhat difficult to implement due to quantity of material. Most effective at preventing exposure to landfilled materials. Retained for combination with other technologies. Retained.
	Disposal On Site	New RCRA-Type Landfill	Disposal of untreated bulk landfill materials in a specially constructed on-base landfill.	Somewhat difficult to implement due to quantity of material. Same effectiveness at preventing exposure to landfilled materials as off-site disposal. Permitting may be difficult and expensive. Eliminated.
		Consolidation (into existing landfill)	Relocation of landfill materials into another on-base landfill. Or relocation of small isolated quantities of contaminated materials into an existing on-base landfill so that one closure action can accommodate both.	Somewhat difficult to implement due to quantity of material. Regulatory approval to consolidate may be difficult to obtain. Eliminated. Offers little additional protection. Eliminated.

TABLE 2-11
PRELIMINARY SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS
FOR SITE 7 CONTAMINATED GROUNDWATER
OPERABLE UNIT 10 FEASIBILITY STUDY
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	DESCRIPTION	SCREENING COMMENTS
No Action	No Action	No Action	No active remediation would be conducted to address contamination.	Retained for baseline comparison purposes, in accordance with NCP.
Limited Action	Institutional Controls	Land Use Restrictions	Administrative action used to restrict future activities on base properties. Installation of drinking water wells without treatment would be prohibited.	Potentially applicable. Retained.
	Long-Term Monitoring	Groundwater Monitoring	Periodic sampling and analysis to assess groundwater contaminant status and potential migration downgradient.	Potentially applicable. Retained.

TABLE 2-12
DETAILED EVALUATION OF TECHNOLOGIES AND PROCESS OPTIONS FOR SITE 7 LANDFILL MATERIALS
OPERABLE UNIT 10 FEASIBILITY STUDY
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	FFECTIVENESS	IMPLEMENTABILITY	COST	CONCLUSION
No Action	No Action	No Action	Would not achieve remedial action objectives.	Implementable.	Capital: None O & M: None	Retained.
Limited Action	Institutional Controls	Land Use Restrictions	Effectiveness dependent on continued future enforcement to prevent use of underlying groundwater or use of landfill for development. No contaminant reduction anticipated.	Can be added to Base Master Plan and is implementable.	Capital: Low O & M: Low	Retained.
	Access Restrictions	Fencing	Would limit access to existing cover soils. No contamination reduction.	Readily implementable; numerous companies available to perform construction.	Capital: Low O & M: Low	Retained.
	Monitoring	Groundwater Monitoring	Would allow assessment of landfill contaminant status and leaching and migration in groundwater. Would enable action to be taken to reduce continuing groundwater contamination. No contaminant reduction.	Readily implementable; numerous companies with personnel and equipment to perform sampling.	Capital: Low O & M: Low	Retained.
Containment	Surface Controls	Grading	Would manage precipitation infiltration and surface runoff.	Implementable, numerous companies with personnel and heavy equipment to perform earth moving and grading.	Capital: Low O & M: None	Retained.

TABLE 2-12
DETAILED EVALUATION OF TECHNOLOGIES AND PROCESS OPTIONS FOR SITE 7 LANDFILL MATERIALS
OU 10 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE
COLTS NECK, NEW JERSEY
PAGE 2 OF 3

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	EFFECTIVENESS	IMPLEMENTABILITY	COST	CONCLUSION
Containment (continued)	Surface Controls	Revegetation	Would minimize erosion and promote evapotranspiration of precipitation, thus reducing infiltration.	Implementable; numerous companies with personnel and equipment available to perform revegetation.	Capital: Low O & M: Low	Retained.
	Cap	Soil (Permeable) Cover	Would prevent direct exposure to site soils. Would reduce precipitation infiltration, leaching, and erosion to adjacent lowlands.	Implementable using standard methods and readily available equipment.	Capital: Low O & M: Low	Retained.
		Single Barrier	Would limit infiltration and significantly reduce contaminant leaching to groundwater. Would prevent exposure to contaminated soils and surface migration of contaminated soils. Would reduce mobility of contaminants in waste.	Implementable by standard construction techniques; would require specialized but readily available equipment and materials to install synthetic cap.	Capital: Moderate O & M: Low	Retained.
		Composite (Double) Barrier	Same as single barrier. Second impermeable barrier would provide greater assurance against cover failure. Level of protection offered by composite barrier cap not required at Site 7 because groundwater contamination is low and groundwater is not used.	Implementable by standard construction; would require specialized equipment and materials to install double barrier cap. More care required to install than soil cover or single barrier.	Capital: High O & M: Low	Eliminated.

TABLE 2-12
DETAILED EVALUATION OF TECHNOLOGIES AND PROCESS OPTIONS FOR SITE 7 LANDFILL MATERIALS
OU 10 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE
COLTS NECK, NEW JERSEY

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	EFFECTIVENESS	IMPLEMENTABILITY	COST	CONCLUSIONS
Removal and Disposal	Excavation	Mechanical Excavation	Effective method for removing highly contaminated soils and hot spots, if encountered during remediation. There has been no indication of hotspots at Site 7, landfill contents are assumed to be homogeneous.	Implementable with standard construction equipment. Equipment and resources are readily available from various contractors.	Capital: Low O & M: None	Retained.
		Drum Removal	Effective for drum removal, if encountered during remediation. There has been no indication of drums or containers at Site 7.	Equipment and resources are readily available from various contractors.	Capital: Low O & M: None	Eliminated.
	Disposal Off-Base	RCRA Landfill	Effectively controls release of contaminants to environment. Would probably handle volume.	Implementable. Commercial landfill facilities are available. Implementation becomes more difficult if excavated materials require segregation or treatment prior to disposal.	Capital: Moderate O & M: None	Retained.
	Disposal On-Base	Consolidation	Allows small volumes of material from other isolated locations to be consolidated and addressed with the majority of landfill materials.	Readily implementable for small or moderate soil volumes. No implementability concerns. Some regulatory approval concerns.	Capital: Low O & M: Low	Eliminated.

TABLE 2-13
DETAILED EVALUATION OF TECHNOLOGIES AND PROCESS OPTIONS FOR SITE 7 CONTAMINATED GROUNDWATER
OPERABLE UNIT 10 FEASIBILITY STUDY
NAVAL WEAPONS STATION EARLE, COLTS NECK, NEW JERSEY

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	EFFECTIVENESS	IMPLEMENTABILITY	COST	RETAINED/ ELIMINATED
No Action	No Action	No Action	Does not achieve remedial action objectives.	Implementable	Capital: None O&M: None	Retained.
Limited Action	Institutional Controls	Land Use Restrictions	Effectiveness depends on future enforcement. Does not reduce contamination.	Can be added to Base Master Plan and is implementable.	Capital: Low O&M: Low	Retained.
	Long-Term Monitoring	Groundwater Monitoring	Effective method for observing contaminant extent and potential migration and for assessing effectiveness of remedial action.	Readily implementable; numerous companies available with resources to perform monitoring.	Capital: Low O&M: Low	Retained.

TABLE 3-1

SITE 7 - REMEDIAL ALTERNATIVE COMPONENTS
OPERABLE UNIT 10 FEASIBILITY STUDY
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

	ALTERNATIVE	KEY COMPONENTS OF ALTERNATIVE
1	No Action	• No actions would be taken • Five-year reviews
2	Limited Action	• Fencing • Land Use Controls (LUCs) (Base Master Plan site use restrictions, CEA*) • Long-term periodic groundwater monitoring • Five-year reviews
3	Surface Controls	• Soil cover, grading and revegetation • Fencing • LUCs (Base Master Plan site use restrictions, CEA*) • Long-term groundwater monitoring • Five-year reviews
4	Single Barrier Cap	• Single barrier synthetic cap • Grading and vegetation establishment • Fencing • LUCs (Base Master Plan site use restrictions, CEA*) • Long-term groundwater monitoring • Five-year reviews
5	Removal and Off-Site Disposal	• Excavation of waste materials and contaminated soil • Disposal in permitted facility • Site restoration

Notes:

*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 GWQS.

TABLE 3-2
SITE 7 - SCREENING OF REMEDIAL ALTERNATIVES
OPERABLE UNIT 10 FEASIBILITY STUDY
NAVY WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

	ALTERNATIVE	EFFECTIVENESS	IMPLEMENTABILITY	COST	COMMENTS
1	No Action	Provides no additional protection of human health or the environment. Does not reduce potential for human exposure to groundwater contaminants or landfill contents. No reduction in toxicity, mobility, or volume of contaminants.	Readily implementable. No technical or administrative difficulties.	Capital: None O&M: None	Retained as baseline alternative, in accordance with NCP. Retained.
2	Limited Action (Institutional controls, access restrictions, long-term monitoring, five-year reviews)	Provides added protection of human health through fencing and institutional controls. Groundwater use and potential contact with landfill contents would be restricted. No reduction in toxicity, mobility, or volume of contaminants.	Readily implementable. No technical or administrative difficulties.	Capital: Low O&M: Low	Relative to Alt. 1 provides significant additional protectiveness for little additional cost. Retained.
3	Surface Controls (Grading and revegetation, access restrictions, long-term monitoring, five-year reviews)	Provides added erosion control of precipitation infiltration and surface runoff. Provides added protection of human health through additional soils at the surface, fencing, and institutional controls. Groundwater use would be restricted. No reduction in toxicity, mobility, or volume of contaminants.	Readily implementable. No technical or administrative difficulties.	Capital: Low O&M: Low	Relative to Alt. 2 provides little additional protectiveness for little additional cost. Retained.
4	Capping (Single Barrier Cap, Institutional controls access restrictions, long-term monitoring, five-year reviews)	Provides added erosion control of precipitation infiltration and surface runoff. Eliminates pathway for potential exposure of landfilled waste materials present at the surface. Use would be restricted. No reduction in toxicity, mobility, or volume of contaminants; cap eliminates infiltration and leachate generation resulting in reaction of contaminant mobility.	Readily implementable. Proven construction techniques. No technical or administrative difficulties.	Capital: Medium O&M: Low	Provides high level of additional protectiveness for minimal additional cost. Retained.
5	Removal and Off-Site Disposal (Excavation and disposal in RCRA Subtitle C or D, or municipal solid waste landfill).	Eliminates source of groundwater contaminants. Placement of waste materials in engineered TSD facility eliminates human health exposure.	Readily implementable. Equipment and experienced personnel are readily available.	Capital: Medium to High O&M: None	Provides most protection of human health and environment. Eliminates source of groundwater contaminants. Retained.

TABLE 5-1
SITE 7 - COMPARATIVE ANALYSIS OF REMEDIAL ACTION ALTERNATIVES
OPERABLE UNIT 10 FEASIBILITY STUDY
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

CRITERION:	ALTERNATIVE 1: NO ACTION	ALTERNATIVE 2: INSTITUTIONAL CONTROLS AND LONG-TERM MONITORING	ALTERNATIVE 3: SOIL COVER, INSTITUTIONAL CONTROLS, AND LONG-TERM MONITORING	ALTERNATIVE 4: SINGLE BARRIER CAP, INSTITUTIONAL CONTROLS AND LONG-TERM MONITORING	ALTERNATIVE 5: REMOVAL AND OFF-SITE DISPOSAL
OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT					
Prevent Human Exposure to Metal Contaminants in Groundwater	No action taken to prevent human exposure to contaminated groundwater. No institutional controls implemented to prohibit use of untreated groundwater.	Institutional controls would minimize potential exposure to landfill contents and site groundwater by prohibiting its use. In time, contaminants expected to decrease until reaching levels that would not pose excess risk. Land use controls would restrict site access.	Same as Alternative 2.	Cap system would prevent exposure to landfill contents and would significantly reduce impact of waste constituents on groundwater quality. Establishment of CEA would minimize potential exposure to groundwater by prohibiting its use. Land use controls would restrict site access.	Landfill contents would be removed from site and disposed in appropriate and permitted manner. Most protective of human health and environment as source of elevated metals in groundwater would be eliminated.
COMPLIANCE WITH ARARs					
Chemical-Specific ARARs	Would not comply with state groundwater quality standards.	A CEA would be established to provide the state official notification that standards would not be met for a specified duration.	Same as Alternative 2.	Same as Alternatives 2 and 3.	Source of elevated metals in groundwater would be eliminated.
Location-Specific ARARs	Not applicable.	Would comply with Federal and state ARARs for wetlands, floodplains, and other sensitive receptors.	Same as Alternative 2.	Same as Alternatives 2 and 3.	Landfill would no longer exist.
Action-Specific ARARs	Would not comply with state final cover system design. Would not meet any components of EPA presumptive remedy for military landfills.	Would not comply with state final cover system design. Long-term monitoring would provide data for five-year reviews and evaluation of risk.	Would not comply with state final cover system design; however soil cap would meet NJDEP soil remediation guidelines. Would not meet any components of EPA presumptive remedy for military landfills. Long-term monitoring would provide data for five-year reviews and evaluation of risk.	Would comply with NJDEP final cover system design. Would meet several components of EPA presumptive remedy for military landfills,	Landfill would no longer exist.
LONG-TERM EFFECTIVENESS AND PERMANENCE					
Magnitude of Residual Risk	Existing risks would remain: HI > 1 non-carcinogenic risk from exposure to site groundwater assuming future residential land use and consumption of contaminated groundwater.	Existing risks would remain: HI > 1 non-carcinogenic risk from exposure to site groundwater assuming future residential land use. Implementation and enforcement of institutional controls would block exposure to site groundwater. Fencing would reduce potential contact with landfill contents and shallow groundwater.	Same as Alternative 2. Additional cover would reduce potential contact with landfill materials, which may be close to the surface (thin cover), during site access (O&M).	Same as Alternative 2 and 3 except synthetic membrane more effective at reducing potential contact with landfill materials and eliminating infiltration and leachate generation.	Most effective and permanent.

TABLE 5-1
SITE 7 - COMPARATIVE ANALYSIS OF REMEDIAL ACTION ALTERNATIVES
OPERABLE UNIT 10 FEASIBILITY STUDY
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

CRITERION:	ALTERNATIVE 1: NO ACTION	ALTERNATIVE 2: INSTITUTIONAL CONTROLS AND LONG-TERM MONITORING	ALTERNATIVE 3: SOIL COVER, INSTITUTIONAL CONTROLS, AND LONG-TERM MONITORING	ALTERNATIVE 4: SINGLE BARRIER CAP, INSTITUTIONAL CONTROLS AND LONG-TERM MONITORING	ALTERNATIVE 5: REMOVAL AND OFF-SITE DISPOSAL
LONG-TERM EFFECTIVENESS AND PERMANENCE (Continued)					
Adequacy and Reliability of Controls	No new controls implemented. Existing site features provide limited controls.	If implemented and enforced, institutional controls could prevent contact with groundwater and landfill contents and the use of contaminated groundwater.	Same as Alternative 2.	Same as Alternatives 2 and 3.	No controls needed.
Need for Five-Year Review	Not applicable.	Review would be required because groundwater contaminants would be left in place.	Same as Alternative 2.	Same as Alternatives 2 and 3.	No review required.
REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT					
Reduction of Toxicity, Mobility, or Volume Through Treatment	No reduction, because no treatment would be employed.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1, though elimination of infiltration would decrease mobility of waste constituents.	No treatment would be employed however wastes would be recycled, placed in secure landfill, or incinerated (if appropriate).
SHORT-TERM EFFECTIVENESS					
Community Protection	No additional risk to community anticipated.	No significant risk to community anticipated. Engineering controls would be used during implementation to mitigate risks.	Same as Alternative 2.	Same as Alternatives 2 and 3.	Some short-term risk to community due to waste excavation and transport. Risks would be minimized through engineering controls and use of experienced firms and personnel.
Worker Protection	No risk to workers anticipated.	No significant risk to workers anticipated if proper PPE is used during well and fence installation and long-term monitoring.	Same as Alternative 2. PPE would also need to be used during surface control improvements.	Same as Alternative 3.	PPE and engineering controls would be used during waste excavation activities.
Environmental Impacts	No adverse impacts to the environment anticipated.	No adverse impacts to the environment anticipated.	Same as Alternative 2.	Same as Alternatives 2 and 3.	Same as Alternatives 2, 3, and 4.
Time Until Action is Complete	Not applicable.	Approximately 1 year to institute CEA.	Same as Alternative 2.	Approximately 18 months to design and implement cap construction and institute CEA.	Approximately 1 year to implement.
IMPLEMENTABILITY					
Ability to Construct and Operate	No construction or operation involved.	No difficulties anticipated. Monitoring well and fencing installation are readily implementable technologies.	No difficulties anticipated. Grading, revegetation, monitoring well, and fencing installation are readily implementable technologies.	No difficulties anticipated. Grading, revegetation, monitoring well, and fencing installation are readily implementable technologies.	No difficulties anticipated. Equipment and personnel readily available. Landfills available to accept waste quantity.

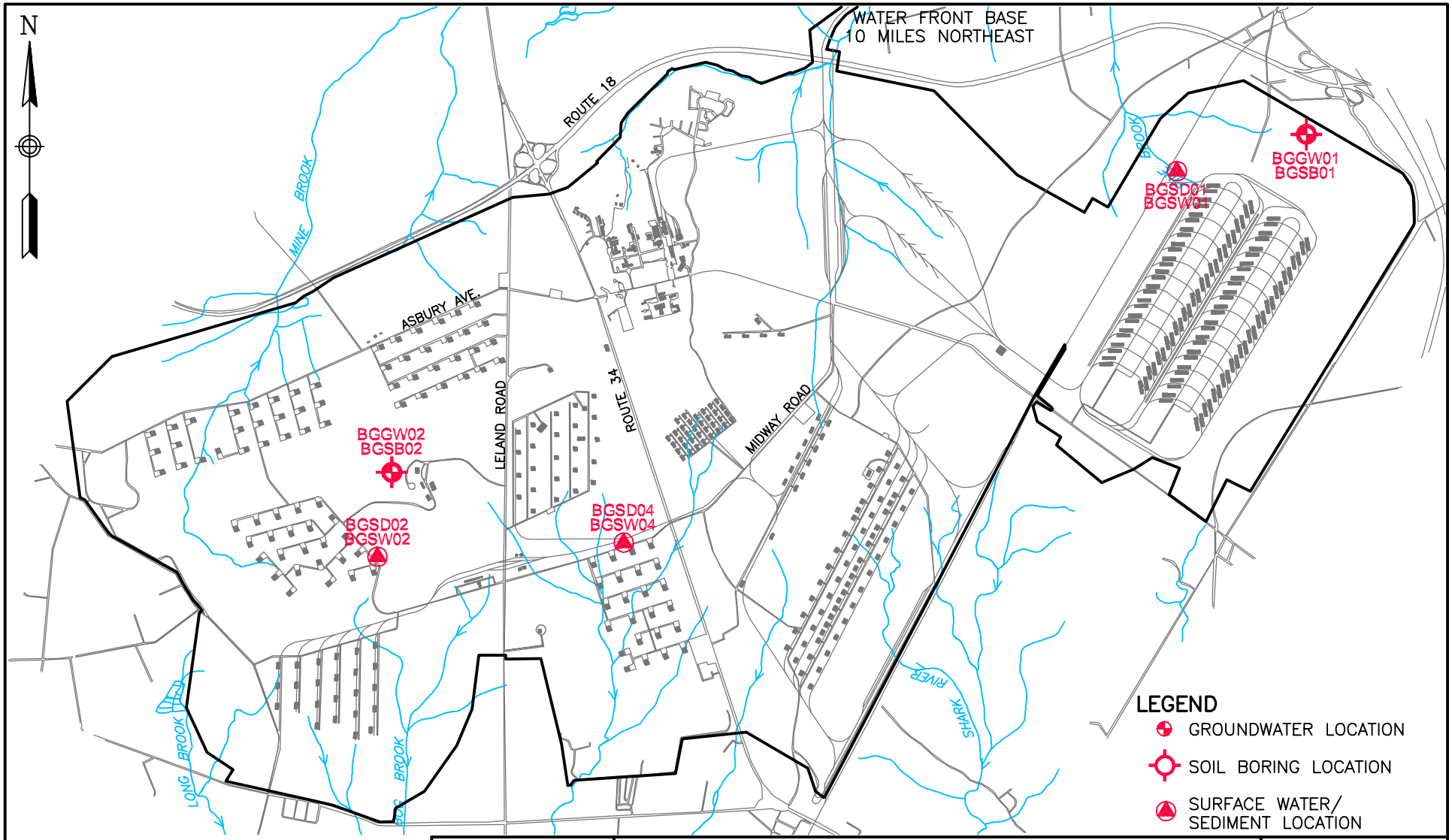
TABLE 5-1
SITE 7 - COMPARATIVE ANALYSIS OF REMEDIAL ACTION ALTERNATIVES
OPERABLE UNIT 10 FEASIBILITY STUDY
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

CRITERION:	ALTERNATIVE 1: NO ACTION	ALTERNATIVE 2: INSTITUTIONAL CONTROLS AND LONG-TERM MONITORING	ALTERNATIVE 3: SOIL COVER, INSTITUTIONAL CONTROLS, AND LONG-TERM MONITORING	ALTERNATIVE 4: SINGLE BARRIER CAP, INSTITUTIONAL CONTROLS AND LONG-TERM MONITORING	ALTERNATIVE 5: REMOVAL AND OFF-SITE DISPOSAL
IMPLEMENTABILITY (Continued)					
Ease of Doing More Action if Needed	Additional actions would be easily implemented if required.	Additional actions would be easily implemented if required.	Same as Alternative 2.	Same as Alternatives 2 and 3.	No additional actions would be needed.
Ability to Monitor Effectiveness	Not applicable.	Monitoring would provide assessment of potential exposures, contaminant presence, and migration, or changes in site conditions.	Same as Alternative 2.	Same as Alternatives 2 and 3. .	Monitoring would not be required because source eliminated.
Ability to Obtain Approvals and Coordinate with Other Agencies	Not applicable.	Coordination for five-year reviews may be required and would be obtainable. Coordination with the state would be required to establish a CEA and would be obtainable.	Same as Alternative 2.	Same as Alternatives 2 and 3.	No five-year reviews would be required; CEA would not be required.
Availability of Treatment, Storage Capacities, and Disposal Services	None required.	None required.	None required.	None required.	Landfill contents would be landfilled, recycled, and/or incinerated (if appropriate). Sufficient capacity exists.
Availability of Equipment, Specialists, and Materials	Not applicable.	Ample availability of equipment and personnel to install monitoring well/fencing and perform long-term maintenance, monitoring, and five-year reviews.	Ample availability of equipment and personnel to perform surface control improvements, install monitoring well/fencing, and perform long-term maintenance, monitoring, and five-year reviews.	Ample availability of equipment and personnel to perform cap improvements, install monitoring well/fencing, and perform long-term maintenance, monitoring, and five-year reviews.	Ample availability of equipment and personnel to perform excavation and transport.
Availability of Technology	Not required.	Common construction techniques and materials required for construction.	Common construction techniques and materials required for construction.	Common construction techniques and materials required for construction.	Common construction techniques and materials required for construction.
COST					
Capital Cost	$0	$117,000	$230,000	$2,031,300	$4,478,000
Annual O&M Cost	$0	$0	$1,000	$1,000	$0
Biennial O&M Cost	$0	$11,100	$11,100	$12,900	$0
CEA Recertification (Every 2 Years)	$0	$10,000	$10,000	$10,000	$0
Five-Year Reviews	$23,000	$23,000	$23,000	$23,000	$0
Present Worth Cost*	$49,600	$266,900	$392,400	$2,204,500	$4,478,000

* Present worth cost is based on discount rate of 7 percent

FIGURES

112G00012/0315/112G00012GM01.DWG 04/23/08 MKB



0 4000 8000

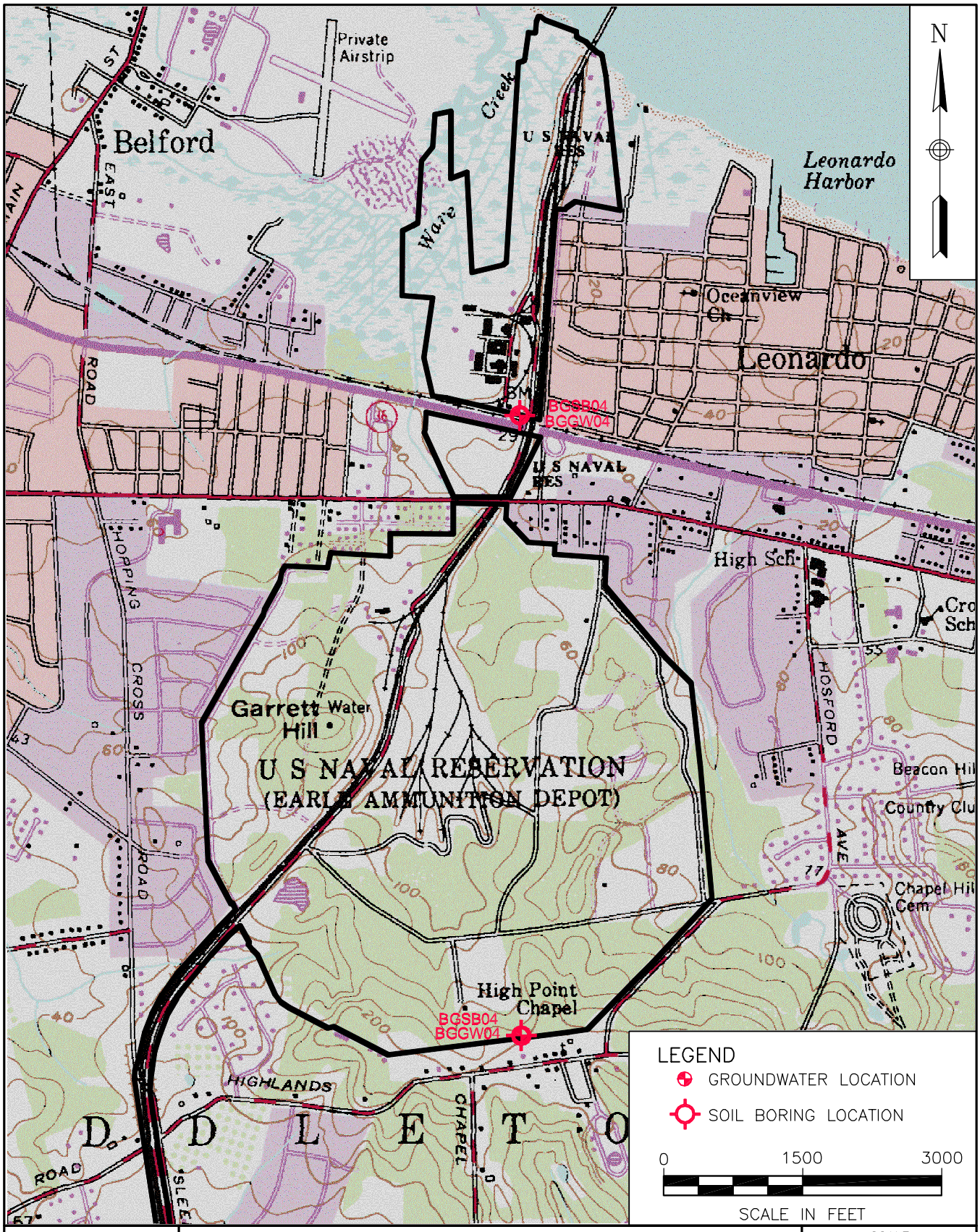
SCALE IN FEET

TETRA TECH NUS, INC.

BACKGROUND SAMPLE LOCATIONS
MAINSIDE AREA
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

SCALE	NOT TO SCALE
FILE	112G00012GM01
REV	0
DATE	04/23/08
FIGURE NUMBER	FIGURE ES–1

112G00012/0315/112G00012GM02.DWG 04/23/08 MKB

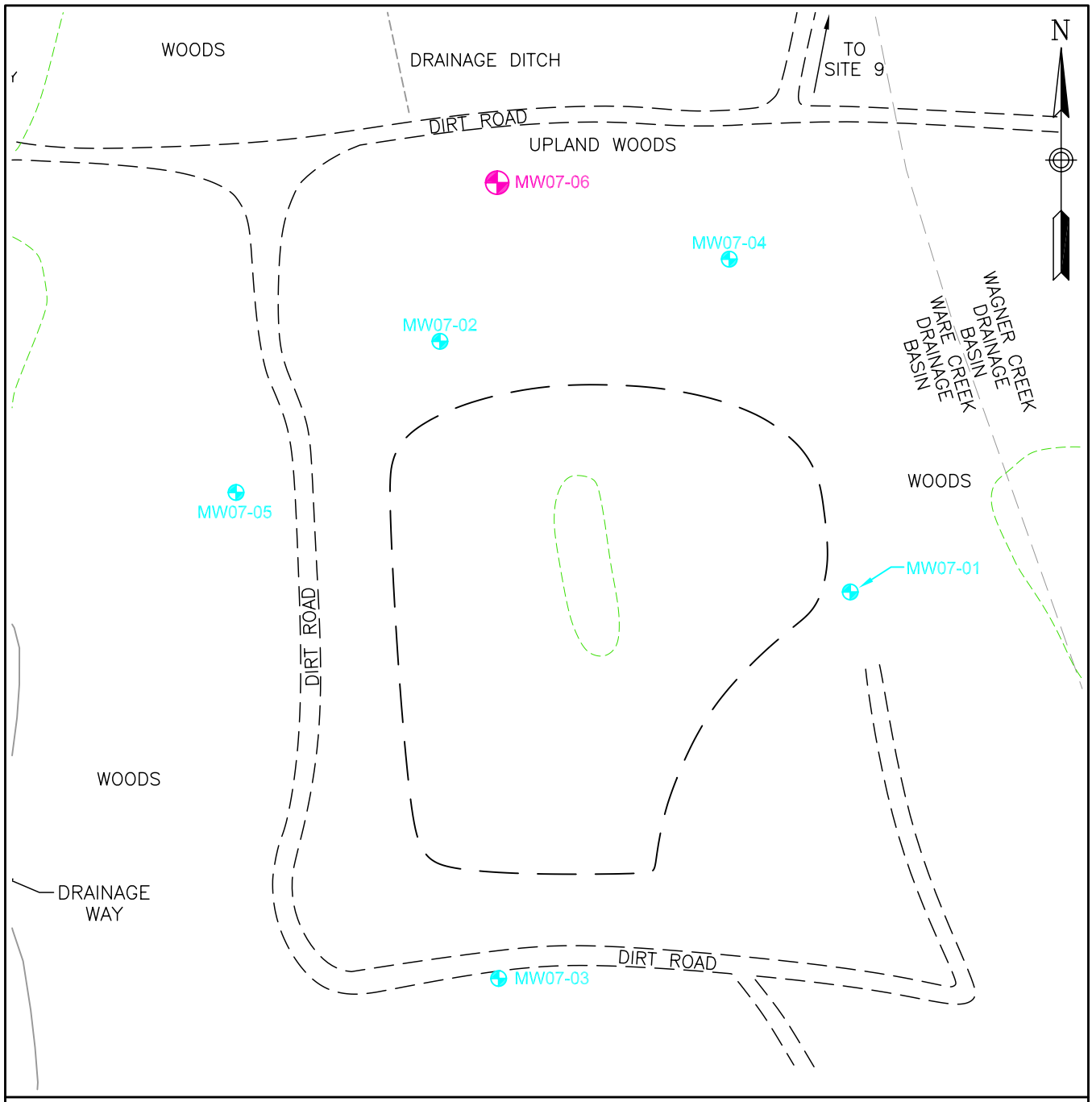


TETRA TECHNUS, INC.

BACKGROUND SAMPLE LOCATIONS
WATERFRONT AREA
NAVAL WEAPONS STATION
COLTS NECK, NEW JERSEY

SCALE	AS NOTED
FILE	112G00012GM02
REV	0
DATE	04/23/08
FIGURE NUMBER	FIGURE ES-2

112G00012/0315/112G00012GM10.DWG 04/24/08 MKB



LEGEND

- MONITORING WELL LOCATION
- PROPOSED MONITORING WELL LOCATION
- FIELD ESTIMATED WETLANDS
- APPROXIMATE LANDFILL BOUNDARY (EPIC, 1974)

0 150 300
SCALE IN FEET

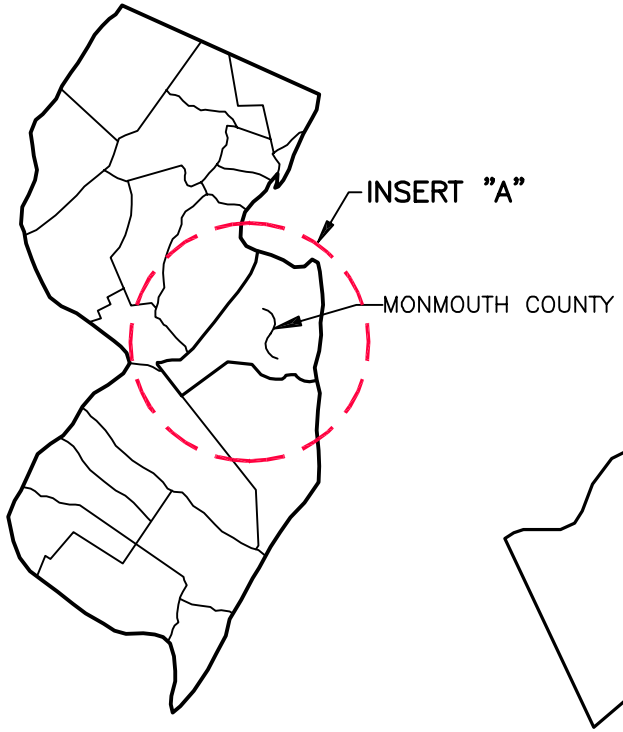
NOTE:
NORTHINGS AND EASTINGS ARE IN NEW JERSEY STATE PLANE COORDINATE SYSTEM.

TETRA TECHNUS, INC.

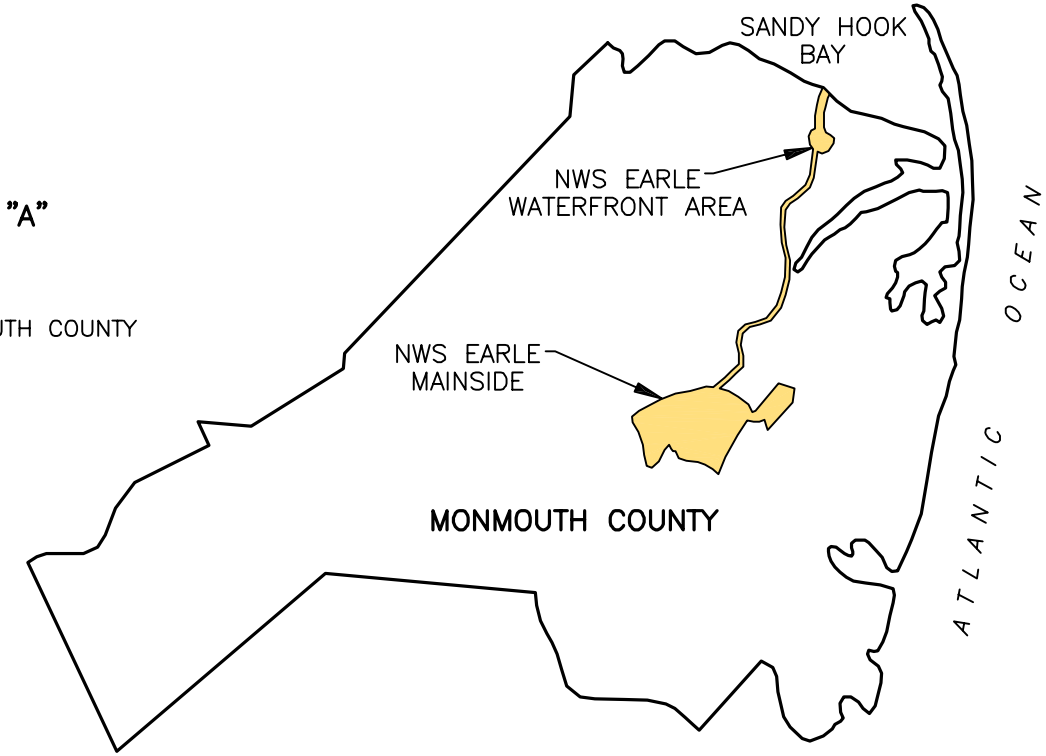
PROPOSED GROUNDWATER MONITORING LOCATIONS
SITE 7 – LANDFILL SOUTH OF "P" BARRICADES
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

SCALE	AS NOTED
FILE	112G00012CM10
REV	0
DATE	04/11/08
FIGURE NUMBER	FIGURE ES–3

112G00012/0315/112G00012CM02.DWG 04/23/08 MKB



STATE OF NEW JERSEY



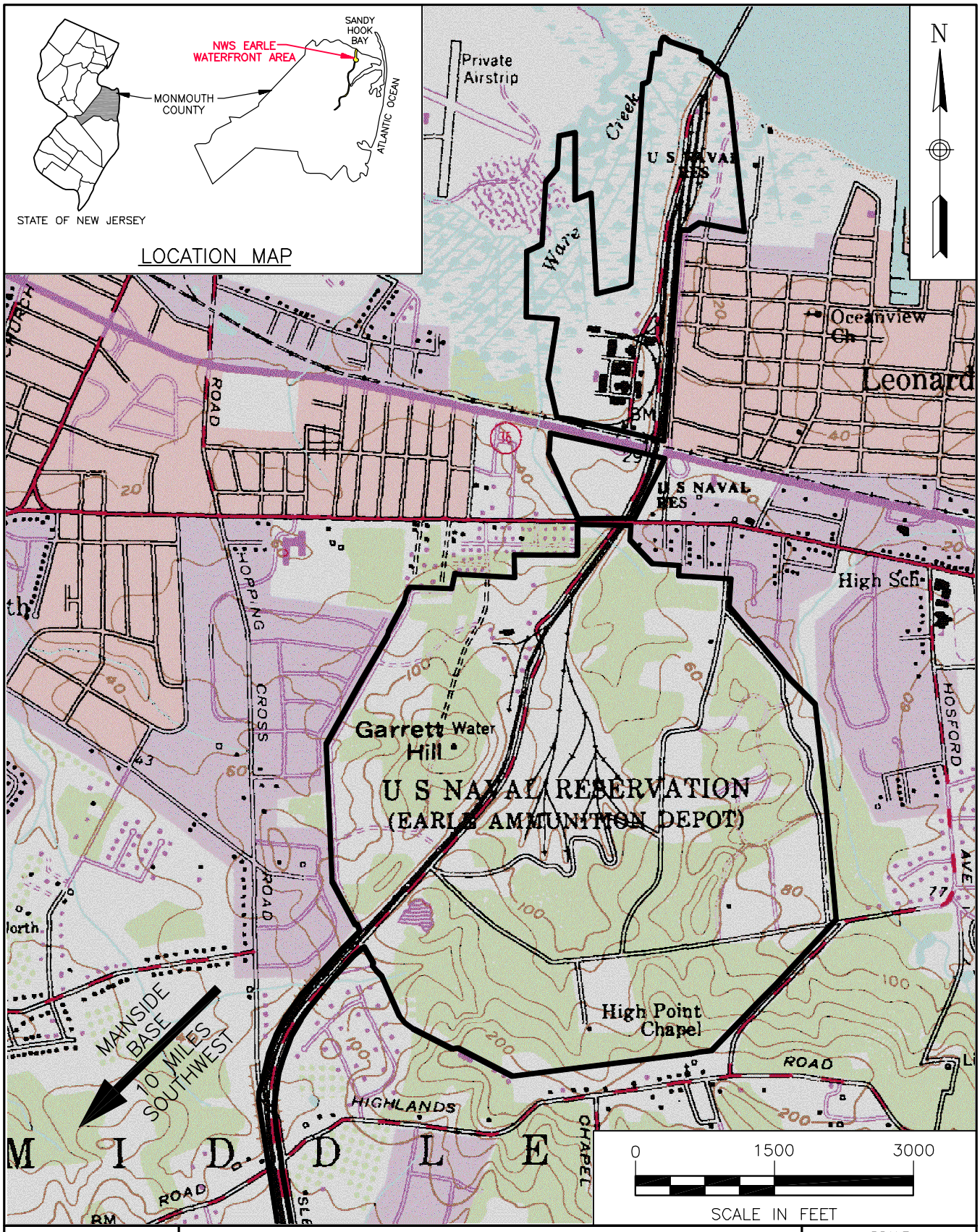
INSERT "A"

TETRA TECHNUS, INC.

SITE LOCATION MAP
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

SCALE	NOT TO SCALE
FILE	112G00012CM02
REV	0
DATE	04/23/08
FIGURE NUMBER	FIGURE 1–1

112G00012/0315/112G00012CM01.DWG 04/28/08 MKB

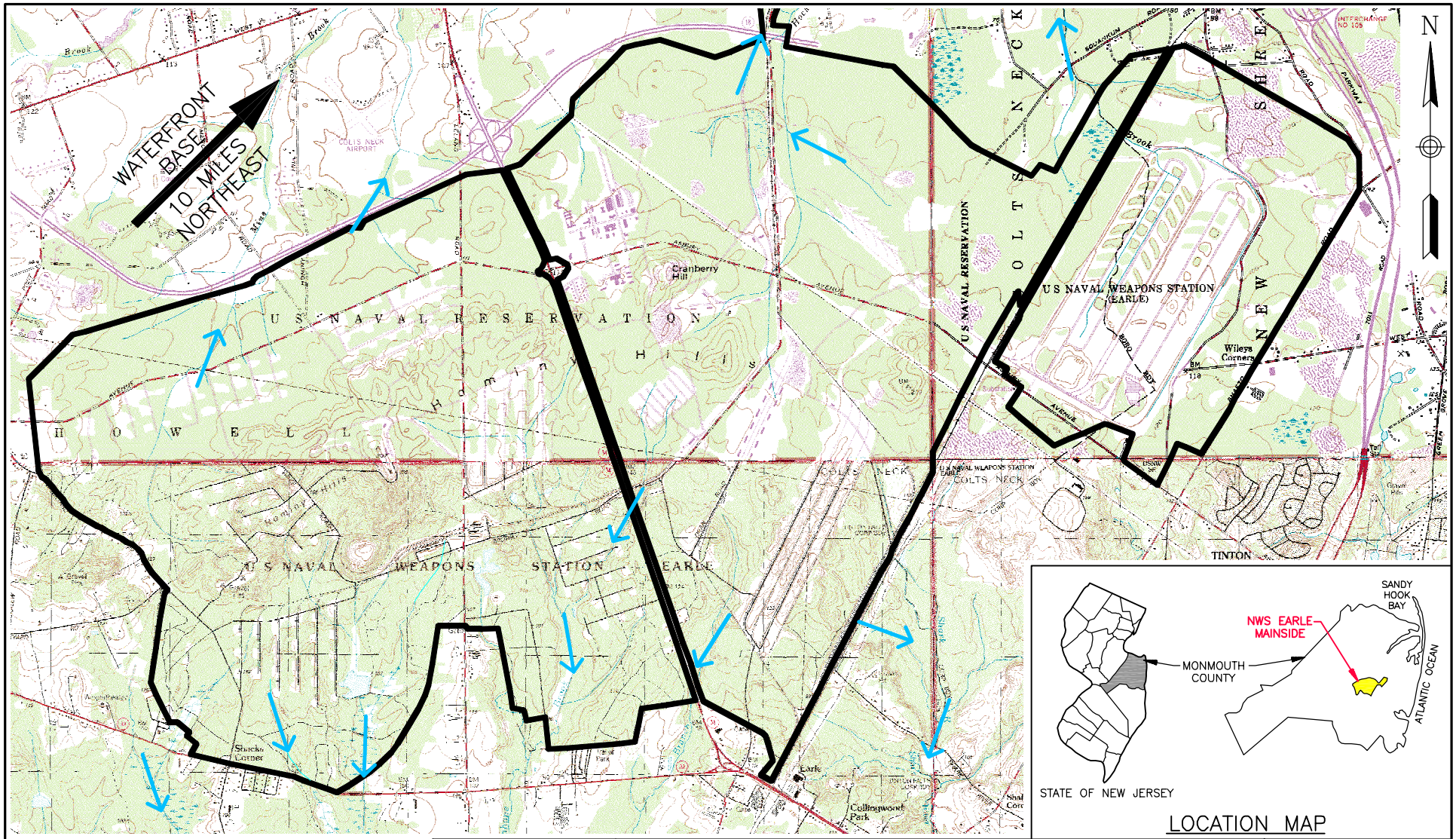


TETRA TECHNUS, INC.

GENERAL LOCATION MAP
WATERFRONT AREA
NAVAL WEAPONS STATION
COLTS NECK, NEW JERSEY

SCALE	AS NOTED
FILE	112G00012CM02
REV	0
DATE	04/28/08
FIGURE NUMBER	FIGURE 1–2

112G00012\0315\112G00012CM03.DWG 04/24/08 MKB



LEGEND

STREAM DIRECTION OF FLOW

0 4000 8000

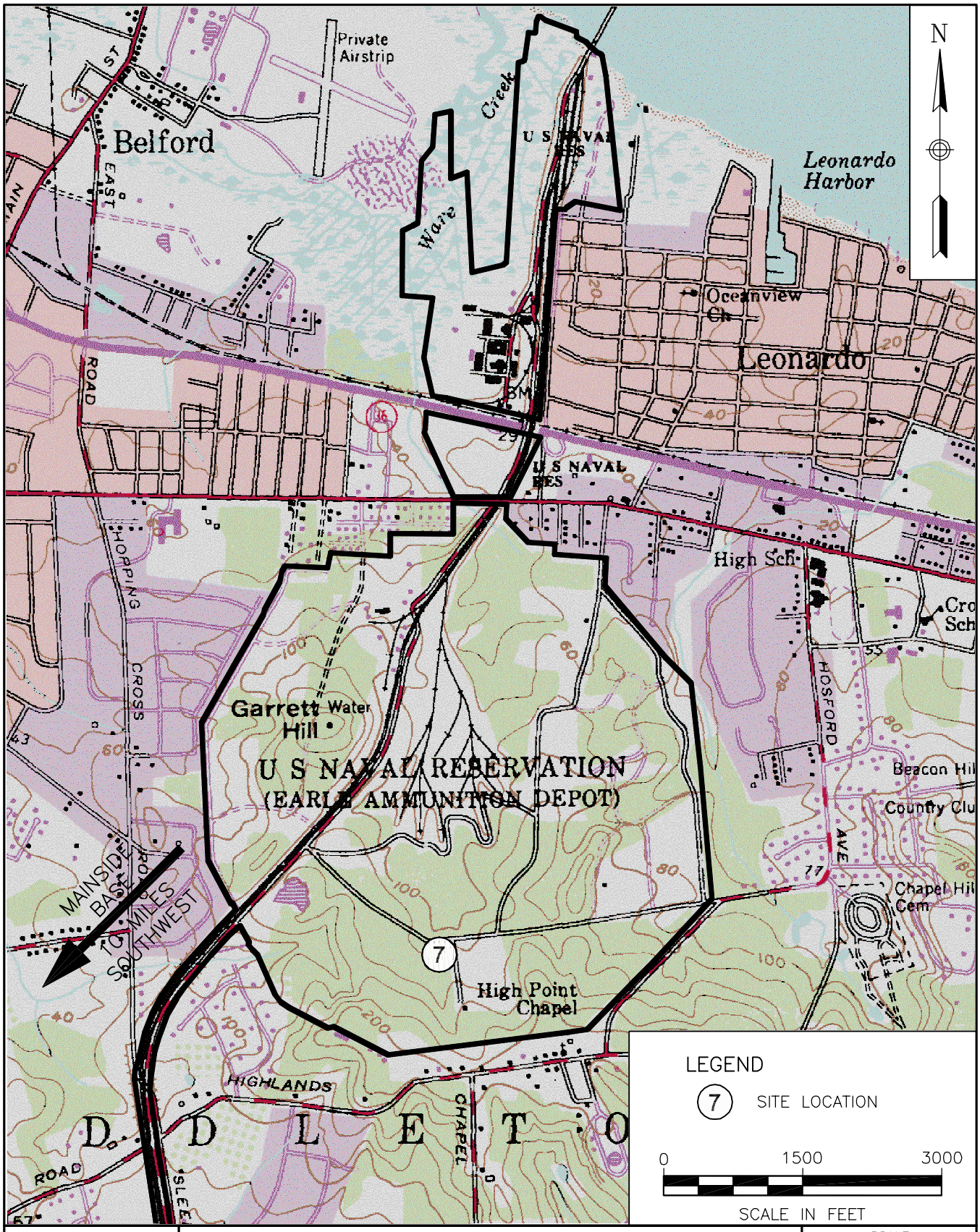
SCALE IN FEET

TETRA TECHNUS, INC.

GENERAL LOCATION MAP
MAINSIDE AREA
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

SCALE	AS NOTED
FILE	112G00012CM03
REV	0
DATE	04/24/08
FIGURE NUMBER	FIGURE 1–3

112G00012/0315/112G00012CM04.DWG 04/28/08 MKB

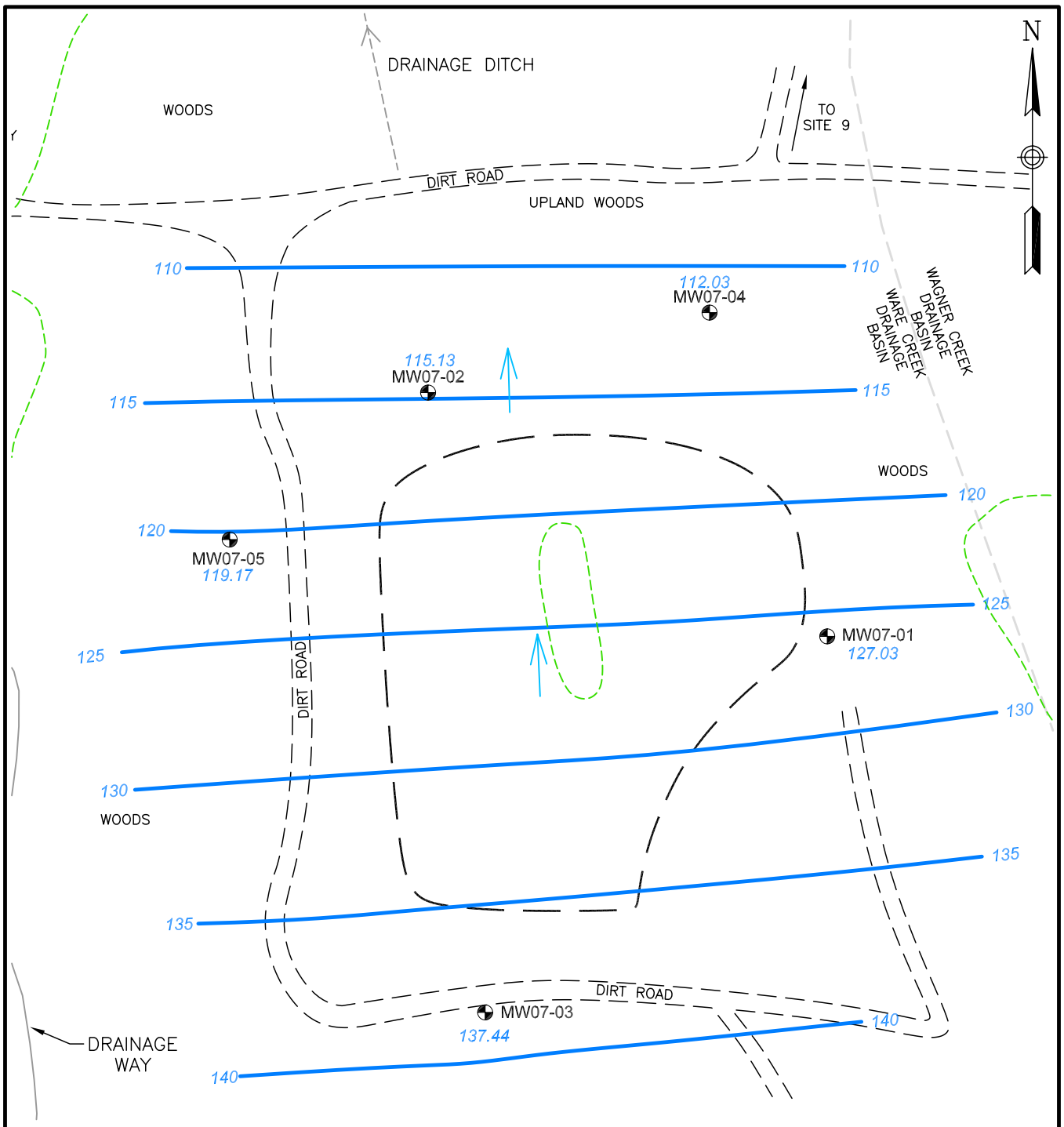


TETRA TECHNUS, INC.

SITE LOCATION
WATERFRONT AREA
NAVAL WEAPONS STATION
COLTS NECK, NEW JERSEY

SCALE	AS NOTED
FILE	12G00012CM04.DWG
REV 0	DATE 04/24/08
FIGURE NUMBER	FIGURE 1–4

112G00012/0315/112G00012GM04-1.DWG 04/24/08 MKB



LEGEND

- MONITORING WELL LOCATION
- APPROXIMATE LANDFILL BOUNDARY (EPIC, 1974)
- FIELD ESTIMATED WETLANDS
- GROUNDWATER CONTOUR
- 115.0 GROUNDWATER ELEVATION
- GROUNDWATER FLOW DIRECTION

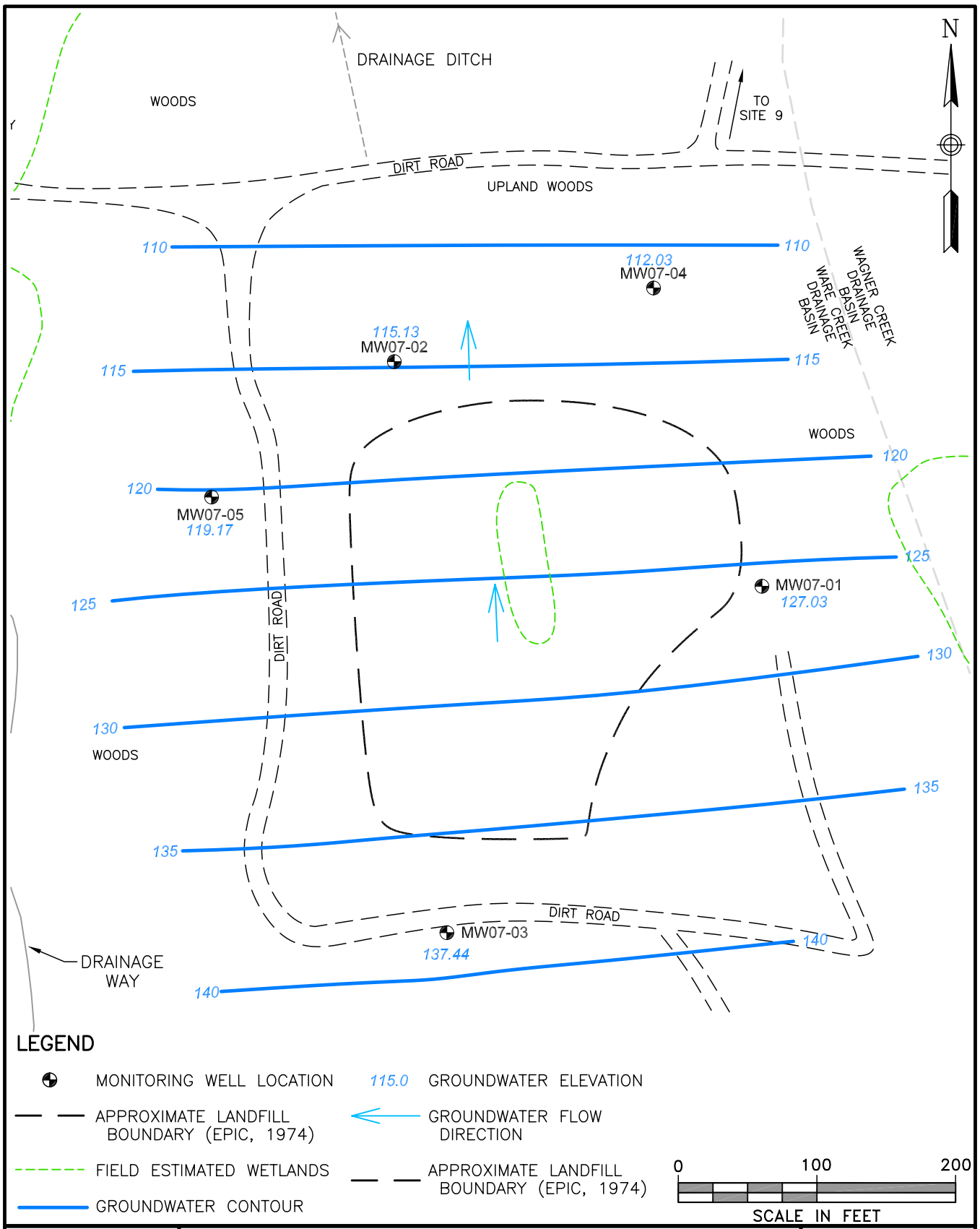
0 100 200
SCALE IN FEET

TETRA TECHNUS, INC.

GROUNDWATER CONTOUR MAP
AUGUST 7, 1995
SITE 7 – LANDFILL SOUTH OF "P" BARRICADES
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

SCALE	AS NOTED
FILE	112G00012GM04-1
REV	0
DATE	04/24/08
FIGURE NUMBER	FIGURE 1-5

112G00012/0315/112G00012GM04-2.DWG 04/24/08 MKB



LEGEND

- MONITORING WELL LOCATION
- 115.0 GROUNDWATER ELEVATION
- APPROXIMATE LANDFILL BOUNDARY (EPIC, 1974)
- GROUNDWATER FLOW DIRECTION
- FIELD ESTIMATED WETLANDS
- APPROXIMATE LANDFILL BOUNDARY (EPIC, 1974)
- GROUNDWATER CONTOUR

0 100 200

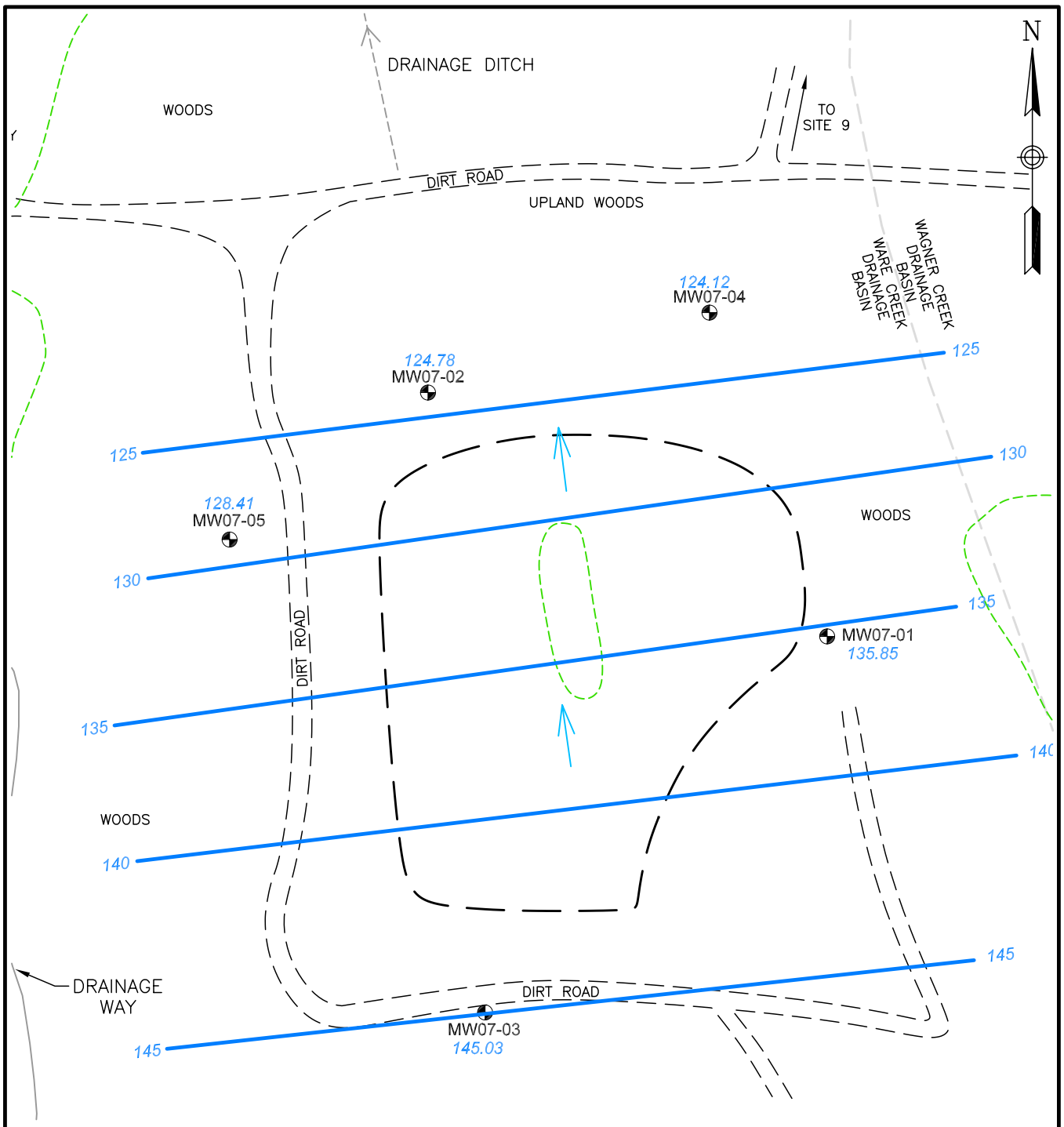
SCALE IN FEET

TETRA TECHNUS, INC.

GROUNDWATER CONTOUR MAP
OCTOBER 17, 1995
SITE 7 – LANDFILL SOUTH OF "P" BARRICADES
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

SCALE	AS NOTED
FILE	112G00012GM04-2
REV	0
DATE	03/24/06
FIGURE NUMBER	FIGURE 1-6

112G00012/0315/112G00012GM05.DWG 04/24/08 MKB



LEGEND

- MONITORING WELL LOCATION
- APPROXIMATE LANDFILL BOUNDARY (EPIC, 1974)
- FIELD ESTIMATED WETLANDS
- GROUNDWATER CONTOUR
- 135.85 GROUNDWATER ELEVATION
- GROUNDWATER FLOW DIRECTION

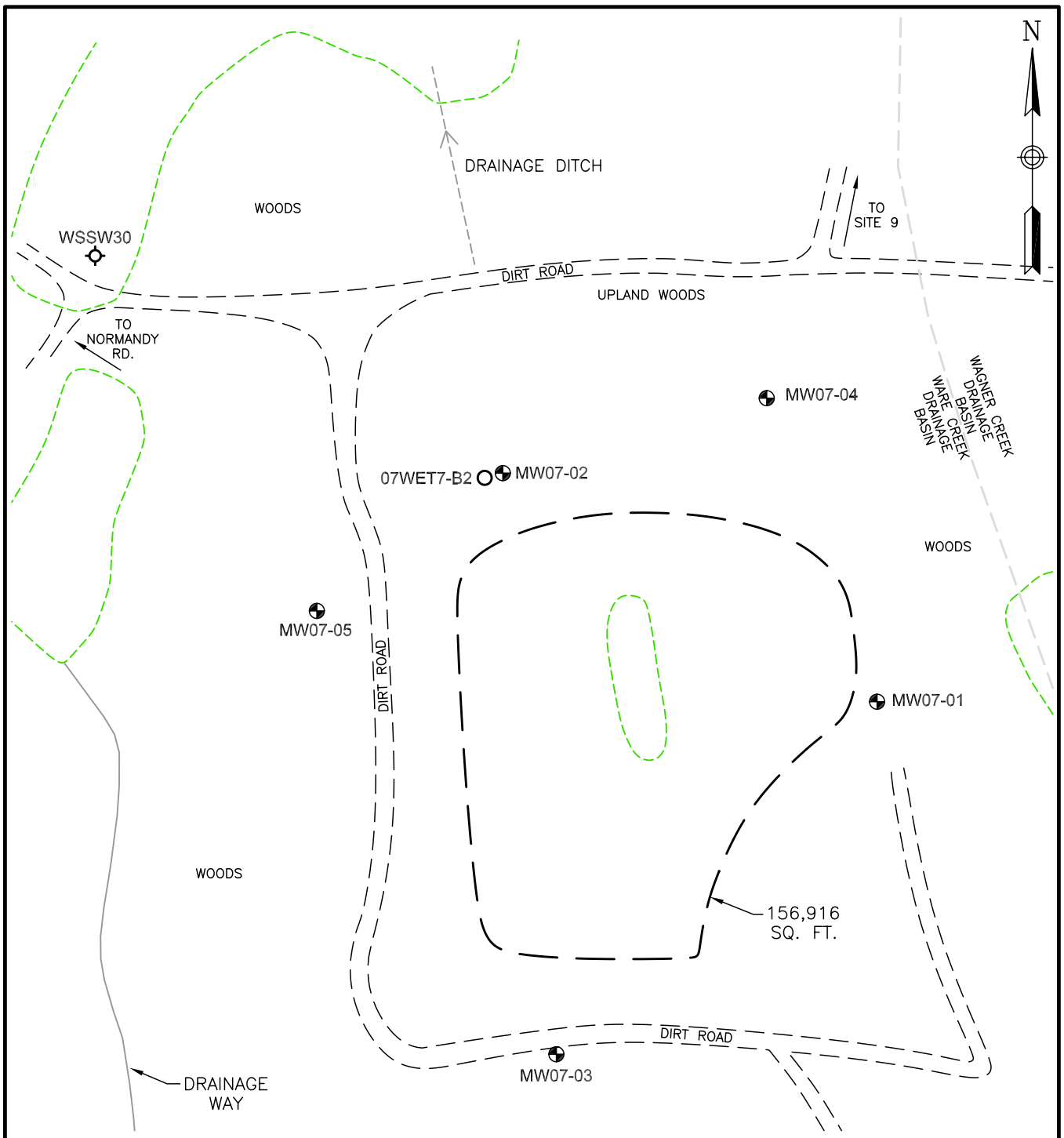
0 150 300
SCALE IN FEET

TETRA TECHNUS, INC.

GROUNDWATER CONTOUR MAP
APRIL 12, 2005
SITE 7 – LANDFILL SOUTH OF "P" BARRICADES
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

SCALE	AS NOTED
FILE	112G00012GM05
REV	0
DATE	04/24/08
FIGURE NUMBER	FIGURE 1–7

112G00012/0315/112G00012GM06-1.DWG 04/24/08 MKB



LEGEND

- MONITORING WELL LOCATION
- SURFACE SOIL SAMPLE LOCATION
- WATERSHED SAMPLE LOCATION
- FIELD ESTIMATED WETLANDS
- APPROXIMATE LANDFILL BOUNDARY (EPIC, 1974)

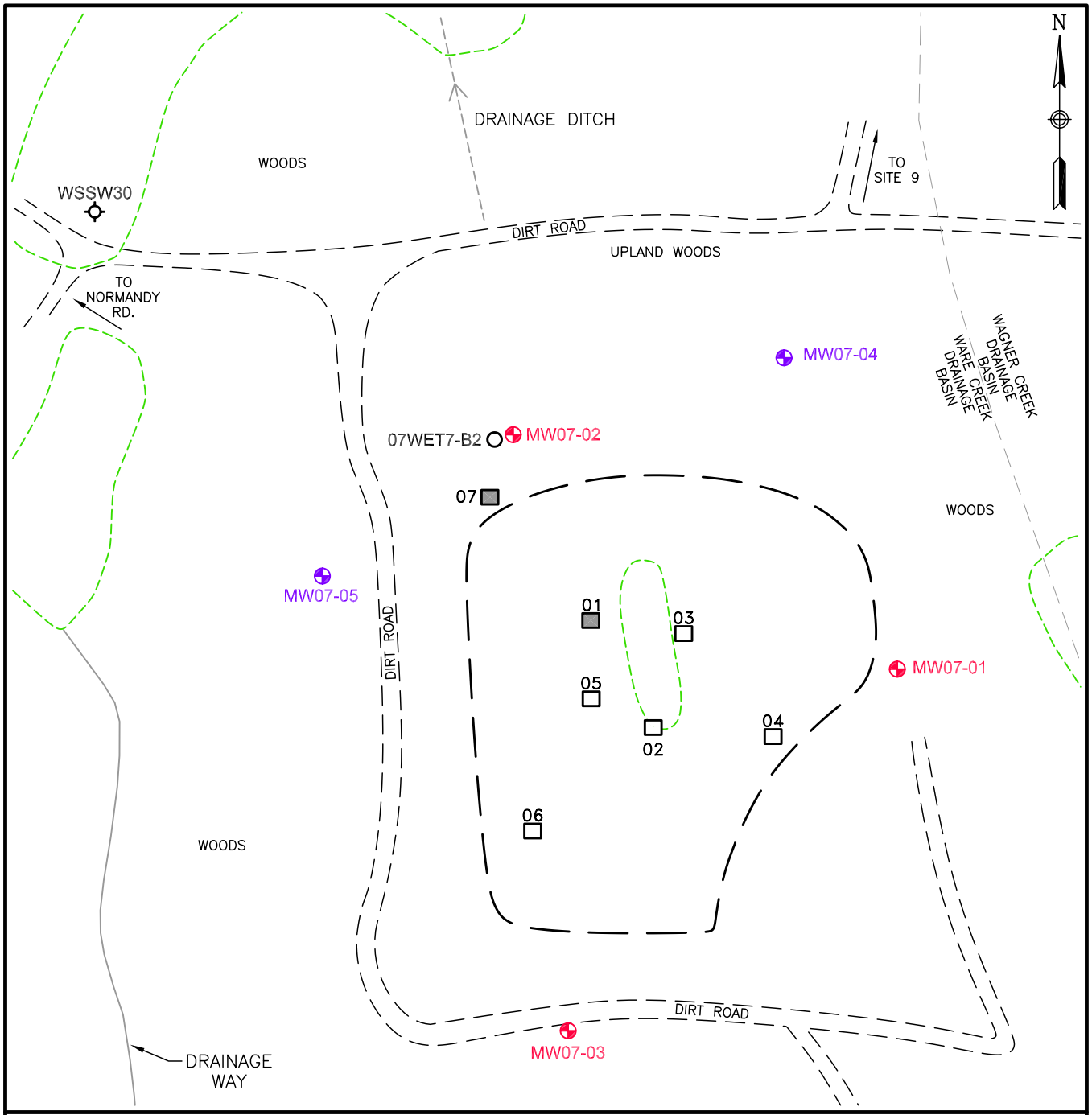
0 150 300
SCALE IN FEET

TETRA TECHNUS, INC.

APPROXIMATE LANDFILL BOUNDARY
SITE 7 – LANDFILL SOUTH OF "P" BARRICADES
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

SCALE	AS NOTED
FILE	112G00012GM06-1
REV	0
DATE	03/24/06
FIGURE NUMBER	FIGURE 1-8

112G00012/0315/112G00012GM07.DWG 04/24/08 MKB



LEGEND

- MONITORING WELL (INSTALLED 1986)
- MONITORING WELL (INSTALLED 1991)
- SURFACE SOIL SAMPLE (1995 RI)
- WATERSHED SAMPLE (1995 RI)
- FIELD ESTIMATED WETLANDS
- APPROXIMATE LANDFILL BOUNDARY
- TEST PIT (1991–1992 RI)
- TEST PIT SAMPLE (1991–1992 RI)

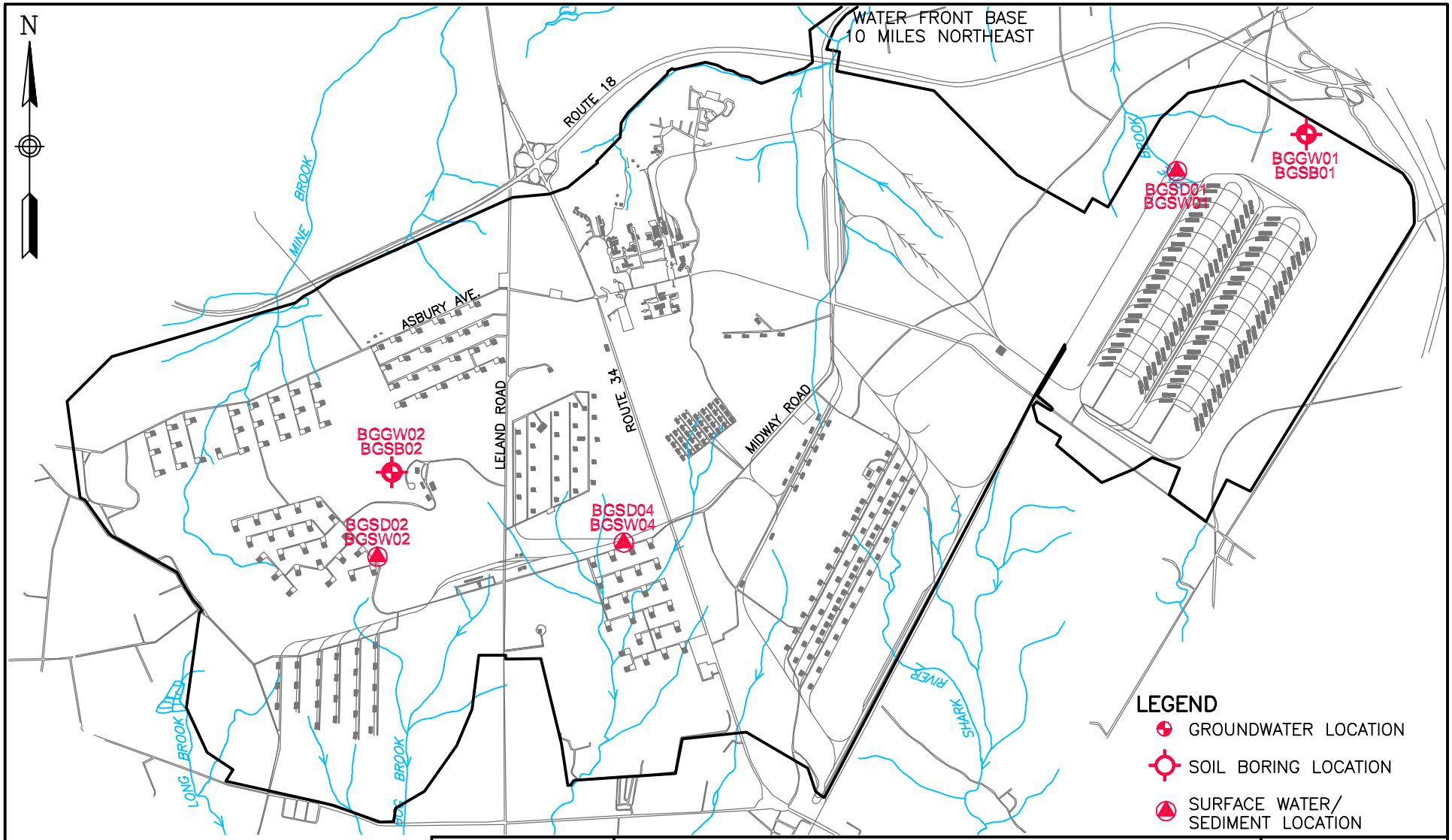
0 150 300
SCALE IN FEET

TETRA TECHNUS, INC.

SAMPLE LOCATION MAP
SITE 7 – LANDFILL SOUTH OF "P" BARRICADES
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

SCALE	AS NOTED
FILE	112G00012GM07
REV	0
DATE	04/24/08
FIGURE NUMBER	FIGURE 1–9

112G00012/0315/112G00012GM01.DWG 04/23/08 MKB



0 4000 8000

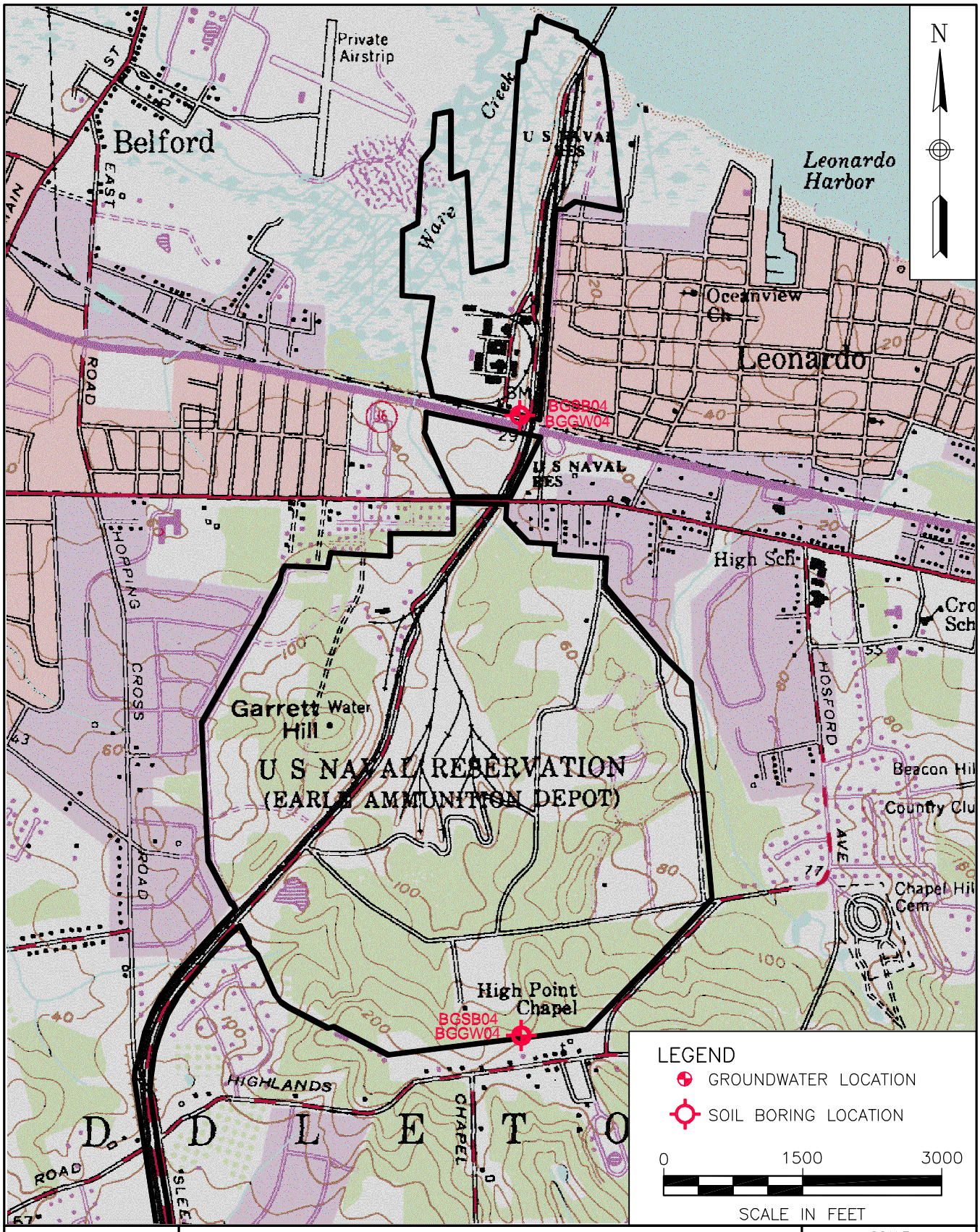
SCALE IN FEET

TETRA TECH NUS, INC.

BACKGROUND SAMPLE LOCATIONS
MAINSIDE AREA
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

SCALE	NOT TO SCALE
FILE	112G00012GM01
REV	0
DATE	04/23/08
FIGURE NUMBER	FIGURE 1–10

112G00012/0315/112G00012GM02.DWG 04/23/08 MKB

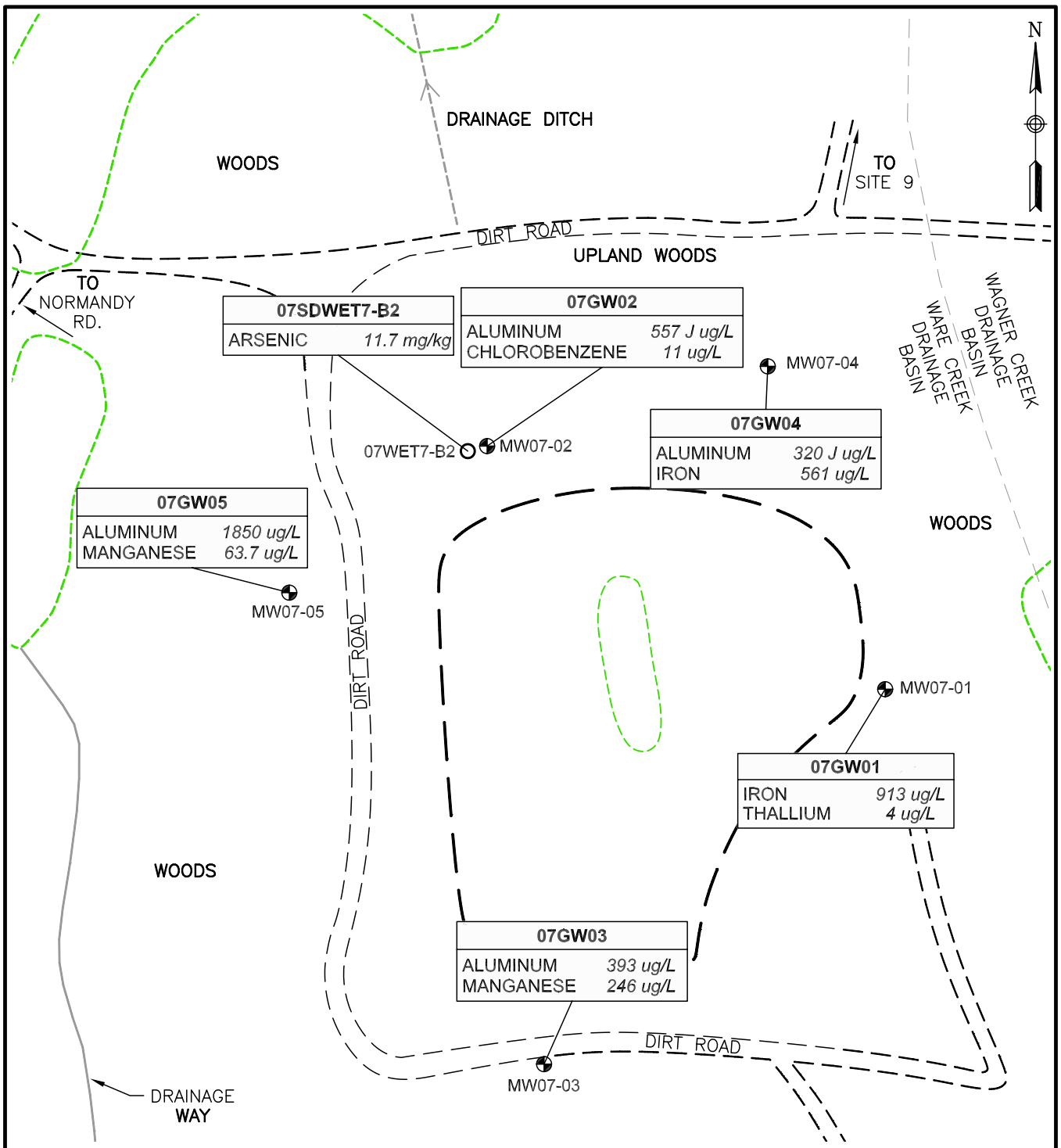


TETRA TECHNUS, INC.

BACKGROUND SAMPLE LOCATIONS
WATERFRONT AREA
NAVAL WEAPONS STATION
COLTS NECK, NEW JERSEY

SCALE	AS NOTED
FILE	112G00012GM02
REV	0
DATE	04/23/08
FIGURE NUMBER	FIGURE 1–11

112G00012/0315/112G00012GM08-1.DWG 04/24/08 MKB



LEGEND

- MONITORING WELL LOCATION
- SURFACE SOIL SAMPLE LOCATION
- FIELD DELINEATED WETLANDS
- APPROXIMATE LANDFILL BOUNDARY (EPIC, 1974)

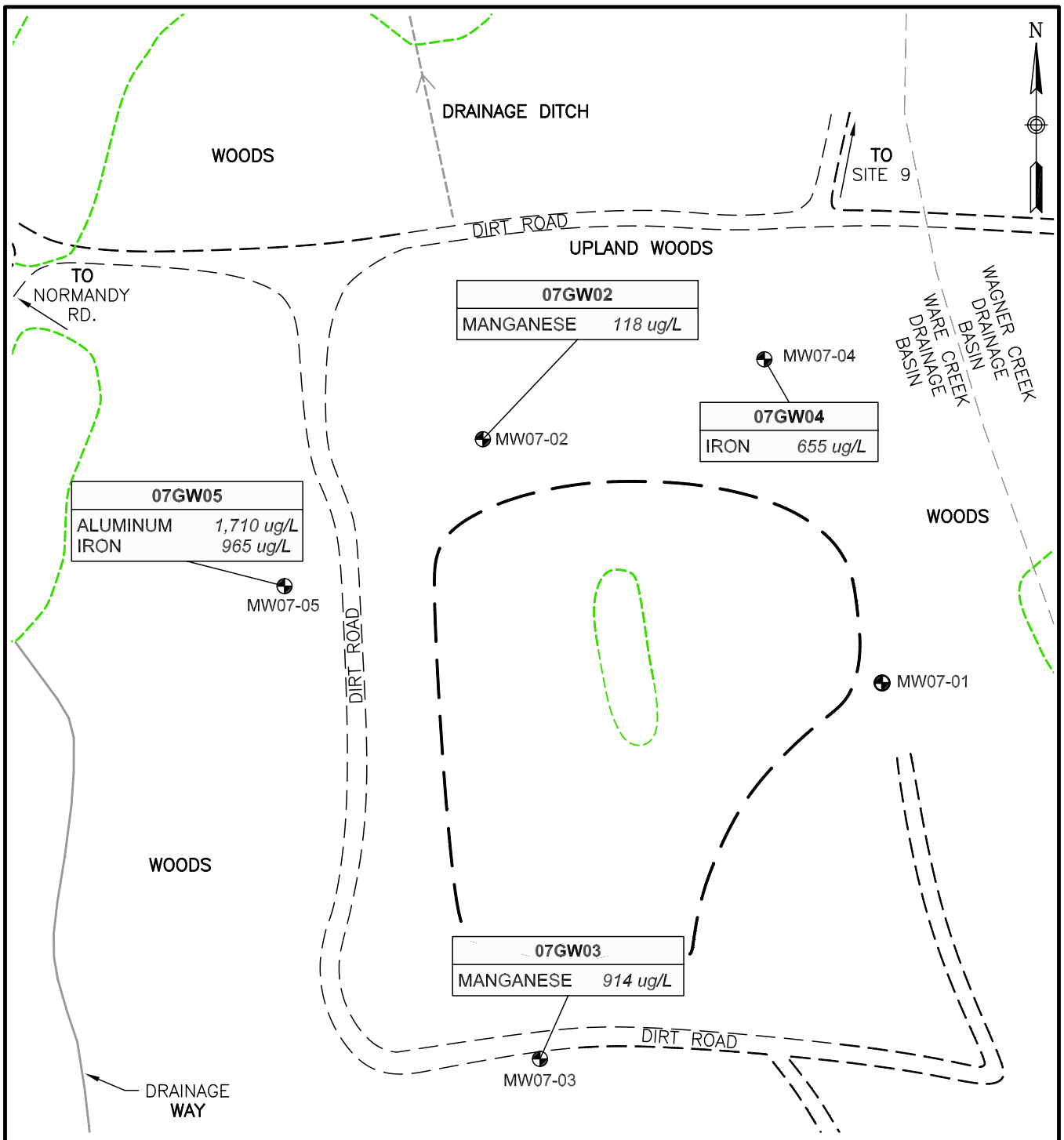
0 150 300
SCALE IN FEET

TETRA TECHNUS, INC.

1995 REMEDIAL INVESTIGATION CONCENTRATIONS ABOVE SCREENING LEVELS SITE 7 – LANDFILL SOUTH OF "P" BARRICADES NAVAL WEAPONS STATION EARLE COLTS NECK, NEW JERSEY

SCALE	AS NOTED
FILE	112G00012GM08
REV	0
DATE	04/24/08
FIGURE NUMBER	FIGURE 1–12

112G00012/0315/112G00012GM08-2.DWG 04/24/08 MKB



LEGEND

- MONITORING WELL LOCATION
- FIELD DELINEATED WETLANDS
- APPROXIMATE LANDFILL BOUNDARY (EPIC, 1974)

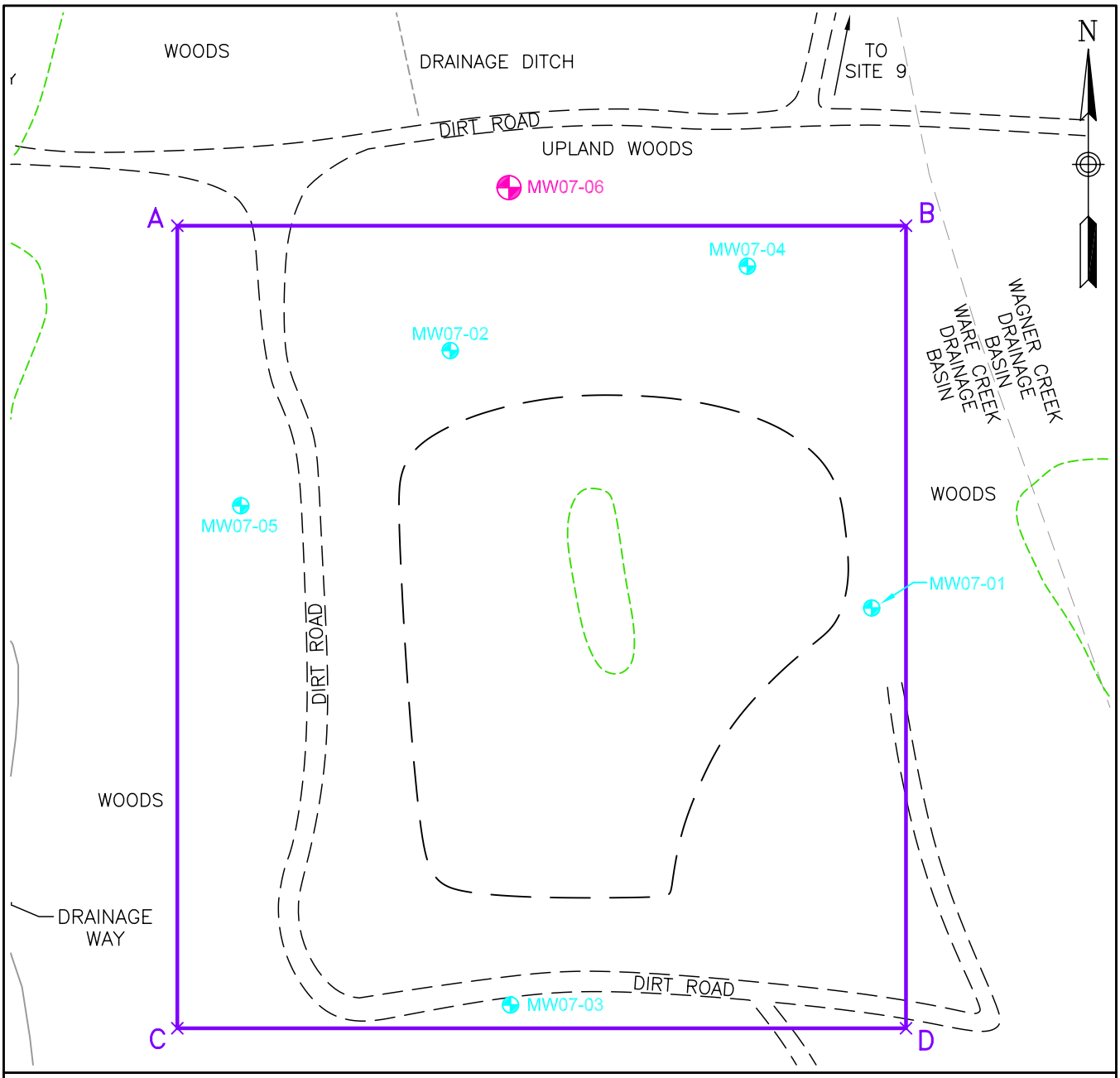
0 150 300
SCALE IN FEET

TETRA TECHNUS, INC.

APRIL 2005 GROUNDWATER SAMPLING
CONCENTRATIONS ABOVE SCREENING LEVELS
SITE 7 – LANDFILL SOUTH OF "P" BARRICADES
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

SCALE	AS NOTED
FILE	112G00012CM12-2
REV	0
DATE	04/25/06
FIGURE NUMBER	FIGURE 1-13

112G00012/0315/112G00012GM09.DWG 06/04/08 MKB



LEGEND

- MONITORING WELL LOCATION
- PROPOSED MONITORING WELL LOCATION
- APPROXIMATE LANDFILL BOUNDARY (EPIC, 1974)
- FIELD ESTIMATED WETLANDS
- PROPOSED CLASSIFICATION EXCEPTION AREA

0 150 300
SCALE IN FEET

POINT	EASTING	NORTHING
A	610971.8318	571330.7679
B	611659.5250	571330.7679
C	610971.8318	570573.5540
D	611659.5250	570573.5540

NOTE:
NORTHINGS AND EASTINGS ARE IN NEW JERSEY STATE PLANE COORDINATE SYSTEM.

TETRA TECHNUS, INC.

LIMIT OF PROPOSED
CLASSIFICATION EXCEPTION AREA
SITE 7 – LANDFILL SOUTH OF "P" BARRICADES
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

SCALE: AS NOTED
FILE: 112G00012GM09
REV: 0
DATE: 06/04/08
FIGURE NUMBER: FIGURE 3–1

APPENDIX A

APRIL 2005 GROUNDWATER SAMPLING RESULTS

DATA SUMMARY OF ORGANIC RESULTS
SDG T2358 - SITE 7 GROUNDWATER
NWS EARLE, COLTS NECK, NEW JERSEY

Sample ID:	**MW7-01**			**DUP-01**			**MW7-02**			**MW7-03**			**MW7-04**			**MW7-05**			**RB-041205**			**TRIPBLANK**		
Sample Date:	**04/12/05**			**04/12/05**			**04/12/05**			**04/12/05**			**04/12/05**			**04/12/05**			**04/12/05**			**04/08/05**		
Duplicate:	**DUP-01**			**MW7-01**																				
	RESULT	**QUAL**	**CODE**	**RESULT**	**QUAL**	**CODE**	**RESULT**	**QUAL**	**CODE**	**RESULT**	**QUAL**	**CODE**	**RESULT**	**QUAL**	**CODE**	**RESULT**	**QUAL**	**CODE**	**RESULT**	**QUAL**	**CODE**	**RESULT**	**QUAL**	**CODE**
VOLATILES	**ug/L**			**ug/L**			**ug/L**			**ug/L**			**ug/L**			**ug/L**			**ug/L**			**ug/L**		
1,1,2-Trichloroethane	0.11	U		0.11	U		0.11	U		0.11	U		0.11	U		0.11	U		0.11	U		0.11	U	
Benzene	0.15	U		0.15	U		0.15	U		0.15	U		0.15	U		0.15	U		0.15	U		0.15	U	
Chlorobenzene	0.11	U		0.11	U		4.4			0.11	U		0.11	U		0.11	U		0.11	U		0.11	U	
Chloroform	0.16	U		0.16	U		0.16	U		0.16	U		0.72	J	P	0.16	U		0.16	U		0.16	U	

Data Qualifiers:

J -- Value is considered estimated due to exceedance of technical quality control criteria or because result is less than the Contract Required Quantitation Limit (CRQL).

U -- Value is a non-detected result as reported by the laboratory.

Validation Code:

P -- The result was qualified as estimated (J) because the reported value was less than the CRQL.

Database source file: H:\EARLE\SITE 7\T2358\T2358.DBF data retrieved on: 06/09/05

DATA SUMMARY OF INORGANIC RESULTS
SDG T2358 - SITE 7 GROUNDWATER
NWS EARLE, COLTS NECK, NEW JERSEY

Sample ID:	MW7-01			DUP-01			MW7-02			MW7-03			MW7-04			MW7-05			RB-041205		
Sample Date:	04/12/05			04/12/05			04/12/05			04/12/05			04/12/05			04/12/05			04/12/05		
Duplicate:	DUP-01			MW7-01																	
	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE
INORGANICS	ug/L			ug/L			ug/L			ug/L			ug/L			ug/L			ug/L		
Aluminum	105	U	A	121	U	A	503	U	A	302	U	A	114	U	A	1710			10.6	J	P
Iron	414	U	A	507	U	A	340	U	A	117	U	A	655			965			27	U	
Manganese	16	U	A	17.4	U	A	118			914			12.3	U	A	38.8	L	K	0.106	U	
Thallium	1.7	U		1.7	U		1.7	U		1.7	U		1.7	U		1.7	U		1.7	U	

Data Qualifiers:
J -- Value is considered estimated due to exceedance of technical quality control criteria or because result is less than the Contract Required Quantitation Limit (CRQL).
L -- Positive result is considered biased low due to exceedance of technical quality control criteria.
U -- Value is a non-detected result as reported by the laboratory.

Validation Code:
A -- The value was qualified as non-detect (U) because of laboratory blank contamination.
K -- The value was qualified as biased low (L) because of ICP interference.
P -- The result was qualified as estimated (J) because the reported value was less than the CRQL.

Database source file: H:\EARLE\SITE 7\T2358\T2358.DBF data retrieved on: 06/09/05

APPENDIX B

HUMAN HEALTH RISK/EXPOSURE SUMMARY TABLES

APPENDIX B - TABLE 1
SITE 7 - SUMMARY OF RME ESTIMATED CANCER RISKS AND NONCARCINOGENIC HAZARD INDICIES
NWS EARLE, COLTS NECK, NEW JERSEY

Medium	Exposure Routes	Estimated Incremental Cancer Risk				Estimated Hazard Index**				
		Current Industrial Employee	Future Industrial Employee	Future Lifetime Resident	Future Recreational Child	Current Industrial Employee	Future Industrial Employee	Future Resident Child	Future Resident Adult	Future Recreational Child
Surface Soil	Incidental Ingestion	N/S	N/A	N/S	N/A	N/S	N/A	N/S	N/A	N/A
	Dermal Contact	N/S	N/A	N/S	N/A	N/S	N/A	N/S	N/A	N/A
	Inhalation of Fugitive Dust	N/S	N/A	N/S	N/A	N/S	N/A	N/S	N/A	N/A
Subsurface Soil	Incidental Ingestion	N/A	N/S	N/S	N/A	N/A	N/S	N/S	N/A	N/A
	Dermal Contact	N/A	N/S	N/S	N/A	N/A	N/S	N/S	N/A	N/A
	Inhalation of Fugitive Dust	N/A	N/S	N/S	N/A	N/A	N/S	N/S	N/A	N/A
Sediment	Incidental Ingestion	N/A	N/A	N/A	1.9E-07	N/A	N/A	N/A	N/A	6.0E-03
	Dermal Contact	N/A	N/A	N/A	8.0E-09	N/A	N/A	N/A	N/A	1.5E-03
Groundwater	Ingestion	N/A	1.0E-05	1.5E-06~	N/A	N/A	4.7E-01	3.0E+00@	N/A	N/A
	Dermal Contact	N/A	4.2E-07	3.3E-07~	N/A	N/A	4.7E-03	1.5E-01~	N/A	N/A
	Inhalation of Volatiles*	N/A	N/A	3.5E-06~	N/A	N/A	N/A	N/A	1.0E-01~	N/A
Surface Water	Incidental Ingestion	N/A	N/A	N/A	N/S	N/A	N/A	N/A	N/A	N/S
	Dermal Contact	N/A	N/A	N/A	N/S	N/A	N/A	N/A	N/A	N/S
TOTAL		-	1.1E-05	5.3E-06	2.0E-07	-	4.7E-01	3.1E+00	1.0E-01	7.5E-03

Notes:
N/A = Not applicable because this media is not associated with this potential receptor
N/S = Not sampled
* = During showering, adult residents only
** = Hazard indicies (i.e., summation of hazard quotients) are used only for comparison purposes and do not reflect actual additive noncarcinogenic effects
~ - Value from amended risk assessment
@ - Result is the maximum of the HIs among the affected target organs from the amended risk assessment

APPENDIX B- TABLE 2
SITE 7 - SUMMARY OF CENTRAL TENDENCY CANCER RISKS AND NONCARCINOGENIC HAZARD INDICIES
NWS EARLE, COLTS NECK, NEW JERSEY

Medium	Exposure Routes	Estimated Incremental Cancer Risk				Estimated Hazard Index**				
		Current Industrial Employee	Future Industrial Employee	Future Lifetime Resident	Future Recreational Child	Current Industrial Employee	Future Industrial Employee	Future Resident Child	Future Resident Adult	Future Recreational Child
Surface Soil	Incidental Ingestion	N/S	N/A	N/S	N/A	N/S	N/A	N/S	N/A	N/A
	Dermal Contact	N/S	N/A	N/S	N/A	N/S	N/A	N/S	N/A	N/A
	Inhalation of Fugitive Dust	N/S	N/A	N/S	N/A	N/S	N/A	N/S	N/A	N/A
Subsurface Soil	Incidental Ingestion	N/A	N/S	N/S	N/A	N/A	N/S	N/S	N/A	N/A
	Dermal Contact	N/A	N/S	N/S	N/A	N/A	N/S	N/S	N/A	N/A
	Inhalation of Fugitive Dust	N/A	N/S	N/S	N/A	N/A	N/S	N/S	N/A	N/A
Sediment	Incidental Ingestion	N/A	N/A	N/A	N/R	N/A	N/A	N/A	N/A	N/R
	Dermal Contact	N/A	N/A	N/A	N/R	N/A	N/A	N/A	N/A	N/R
Groundwater	Ingestion	N/A	N/R	N/R	N/A	N/A	N/R	1.4E+00@	N/A	N/A
	Dermal Contact	N/A	N/R	N/R	N/A	N/A	N/R	9.8E-02~	N/A	N/A
	Inhalation of Volatiles*	N/A	N/A	N/R	N/A	N/A	N/A	N/A	N/R	N/A
Surface Water	Incidental Ingestion	N/A	N/A	N/A	N/S	N/A	N/A	N/A	N/A	N/S
	Dermal Contact	N/A	N/A	N/A	N/S	N/A	N/A	N/A	N/A	N/S
TOTAL		-	-	-	-	-	-	1.5E+00	-	-

Notes:
N/A = Not applicable because this media is not associated with this potential receptor
N/S = Not sampled
N/R = Central Tendency calculation not required
* = During showering, adult residents only
** = Hazard indicies (i.e., summation of hazard quotients) are used only for comparison purposes and do not reflect actual additive noncarcinogenic effects
~ - Value from amended risk assessment
@ - Result is the maximum of the HIs among the affected target organs from the amended risk assessment

APPENDIX C

SITE 7 INSPECTION PICTURES TAKEN IN JANUARY 2005

APPENDIX D

HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT EVALUATION

HUMAN HEALTH RISK ASSESSMENT EVALUATION

The human health risk assessment (HHRA) for Site 7 was conducted primarily following USEPA guidance documents from 1989 (Risk Assessment Guidance for Superfund - Volume I-Human Health Evaluation Manual Part A-Interim Final), 1991 (Risk Assessment Guidance for Superfund-Volume I: Human Health Evaluation Manual-Supplemental Guidance-"Standard Default Exposure Factors"-Interim Final), and 1992 (Dermal Exposure Assessment: Principles and Applications). The human health risk assessment methodologies used at the time of preparing the RI were selected by agreement among the USEPA, NJDEP, and Navy, and reflect similar methodologies that would be used now. However, the methodology for the background comparison test has changed, and there have been minor revisions to the guidance for human health risk assessments since the RI was prepared. Sources for changes include EPA, 1997-Exposure Factors Handbook-Update to Exposure Factors Handbook-EPA/600/8-89/043 and EPA, 2004-Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual-Part E, Supplemental Guidance for Dermal Risk Assessment-Final-EPA/540/R/99/005.

Recent changes include EPA guidance pertaining to calculating exposure point concentrations (EPCs) (EPA, 2002-Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites-OSWER 9285.6-10). For each chemical found in a medium of concern, the EPC is an estimate of the upper range of possible concentrations to which a receptor may be exposed. The EPC is selected as either the maximum of the upper 95 percent estimate of the mean concentration or the maximum detected value, whichever is less. Although the statistical methods for estimating EPCs were recently revised, the underlying process of selecting the best distributional fit is not considered reliable with small data sets of five samples or less, and such is the case for both groundwater and sediment in the Site 7 RI report. An acceptable solution for this problem is to use the maximum detected value for small data sets or whenever the statistical EPC exceeds the maximum detected value. Therefore, the Site 7 RI report appropriately selected EPCs using the maximum detected value for most chemicals in groundwater and all chemicals in sediment.

Since the date of the RI report, toxicity factors published on EPA's Integrated Risk Information System (IRIS) have been updated, as have toxicity factors from other published sources. Updated toxicity values were obtained from a descending order-of-priority list of sources, including IRIS, USEPA's Provisional Peer Reviewed Toxicity Values (PPRTVs), and other peer reviewed values, such as EPA's Health Effects Assessment Summary Tables (HEAST) or ATSDR's minimal risk levels. Most or many of the lower tier toxicity values originate from USEPA's National Center for Exposure Analysis (NCEA) Superfund Technical Support Center.

To streamline the evaluation of the Site 7 risk assessment, a new risk-based screening step was employed to eliminate chemicals that would not contribute to risks above the lower threshold of the acceptable risk range [1 x 10^{-6} cancer risk or a Hazard Index (HI) of 0.1]. The maximum concentrations of each detected substance in Site 7 groundwater were compared to USEPA Region III Risk-Based Concentrations (RBCs) for tap water residential use. Similarly, maximum sediment concentrations were compared to Region III RBCs for soil, using residential exposure assumptions (EPA Region III RBCs are updated twice a year. October 2004 was the latest revision). Substances having concentrations exceeding RBCs in either groundwater or sediment have been selected as Chemicals of Potential Concern (COPCs) for further evaluation of potentially significant changes in calculated cancer and non-cancer risks. The following table presents the results of RBC screening performed with groundwater data for Site 7. In addition, the table presents the NJDEP GWQSs as well as practical quantitation limits (PQL):

TABLE D-1
RISK-BASED SCREENING COMPARISON FOR SITE 7 GROUNDWATER

Substance	Maximum Concentration (ug/L)	Adjusted RBC (ug/L)	Retain Chemical as a COPC (Y/N)?	NJDEP GWQS (ug/L)
Aluminum	1850	3700	N	200
Barium	112	260	N	2000
Beryllium	0.66	7.3	N	20 (PQL)
Calcium	1480	Essential Nutrient	N	-
Chromium	1.9	11	N	100
Cobalt	28.2	73	N	-
Copper	1.8	150	N	1000
Iron	913	1100	N	300
Lead	2.3	15	N	10 (PQL)
Magnesium	6920	Essential Nutrient	N	-
Manganese	246	73	**Y**	50.0
Mercury	0.34	0.37	N	2.00
Nickel	4.8	73	N	100
Potassium	1950	Essential Nutrient	N	-
Sodium	20600	Essential Nutrient	N	50000
Thallium	4	0.26	**Y**	10 (PQL)
Vanadium	0.83	3.7	N	-
Zinc	13.4	1100	N	5000
1,1,2-Trichloroethane	1	0.19	**Y**	3.00
1,2-Dichloroethene (Total)	4	5.5	N	10.0
Benzene	1	0.34	**Y**	1.0 (PQL)
Chlorobenzene	11	11	**Y**	4.00
Chloroform	2	0.15	**Y**	6.00

NOTE: Adjusted RBC based on EPA Region 3 Residential Tap Water RBC adjusted to 1 X 10^{-6} risk or an HI of 0.1.

In the preceding table, the groundwater COPCs selected for the evaluation of the Site 7 HHRA are manganese, thallium, 1,1,2-trichloroethane, benzene, chlorobenzene, and chloroform. For these COPCs, the RI report's exposure factors, toxicity factors, and risk assessment calculation methods were compared to revised criteria to determine if the risks estimated in the RI report would be consistent with those obtained using the latest risk assessment guidance.

For thallium, the estimated non-cancer hazard quotient (HQ) for exposure to groundwater by a child resident exceeded the target acceptable risk level (HQ of 1) in the original RI report. Using revised guidance, the calculated HQ would be approximately a factor of 1.5 times the HQ estimated in the RI report, primarily because of a revised exposure assumption for child tap water intake (a new value of 1.29 liters per day versus 1 liter per day used in the RI report). In addition, there were small changes in the oral reference dose (RfD) for thallium (new value of 7E-05 mg/kg/day versus 8E-05 mg/kg/day) and recommended value for child body weight (new value of 14.4 kg versus 15 kg).

In the RI report, for 1,1,2-trichloroethane, benzene, and chloroform, the estimated incremental cancer risk (ICR) from lifetime residential exposure to tap water via drinking, bathing, and showering was within the target acceptable cancer risk range (1×10^{-6} to 1×10^{-4}), considering the cumulative risk from exposure to all three substances. Using revised guidance, the calculated ICR would still be within the target risk range, but the estimated cancer risks from exposure to each chemical individually and the total risk from all chemical exposures would be approximately 2.5 times greater than the risks presented in the RI report. While toxicity factors did not change appreciably for these substances, the exposure assumptions for the dominant exposure pathway, inhalation of VOCs during showering, have been revised. EPA guidance now recommends a reasonable maximum exposure (RME) assumption of a 35-minute showering time, compared to the 15-minute exposure time used in the RI report. The oral cancer slope factor for chloroform was withdrawn since the date of the RI report, which slightly reduces the estimated cancer risk from exposure to chloroform from all routes of contact.

For groundwater, manganese was not selected as a COPC in the previous RI report because it was presumed present at concentrations similar to the background levels. Regardless of changes in background guidance, manganese would still not be considered a significant risk, even though the concentration exceeds the RBC screening criteria. Using revised guidance, the non-cancer HQ for manganese would be less than 1 for the child resident, indicating negligible non-cancer risk.

The following table presents the results of RBC screening performed with sediment data for Site 7:

TABLE D-2

RISK-BASED SCREENING COMPARISON FOR SITE 7 SEDIMENT

Substance	Maximum Concentration (mg/kg)	Adjusted RBC (mg/kg)	Retain Chemical as a COPC (Y/N)?
Aluminum	2770	7800	N
Arsenic	11.7	0.43	**Y**
Barium	8.6	550	N
Calcium	568	0	N
Chromium	13.2	23	N
Copper	3.6	310	N
Iron	10000	2300	**Y**
Lead	19.6	400	N
Magnesium	243	0	N
Manganese	38.1	160	N
Potassium	332	0	N
Sodium	28.7	0	N
Vanadium	19.3	7.8	**Y**
Zinc	33.7	2300	N

NOTE: Adjusted RBC based on EPA Region 3 Residential Soil RBC adjusted to 1 X 10^{-6} risk or an HI of 0.1.

The sediment COPCs selected for the evaluation of the Site 7 HHRA are arsenic, iron, and vanadium. For these COPCs, the RI report's exposure factors, toxicity factors, and risk assessment calculation methods were compared to revised criteria to determine if the risks estimated in the RI report would be consistent with those obtained using the latest risk assessment guidance. In addition, the RI report also estimated sediment exposure risks to be below the target risk range for two additional substances, manganese and zinc. This is consistent with the findings presented in the preceding RBC table, which confirms that detected concentrations for manganese and zinc are below their respective RBCs, indicating negligible risk.

For sediment exposure, the RI report estimated that non-cancer and cancer risks would be below the lower limit of the target acceptable risk range for arsenic. Using current guidance for exposure assumptions and toxicity factors, estimated risks would still be below the target acceptable risk range, but the revised HQ and cancer risk would be slightly increased, based on new EPA guidance for dermal exposure evaluation (EPA, 2004). For sediment, vanadium and iron were not selected as COPCs in the previous RI report, but using revised guidance, these substances have been found to exceed their respective RBC screening criteria. However, non-cancer HQs would be in the 10^{-3} range, indicating

negligible non-cancer risk. This conclusion is based upon using a revised oral reference dose (RfD) for vanadium (0.001 mg/kg/day), instead of the 0.007 mg/kg/day value considered for the RI report.

Based on the foregoing evaluation, changes in the updated documents would not be expected to significantly change the overall conclusions of the Site 7 HHRA. Because of the inclusion of a risk-based COPC screening step, different chemicals would be retained as COPCs if the risk assessment were conducted at present. However, the decision to remediate a site is typically not based on screening benchmarks because of their conservative nature.

In conclusion, evaluation of the HHRA methods, guidance, and toxicity factors for Site 7 groundwater and sediment has found several minor changes that would impact the Site 7 RI report's risk calculations, but none of the major conclusions of the HHRA would be affected. Some of the cancer slope factors (SFs) and noncancer reference doses (RfDs) have been changed, withdrawn, or added. Estimated risks would be slightly different if the HHRA were to be recalculated at present. In addition, some of the dermal exposure parameters have been changed slightly with the issuance of the 2004 final USEPA dermal exposure guidance; however, the underlying methods for dermal exposure assessment were not changed, and the recommended dermal exposure factors and chemical-specific constants were only slightly altered due to re-evaluation of the same data sources by a USEPA workgroup. Overall, the decision to remediate or not remediate based on risk assessment results would not be affected, and the regulatory criteria selected for monitoring would still be the MCLs and NJDEP standards for groundwater.

ECOLOGICAL RISK ASSESSMENT EVALUATION

Data collected for the 1996 RI and 1993 RI/FS indicate that potential risk to ecological receptors is negligible at Site 7. Surface water is not present near the site in the direction of groundwater flow, and thus, groundwater-to-surface water migration is not an issue. In addition, no site-related contaminants were found in the nearest down-gradient surface water sample (WS SW 30; north of the site). Although the site is located on a slight slope, there is no evidence of erosion (ditches, gulleys, etc) and thus, overland migration of soil contaminants does not appear to be occurring. Apparently, the extensive vegetation and soil types inhibit soil erosion at the site. Arsenic was the only chemical that exceeded its ecological screening value in a wet soil sample collected immediately north (downslope) of the land fill, but the arsenic concentration only slightly exceeded the screening value, suggesting low potential risk. In addition, there was minimal soil contamination in two test pits at the landfill. Any soil contamination that might exist at the site is probably below the surface, and is largely not available to most receptors. For these reasons, further ecological study or additional samples does not appear to be warranted.

APPENDIX E

TEST PIT LOGS

(Source: Installation Restoration Program Remedial Investigation/Feasibility Study for 11 Sites at NWS Earle, Colts Neck, New Jersey", Volume 2. Weston. 1992.)

TABLE A-1
Summary of Test Pit Investigations,
Site 7, Landfill South of "P" Barricades
NWS Earle, Colts Neck, New Jersey

Test Pit Number	Test Pit Total Depth (ft)	Thickness (ft)		Composition Description		Comments
		Cover	Waste	Cover	Waste	
TP 7-1	4	--	0.25-3.75	—	Mixed fill, plastic, wood, cans, paper, cardboard	--
TP 7-2	8	--	1.5-4	--	Household type trash, plastic, cans, glass, wood, etc.	Thin black clay layers
TP 7-3	7	--	2.5-4	--	Household trash	--
TP 7-4	3.5	--	0-3.5	--	Household trash	--
TP 7-5	4	--	--	--	Debris on ground surface	--
TP 7-6	6.5	--	--	--	--	--
TP 7-7	7.5	--	0-6	--	Household type trash, plastic, cans, wood	--

APPENDIX F

COSTS

NAVAL WEAPONS STATION EARLE
Colts Neck, New Jersey
Operable Unit 10 (Site 7)
ALTERNATIVE 1: NO ACTION
Annual Sampling Cost

Item	Item Cost per 5 Years	Notes
Site Review	$23,000	Review of documents and data evaluation/recommendations, preparation of summary reports for 5-year CERCLA reviews.
TOTALS	$23,000	

NAVAL WEAPONS STATION EARLE
Colts Neck, New Jersey
Operable Unit 10 (Site 7)
ALTERNATIVE 1: NO ACTION
Present Worth Analysis

Year	Annual Cost	Total Year Cost	Annual Discount Rate at 7%	Present Worth
0	$0	$0	1.000	$0
1	$0	$0	0.935	$0
2	$0	$0	0.873	$0
3	$0	$0	0.816	$0
4	$0	$0	0.763	$0
5	$23,000	$23,000	0.713	$16,399
6	$0	$0	0.666	$0
7	$0	$0	0.623	$0
8	$0	$0	0.582	$0
9	$0	$0	0.544	$0
10	$23,000	$23,000	0.508	$11,684
11	$0	$0	0.475	$0
12	$0	$0	0.444	$0
13	$0	$0	0.415	$0
14	$0	$0	0.388	$0
15	$23,000	$23,000	0.362	$8,326
16	$0	$0	0.339	$0
17	$0	$0	0.317	$0
18	$0	$0	0.296	$0
19	$0	$0	0.277	$0
20	$23,000	$23,000	0.258	$5,934
21	$0	$0	0.242	$0
22	$0	$0	0.226	$0
23	$0	$0	0.211	$0
24	$0	$0	0.197	$0
25	$23,000	$23,000	0.184	$4,232
26	$0	$0	0.172	$0
27	$0	$0	0.161	$0
28	$0	$0	0.150	$0
29	$0	$0	0.141	$0
30	$23,000	$23,000	0.131	$3,013
			TOTAL PRESENT WORTH	**$49,588**

NAVAL WEAPONS STATION EARLE
Colts Neck, New Jersey
Operable Unit 10 (Site 7)
Alternative 2 - Limited Action
Capital Cost

6/4/2008 3:20 PM

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
1 MONITORING WELL and FENCE INSTALLATION											
1.1 Temporary Decon Pad	1	ls	$500.00				$500	$0	$0	$0	$500
1.2 Drill Rig mob/demob	1	ls	$1,200.00				$1,200	$0	$0	$0	$1,200
1.3 Well drilling	25	ft	$25.00				$625	$0	$0	$0	$625
1.4 Well Installation	25	ft	$16.00				$400	$0	$0	$0	$400
1.5 Well Protectors	1	ls	$350.00				$350	$0	$0	$0	$350
1.6 NJ Well Permit	1	ls	$100.00				$100	$0	$0	$0	$100
1.7 Install New Post and Cable Fence	1,513	lf	$18.04				$27,295	$0	$0	$0	$27,295
1.8 Well Survey	1	ls	$968.00				$968	$0	$0	$0	$968
2 OVERSIGHT											
2.1 Engineering Oversight	3	mn-day			$300.00		$0	$0	$900	$0	$900
3 INSTITUTIONAL CONTROLS											
3.1 CEA & Modify Base Master Plan	1	ls			$16,500.00		$0	$0	$16,500	$0	$16,500
Subtotal							$31,438	$0	$17,400	$0	$48,838
Local Area Adjustments							100.0%	101.9%	105.3%	105.3%	
							$31,438	$0	$18,322	$0	$49,760
Overhead on Labor Cost @ 30%									$5,497		$5,497
G & A on Labor Cost @ 10%									$1,832		$1,832
G & A on Material Cost @ 10%								$0			$0
G & A on Subcontract Cost @ 10%							$3,144				$3,144
G & A on Equipment Cost @ 10%										$0	$0
Total Direct Cost							$34,581	$0	$25,651	$0	$60,232
Indirects on Total Direct Cost @ 35%											$21,081
Profit on Total Direct Cost @ 10%											$6,023
Subtotal											$87,337
Health & Safety Monitoring @ 3%											$2,620
Total Field Cost											$89,957
Contingency on Total Field Costs @ 20%											$17,991
Engineering on Total Field Cost @ 10%											$8,996
TOTAL COST											**$116,944**

NAVAL WEAPONS STATION EARLE
Colts Neck, New Jersey
Operable Unit 10 (Site 7)
Alternative 2 - Limited Action
Capital Cost

Item	Item Cost per 2 years until Year 30	Item Cost per 2 years until Year 10	Item Cost per 5 years	Notes
Sampling	$4,336			Collect six groundwater samples per sampling period plus travel, living, and shipping costs
Analysis/Water	$756			Nine water samples per sampling period for aluminum, iron, and manganese analysis + 40% for QA
Biennial Report	$6,000			Ten hours per sampling report plus markups and other direct costs
Biennial Recertification of CEA		$10,000		
Site Review			$23,000	Review of site conditions by three engineers for Years 5, 10, 15, 20, 25, and 30
TOTALS	$11,092	$10,000	$23,000	

NAVAL WEAPONS STATION EARLE
Colts Neck, New Jersey
Operable Unit 10 (Site 7)
Alternative 2 - Limited Action
Present Worth Analysis

Year	Capital Cost	Annual Cost	Total Year Cost	Annual Discount Rate at 7%	Present Worth
0	**$116,944**		$116,944	1.000	$116,944
1		$0	$0	0.935	$0
2		$21,092	$21,092	0.873	$18,413
3		$0	$0	0.816	$0
4		$21,092	$21,092	0.763	$16,093
5		$23,000	$23,000	0.713	$16,399
6		$21,092	$21,092	0.666	$14,047
7		$0	$0	0.623	$0
8		$21,092	$21,092	0.582	$12,276
9		$0	$0	0.544	$0
10		$44,092	$44,092	0.508	$22,399
11		$0	$0	0.475	$0
12		$11,092	$11,092	0.444	$4,925
13		$0	$0	0.415	$0
14		$11,092	$11,092	0.388	$4,304
15		$23,000	$23,000	0.362	$8,326
16		$11,092	$11,092	0.339	$3,760
17		$0	$0	0.317	$0
18		$11,092	$11,092	0.296	$3,283
19		$0	$0	0.277	$0
20		$34,092	$34,092	0.258	$8,796
21		$0	$0	0.242	$0
22		$11,092	$11,092	0.226	$2,507
23		$0	$0	0.211	$0
24		$11,092	$11,092	0.197	$2,185
25		$23,000	$23,000	0.184	$4,232
26		$11,092	$11,092	0.172	$1,908
27		$0	$0	0.161	$0
28		$11,092	$11,092	0.150	$1,664
29		$0	$0	0.141	$0
30		$34,092	$34,092	0.131	$4,466
				TOTAL PRESENT WORTH	**$266,926**

NAVAL WEAPONS STATION EARLE
Colts Neck, New Jersey
Operable Unit 10 (Site 7)
Alternative 3 - Surface Controls
Capital Cost

6/4/2008 3:20 PM

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
1 MONITORING WELL and FENCE INSTALLATION											
1.1 Temporary Decon Pad	1	ls	$500.00				$500	$0	$0	$0	$500
1.2 Drill Rig mob/demob	1	ls	$1,200.00				$1,200	$0	$0	$0	$1,200
1.3 Well drilling	25	ft	$25.00				$625	$0	$0	$0	$625
1.4 Well Installation	25	ft	$16.00				$400	$0	$0	$0	$400
1.5 Well Protectors	1	ls	$350.00				$350	$0	$0	$0	$350
1.6 NJ Well Permit	1	ls	$100.00				$100	$0	$0	$0	$100
1.7 Install New Post and Cable Fence	1,513	lf	$18.04				$27,295	$0	$0	$0	$27,295
1.8 Well Survey	1	ls	$968.00				$968	$0	$0	$0	$968
2 LANDFILL REGRADING and SITE RESTORATION											
2.1 Clear and Grub, light trees to 6" dia	3.6	ac			$1,550.00	$1,175.00	$0	$0	$5,580	$4,230	$9,810
2.2 Equipment Mob/demob	2	ea			$61.00	$110.00	$0	$0	$122	$220	$342
2.2 Grade Existing Soil	8,712	cy			$0.16	$0.15	$0	$0	$1,394	$1,307	$2,701
2.3 Topsoil, Furnish and Place, 6" thickness	2,904	sy		$3.50	$0.49	$0.29	$0	$10,164	$1,423	$842	$12,429
2.4 Fine Grading and seeding, incl. lime, fert, and seed	2,904	sy		$0.42	$1.53	$0.29	$0	$1,220	$4,443	$842	$6,505
3 OVERSIGHT											
3.1 Engineering Oversight	15	mn-days			$300.00		$0	$0	$4,500	$0	$4,500
3.2 Site Manager	5	mn-days			$280.00		$0	$0	$1,400	$0	$1,400
4 INSTITUTIONAL CONTROLS											
4.1 CEA & Modify Base Master Plan	1	ls			$16,500.00		$0	$0	$16,500	$0	$16,500
5 DELIVERABLES											
5.1 Post Completion Document	1	ls			$5,500.00		$0	$0	$5,500	$0	$5,500
Subtotal							$31,438	$11,384	$40,862	$7,441	$91,124
Local Area Adjustments							100.0%	101.9%	105.3%	105.3%	
							$31,438	$11,600	$43,028	$7,835	$93,901
Overhead on Labor Cost @ 30%									$12,908		$12,908
G & A on Labor Cost @ 10%									$4,303		$4,303
G & A on Material Cost @ 10%								$1,160			$1,160
G & A on Subcontract Cost @ 10%							$3,144				$3,144
G & A on Equipment Cost @ 10%										$784	$784
Total Direct Cost							$34,581	$12,760	$60,239	$8,619	$116,199
Indirects on Total Direct Cost @ 35%											$40,670
Profit on Total Direct Cost @ 10%											$11,620
Subtotal											$168,489
Health & Safety Monitoring @ 5%											$8,424
Total Field Cost											$176,913
Contingency on Total Field Costs @ 20%											$35,383
Engineering on Total Field Cost @ 10%											$17,691
TOTAL COST											**$229,987**

NAVAL WEAPONS STATION EARLE
Colts Neck, New Jersey
Operable Unit 10 (Site 7)
Alternative 3 - Surface Controls
Capital Cost

6/4/2008 3:20 PM

Item	Item Cost Annually	Item Cost per 2 years until Year 30	Item Cost per 2 years until Year 10	Item Cost per 5 years	Notes
Cap and Fence Inspection	$250				Visual inspection every 6 months
Fence Repair	$250				
Cap Maintenance	$500				Annual maintenance
Sampling		$4,336			Collect six groundwater samples per sampling period plus travel, living, and shipping costs
Analysis/Water		$756			Nine water samples per sampling period for aluminum, iron, and manganese analysis + 40% for QA
Biennial Report		$6,000			Ten hours per sampling report plus markups and other direct costs
Biennial Recertification of CEA			$10,000		
Site Review				$23,000	Review of site conditions by three engineers for Years 5, 10, 15, 20, 25, and 30
TOTALS	$1,000	$11,092	$10,000	$23,000	

NAVAL WEAPONS STATION EARLE
Colts Neck, New Jersey
Operable Unit 10 (Site 7)
Alternative 3 - Surface Controls
Present Worth Analysis

Year	Capital Cost	Annual Cost	Total Year Cost	Annual Discount Rate at 7%	Present Worth
0	**$229,987**		$229,987	1.000	$229,987
1		$1,000	$1,000	0.935	$935
2		$22,092	$22,092	0.873	$19,286
3		$1,000	$1,000	0.816	$816
4		$22,092	$22,092	0.763	$16,856
5		$24,000	$24,000	0.713	$17,112
6		$22,092	$22,092	0.666	$14,713
7		$1,000	$1,000	0.623	$623
8		$22,092	$22,092	0.582	$12,858
9		$1,000	$1,000	0.544	$544
10		$45,092	$45,092	0.508	$22,907
11		$1,000	$1,000	0.475	$475
12		$12,092	$12,092	0.444	$5,369
13		$1,000	$1,000	0.415	$415
14		$12,092	$12,092	0.388	$4,692
15		$24,000	$24,000	0.362	$8,688
16		$12,092	$12,092	0.339	$4,099
17		$1,000	$1,000	0.317	$317
18		$12,092	$12,092	0.296	$3,579
19		$1,000	$1,000	0.277	$277
20		$35,092	$35,092	0.258	$9,054
21		$1,000	$1,000	0.242	$242
22		$12,092	$12,092	0.226	$2,733
23		$1,000	$1,000	0.211	$211
24		$12,092	$12,092	0.197	$2,382
25		$24,000	$24,000	0.184	$4,416
26		$12,092	$12,092	0.172	$2,080
27		$1,000	$1,000	0.161	$161
28		$12,092	$12,092	0.150	$1,814
29		$1,000	$1,000	0.141	$141
30		$35,092	$35,092	0.131	$4,597
				TOTAL PRESENT WORTH	**$392,378**

NAVAL WEAPONS STATION EARLE
Colts Neck, New Jersey
Operable Unit 10 (Site 7)
ALTERNATIVE 4: SINGLE BARRIER CAP, INSTITUTIONAL CONTROLS, AND LONG-TERM MONITORING
Capital Cost

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Extended Cost Subcontract	Extended Cost Material	Extended Cost Labor	Extended Cost Equipment	Subtotal
1 PROJECT PLANNING											
1.1 Prepare Construction Plan	150	hours			$30.00		$0	$0	$4,500	$0	$4,500
1.2 CEA & Modify Base Master Plan	1	ls			$16,500.00		$0	$0	$16,500	$0	$16,500
2 MOBILIZATION/DEMOBILIZATION AND FIELD SUPPORT											
2.1 Office Trailer	7	mo				$282.00	$0	$0	$0	$1,974	$1,974
2.2 Storage Trailer	7	mo				$97.50	$0	$0	$0	$683	$683
2.3 Initial and Final Surveys	7.2	ac	$1,350.00				$9,720	$0	$0	$0	$9,720
2.4 Equipment Mobilization/Demobilization	6	ea			$61.00	$110.00	$0	$0	$366	$660	$1,026
2.6 Site Utilities	7	mo		$427.00			$0	$2,989	$0	$0	$2,989
2.7 Remove fence, decon and disposal	1	ls	$5,000.00				$5,000	$0	$0	$0	$5,000
3 MONITORING WELL AND GAS VENTS											
3.1 Drill rig mob/demob	1	ls	$1,200.00				$1,200	$0	$0	$0	$1,200
3.2 Well drilling (1 at 25 ft)	25	ft	$25.00				$625	$0	$0	$0	$625
3.3 Well Installation	25	ft	$16.00				$400	$0	$0	$0	$400
3.4 Well Protectors	1	ls	$350.00				$350	$0	$0	$0	$350
3.5 NJ Well Permit	1	ls	$100.00				$100	$0	$0	$0	$100
3.6 Well Survey	1	ls	$968.00				$968	$0	$0	$0	$968
3.7 Gas Vent Drillling (6 at 6 ft each)	36	lf	$25.00				$900	$0	$0	$0	$900
3.8 Gas Vent Installation (6 at 8 ft each)	48	ft	$16.00				$768	$0	$0	$0	$768
3.9 Gas Vent Stick-up and Hood	6	ea	$550.00				$3,300	$0	$0	$0	$3,300
3.10 Collect/Containerize IDW	2	ea	$50.00				$100	$0	$0	$0	$100
3.11 Transport/Dispose IDW	2	drums	$150.00				$300	$0	$0	$0	$300
4 DECONTAMINATION											
4.1 Equipment Decon Pad	1	ls		$5,800.00	$6,650.00	$700.00	$0	$5,800	$6,650	$700	$13,150
4.2 Decontamination Services	5	mo		$210.00	$1,800.00	$315.00	$0	$1,050	$9,000	$1,575	$11,625
4.3 Decon Water	5,000	gal		$0.20			$0	$1,000	$0	$0	$1,000
4.4 Decon Water Storage Tank, 6,000 gallon	5	mo				$645.00	$0	$0	$0	$3,225	$3,225
4.5 Clean Water Storage Tank, 4,000 gallon	5	mo				$580.00	$0	$0	$0	$2,900	$2,900
5 SITE REGRADING & CAP											
5.1 Dozer, 140 H. P.	6	mo			$9,522.54	$11,809.06	$0	$0	$57,135	$70,854	$127,990
5.2 Front End Loader, 2 C. Y.	6	mo			$9,522.54	$11,128.68	$0	$0	$57,135	$66,772	$123,907
5.3 Compaction Equipment, Compact Subgrade	2	days			$439.84	$681.40	$0	$0	$880	$1,363	$2,242
2.1 Clear and Grub, light trees to 6" dia	3.6	ac			$1,550.00	$1,175.00	$0	$0	$5,580	$4,230	$9,810
5.5 Spread Subgrade Soil, Common Fill, 6" Thick	2,904	cy		$11.25			$0	$32,670	$0	$0	$32,670
5.6 Install 40 mil smooth LLDPE	172,498	sf	$0.80				$137,998	$0	$0	$0	$137,998
5.7 Install geocomposite drainage layer	172,498	sf	$0.60				$103,499	$0	$0	$0	$103,499
5.8 Drainage layer outlet trench w/ corrugated pipe	500	lf		$1.47			$0	$733	$0	$0	$733
5.9 Spread Vegetative Layer, Select Fill, 18 " Thick	8,712	cy		$15.00			$0	$130,680	$0	$0	$130,680
5.10 Topsoil, Furnish and Place, 6" Thick	2,904	sy		$3.50			$0	$10,164	$0	$0	$10,164
5.11 Fine Grading and seeding, incl. lime, fert, and seed	2,904	sy		$0.42	$1.53	$0.29	$0	$1,220	$4,443	$842	$6,505
5.12 Install Fencing, 6' High	1,513	ft		$14.60	$3.00	$0.78	$0	$22,090	$4,539	$1,180	$27,809
5.13 Install Double Swing Gate, 6' High, 12' Opening	1	ea		$835.00	$225.00	$58.00	$0	$835	$225	$58	$1,118
6 MISCELLANEOUS											
6.1 Construction Oversite (3p*5days*6 months)	390	mn-days			$160.00		$0	$0	$62,352	$0	$62,352
6.2 Post Construction Documents	200	hr			$35.00		$0	$0	$7,000	$0	$7,000
Subtotal							265227.64	209229.98	236305.23	$157,016	$867,779
Local Area Adjustments							100.0%	101.9%	105.3%	105.3%	
							$265,228	$213,205	$248,829	$165,338	$892,600
Overhead on Labor Cost @ 30%									$74,649		$74,649
G & A on Labor Cost @ 10%									$24,883		$24,883
G & A on Material Cost @ 10%								$21,321			$21,321
G & A on Subcontract Cost @ 10%							$26,523				$26,523

NAVAL WEAPONS STATION EARLE
Colts Neck, New Jersey
Operable Unit 10 (Site 7)
ALTERNATIVE 4: SINGLE BARRIER CAP, INSTITUTIONAL CONTROLS, AND LONG-TERM MONITORING
Capital Cost

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Extended Cost Subcontract	Extended Cost Material	Extended Cost Labor	Extended Cost Equipment	Subtotal
G & A on Equipment Cost @ 10%										$16,534	$16,534
Total Direct Cost							$291,750	$234,526	$348,361	$181,872	$1,056,509
Indirects on Total Direct Cost @ 35%											$369,778
Profit on Total Direct Cost @ 10%											$105,651
Subtotal											$1,531,938
Health & Safety Monitoring @ 2%											$30,639
Total Field Cost											$1,562,577
Contingency on Total Field Costs @ 20%											$312,515
Engineering on Total Field Cost @ 10%											$156,258
TOTAL COST											**$2,031,350**

NAVAL WEAPONS STATION EARLE
Colts Neck, New Jersey
Operable Unit 10 (Site 7)
Alternative 4 - Single Barrier Cap, Institutional Controls, and Long-Term Monitoring
Capital Cost

Item	Item Cost Annually	Item Cost per 2 years until Year 30	Item Cost per 2 years until Year 10	Item Cost per 5 years	Notes
Cap and Fence Inspection	$250				Visual inspection every 6 months
Fence Repair	$250				
Cap Maintenance	$500				Annual maintenance
Sampling		$4,336			Collect six groundwater samples per sampling period plus travel, living, and shipping costs
Analysis/Water		$756			Nine water samples per sampling period for aluminum, iron, and manganese analysis + 40% for QA
Analysis/Air		$1,800			Six samples for VOCs, methane and CO_2
Biennial Report		$6,000			Ten hours per sampling report plus markups and other direct costs
Biennial Recertification of CEA			$10,000		
Site Review				$23,000	Review of site conditions by three engineers for Years 5, 10, 15, 20, 25, and 30
TOTALS	$1,000	$12,892	$10,000	$23,000	

NAVAL WEAPONS STATION EARLE
Colts Neck, New Jersey
Operable Unit 10 (Site 7)
ALTERNATIVE 4: SINGLE BARRIER CAP, INSTITUTIONAL CONTROLS, AND LONG-TERM MONITORING
Present Worth Analysis

Year	Capital Cost	Annual Cost	Annual Discount Rate at 7%	Present Worth
0	$2,031,350		1.000	$2,031,350
1		$1,000	0.935	$935
2		$23,892	0.873	$20,858
3		$1,000	0.816	$816
4		$23,892	0.763	$18,230
5		$24,000	0.713	$17,112
6		$23,892	0.666	$15,912
7		$1,000	0.623	$623
8		$23,892	0.582	$13,905
9		$1,000	0.544	$544
10		$46,892	0.508	$23,821
11		$1,000	0.475	$475
12		$13,892	0.444	$6,168
13		$1,000	0.415	$415
14		$13,892	0.388	$5,390
15		$24,000	0.362	$8,688
16		$13,892	0.339	$4,709
17		$1,000	0.317	$317
18		$13,892	0.296	$4,112
19		$1,000	0.277	$277
20		$36,892	0.258	$9,518
21		$1,000	0.242	$242
22		$13,892	0.226	$3,140
23		$1,000	0.211	$211
24		$13,892	0.197	$2,737
25		$24,000	0.184	$4,416
26		$13,892	0.172	$2,389
27		$1,000	0.161	$161
28		$13,892	0.150	$2,084
29		$1,000	0.141	$141
30		$36,892	0.131	$4,833
			TOTAL PRESENT WORTH	**$2,204,529**

NAVAL WEAPONS STATION EARLE
Colts Neck, New Jersey
Operable Unit 10 (Site 7)
Alternative 5: EXCAVATION AND OFF-SITE DISPOSAL
Capital Cost

6/4/2008 3:20 PM

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Extended Cost Subcontract	Extended Cost Material	Extended Cost Labor	Extended Cost Equipment	Subtotal
1 PROJECT PLANNING & DOCUMENTS											
1.1 Prepare Documents & Plans including Permits	100	hr			$30.00		$0	$0	$3,000	$0	$3,000
2 MOBILIZATION/DEMOBILIZATION & SITE SUPPORT											
2.1 Office Trailer	4	mo				$208.00	$0	$0	$0	$832	$832
2.2 Storage Trailer	4	mo				$109.00	$0	$0	$0	$436	$436
2.3 Initial and Final Surveys	7.2	ac	$1,250.00				$9,000	$0	$0	$0	$9,000
2.4 Equipment Mobilization/Demobilization	6	ea			$56.50	$112.00	$0	$0	$339	$672	$1,011
2.5 Site Utilities	4	mo		$450.00			$0	$1,800	$0	$0	$1,800
2.6 Remove fence, decon and disposal	1	ls	$5,000.00				$5,000	$0	$0	$0	$5,000
2.7 Truck Scale Mobilization/Demobilization	1	ea				$12,000.00	$0	$0	$0	$12,000	$12,000
3 DECONTAMINATION											
3.1 Equipment Decon Pad	1	ls		$5,800.00	$6,650.00	$700.00	$0	$5,800	$6,650	$700	$13,150
3.2 Decontamination Services	5	mo		$210.00	$1,800.00	$315.00	$0	$1,050	$9,000	$1,575	$11,625
3.3 Decon Water	5,000	gal		$0.20			$0	$1,000	$0	$0	$1,000
3.4 Decon Water Storage Tank, 6,000 gallon	5	mo				$645.00	$0	$0	$0	$3,225	$3,225
3.5 Clean Water Storage Tank, 4,000 gallon	5	mo				$580.00	$0	$0	$0	$2,900	$2,900
4 EXCAVATION AND DISPOSAL											
4.1 Excavator, Crawler Mounted, 2 cy	4	mo			$8,729.28	$16,241.20	$0	$0	$34,917	$64,965	$99,882
4.2 Front End Loader, 2 C. Y.	4	mo			$8,729.28	$9,613.50	$0	$0	$34,917	$38,454	$73,371
4.3 Verification Sampling (Al, Mn, & Fe)	15	ea	$60.00	$20.00	$30.00		$900	$300	$450	$0	$1,650
4.4 Waste Characterization Testing (TCLP)	20	ea	$785.00	$5.00	$30.00		$15,700	$100	$600	$0	$16,400
4.5 Truck Scale	4	mo				$3,175.00	$0	$0	$0	$12,700	$12,700
4.6 Off-Site Trans and Disposal, Non-Haz Soil	17,820	cy	$95.00				$1,692,900	$0	$0	$0	$1,692,900
4.7 Off-Site Trans and Disposal, Paint & Solvents	1,980	cy	$330.00				$653,400	$0	$0	$0	$653,400
5 SITE RESTORATION											
5.1 Grade Subsoil	8,712	cy			$0.15	$0.13	$0	$0	$1,307	$1,133	$2,439
5.2 Clean backfill	1,697	cy		$11.25			$0	$19,093	$0	$0	$19,093
5.3 Dozer, tractor, 105 H. P.	0.5	mo			$8,729.28	$8,183.60	$0	$0	$4,365	$4,092	$8,456
5.4 Topsoil, Furnish and Place, 6" thickness	2,904	sy		$3.50	$0.49	$0.29	$0	$10,164	$1,423	$842	$12,429
5.5 Fine Grading and seeding, incl. lime, fert, and seed	2,904	sy		$0.36	$1.39	$0.23	$0	$1,045	$4,037	$668	$5,750
6 MISCELLANEOUS											
6.1 Construction Oversite (3p*5days*16 weeks)	240	mn-days			$160.00		$0	$0	$38,400	$0	$38,400
6.2 Post Construction Documents	50	hr			$35.00		$0	$0	$1,750	$0	$1,750
Subtotal							$2,376,900	$40,352	$141,154	$145,193	$2,703,600
Local Area Adjustments							100.0%	106.2%	105.4%	101.5%	
							$2,376,900	$42,854	$148,777	$147,371	$2,715,902
Overhead on Labor Cost @ 30%									$44,633		$44,633
G & A on Labor Cost @ 10%									$14,878		$14,878
G & A on Material Cost @ 10%								$4,285			$4,285
G & A on Subcontract Cost @ 10%							$237,690				$237,690
Total Direct Cost							$2,614,590	$47,140	$208,287	$147,371	$3,017,388
Indirects on Total Direct Cost @ 35%		(Total Direct Cost minus Transportation and Disposal Costs)									$234,881
Profit on Total Direct Cost @ 10%											$301,739
Subtotal											$3,554,007
Health & Safety Monitoring @ 2%											$71,080

Colts Neck, New Jersey
Operable Unit 10 (Site 7)
Alternative 5: EXCAVATION AND OFF-SITE DISPOSAL
Capital Cost

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Extended Cost Subcontract	Extended Cost Material	Extended Cost Labor	Extended Cost Equipment	Subtotal
Total Field Cost											$3,625,088
Contingency on Total Field Costs @ 20%											$725,018
Engineering on Total Field Cost @ 10%		(Total Field Cost minus Transportation and Disposal Costs)									$127,879
TOTAL COST											**$4,477,984**

APPENDIX G

SUPPORTING DOCUMENTATION
DEVELOPMENT OF GROUNDWATER RISK-BASED CLEANUP GOALS

PRG DEVELOPMENT FOR GROUNDWATER CANDIDATE COCS
SITE 7 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY

Candidate PRG	Candidate PRG (ug/L)	Oral RfD mg/kg/day	Cancer Slope Factor (CSF) 1/(mg/kg/day)	RfD/CSF Source	Target Risk Level (Target Organ)	Pathway	Basis of PRG (ug/L)	Receptor Assumptions
Aluminum	7800	1		NCEA	HQ = 0.5 (CNS)	Ingestion	Noncancer risk, tap water ingestion	Child Resident, 15 kg BW, 1 L/day water intake, 350 days/yr EF
Iron	5500	0.7		NCEA	HQ = 0.5 (Liver/Blood/GI Tract)	Ingestion	Noncancer risk, tap water ingestion	Child Resident, 15 kg BW, 1 L/day water intake, 350 days/yr EF
Manganese	160	0.02		IRIS	HQ = 0.5 (CNS)	Ingestion	Noncancer risk, tap water ingestion	Child Resident, 15 kg BW, 1 L/day water intake, 350 days/yr EF
Chlorobenzene	160	0.02		IRIS	HQ = 0.5 (Liver)	Ingestion	Noncancer risk, tap water ingestion	Child Resident, 15 kg BW, 1 L/day water intake, 350 days/yr EF
Chloroform	190		0.0805	IRIS	10^{-4} cancer risk	Inhalation	Cancer risk, showering inhalation	Adult resident, daily showering (Foster and Chrostowski model)

Candidate risk based PRGs are based on tap water ingestion for aluminum, iron, manganese, and chlorobenzene. Candidate PRG for chloroform is based on inhalation during showering.
Note that the noncancer target hazard quotient (HQ) was adjusted to equal the reciprocal of the number of contaminants that affect the same target organ (HQ = 1/2 in each case).

Risk-based PRGs for tap water ingestion for contaminants associated with noncancer toxicity were calculated using the formula:

$$\text{PRG (ug/L)} = \frac{\text{(0.5 Target HQ) x (RfD-oral) x (15 kg BWc) x (6 yr EDc x 365 days/yr ATn)}}{\text{(350 days/yr EF) x (6 yr EDc) x (1 L/day IRWc) x (0.001 mg/ug)}}$$

Chloroform candidate PRG was estimated based on shower model risk calculation which indicates 1 ug/L chloroform would yield a cancer risk of 5.15E-07 (model input parameters listed below)
The risk-based candidate PRG for chloroform inhalation was calculated using the formula:

$$\text{PRG (ug/L)} = \frac{\text{(}10^{-4}\text{ Target Risk) x (1 ug/L concentration used to estimate showering risk)}}{\text{(5.15E-7 cancer risk from showering given 1 ug/L chloroform)}}$$

Showering model reference:
Foster, S. A. and P.C. Chrostowski. 1987. Inhalation Exposures to Volatile Organic Contaminants in the Shower. Presented at the 80th Annual Meeting of the Air Pollution Control Association. New York, NY. June.
Showering model input parameter assumptions included the following:

		0.01667 room volume air exchanges per minute
10 L/min flow rate	1 mm droplet diameter	70 kg BW
12 m3 shower enclosure volume	0.84 m3/hr inhalation rate	24 years ED
45 degrees C water temperature	30 minute shower duration	350 days/yr EF
0.5 sec droplet fall time	60 minutes after shower in bathroom	0.00782 Henry's Law for Chlorform at 45 degrees C

Comparison to EPA Region 3 Tap Water RBCs			
Substance	Reg.3 RBC at HQ=0.5 Converted from Adult to Child Exposure	EPA Tap Water RBC ug/L	
Aluminum	7800	36500	
Iron	5500	25550	
Manganese	160	730	
Chlorobenzene	20	89.65	<--- Difference versus calculated PRG is because Region 3 RBC also includes inhalation exposure.

VALUES USED FOR DAILY INTAKE CALCULATIONS - ADULT RESIDENT CONTACT WITH SITE 7 GROUNDWATER
REASONABLE MAXIMUM EXPOSURE
NWS EARLE, COLTS NECK, NEW JERSEY

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Resident	Adult	Inhalation of Vapors During Showering	EF	Exposure Frequency	350	days/year	USEPA, 2004	Intake (mg/kg-day) = (D x EF x ED)/AT
				ED	Exposure Duration	24	years	USEPA, 2004	See Foster and Chrotowski, 1987
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8760	days	USEPA, 1989	
				D	Inhalation Dose for Each Shower	Chemical Specific	mg/kg/shower	Fos&Chr, 1987	where: D = [(IR x S) / (BW x Ra x CF1)] x Q
				IR-SH	Inhalation Rate in Shower	14	l/min	USEPA, 2006	
				BW	Body Weight	70	kg	USEPA, 2004	
				CF1	Conversion Factor	1.00E+06	(ug x l)/(mg x m3)		
				Q	Function of Air Exchange Rate & Time in Shower & Shower Room	15.68	min	Calculated	where: Q = Ds + [(exp(-Ra x Dt))/Ra] - [(exp(Ra x (Ds - Dt)))/Ra]
				Ds	Duration of Shower	30	min	USEPA, 2006	
				Dt	Total Time in Shower Room	60	min	USEPA, 2006	
				Ra	Rate of Air Exchange	0.01667	1/min	Fos&Chr, 1987	
				S	Indoor VOC Generation Rate	Chemical Specific	ug/m3/min	Fos&Chr, 1987	where: S = CWD x FR/SV
				FR	Shower Flow Rate	10	l/min	USEPA, 2006	
				SV	Shower Room Air Volume	12	m3	USEPA, 2006	
				CWD	Chemical Concentration Leaving Water Droplet after time ts	Chemical Specific	ug/l	Fos&Chr, 1987	where: CWD = CW x {1-exp[-KaL x ts x (6/d) x CF2 x CF3]}
				CW	Chemical Concentration in Groundwater	Max or 95% UCL	ug/l	USEPA, 2002a	
				CF2	Conversion Factor	1/3600	hr/sec		
				CF3	Conversion Factor	10	mm/cm		
				ts	Shower Droplet Time	0.5	sec	USEPA, 2006	
				d	Shower Droplet Diameter	1	mm	Fos&Chr, 1987	
				KaL	Adjusted overall mass transfer coefficient	Chemical Specific	cm/hr	Fos&Chr, 1987	where: KaL = KL/SQRT[(T1 x us)/(Ts x u1)]
				T1	Calibration Water Temperature of KL	293	K	Fos&Chr, 1987	
				Ts	Shower Water Temperature	318	K	Fos&Chr, 1987	
				u1	Water Viscosity at T1	1.002	centipose	Fos&Chr, 1987	
				us	Water Viscosity at Ts	0.596	centipose	Fos&Chr, 1987	

VALUES USED FOR DAILY INTAKE CALCULATIONS - ADULT RESIDENT CONTACT WITH SITE 7 GROUNDWATER
REASONABLE MAXIMUM EXPOSURE
NWS EARLE, COLTS NECK, NEW JERSEY

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Resident	Adult	Inhalation of Vapors During Showering	KL	Mass Transfer Coefficient	Chemical Specific	cm/hr	Fos&Chr, 1987	where: KL = 1/[(1/KL) + ((R x T)/(H x kg))]
				R	Ideal Gas law Constant	8.21E-05	atm m3/mole/K	Fos&Chr, 1987	
				T	Absolute Temperature	293	K	Fos&Chr, 1987	
				H	Henry's law Constant	Chemical Specific	atm m3/mole	USEPA, 2002b	
				kg	Gas-film Mass Transfer Coefficient	Chemical Specific	cm/hr	Fos&Chr, 1987	where: kg = kH x SQRT[MWH/MW]
				kl	Liquid-film Mass Transfer Coefficient	Chemical Specific	cm/hr	Fos&Chr, 1987	where: kl = kC x SQRT[MWC/MW]
				kH	Gas-film Mass Transfer Coefficient for Water	3000	cm/hr	Fos&Chr, 1987	
				kC	Liquid-film Mass Transfer Coefficient for Carbon Dioxide	20	cm/hr	Fos&Chr, 1987	
				MWH	Molecular Weight of Water	18	g/mole	Fos&Chr, 1987	
				MWC	Molecular Weight of Carbon Dioxide	44	g/mole	Fos&Chr, 1987	
				MW	Molecular Weight of COPC	Chemical Specific	g/mole	Fos&Chr, 1987	

Sources

USEPA, 1989. Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A). USEPA 540/1-89/002. Office of Emergency and Remedial Response. Washington, DC.

USEPA, 1997. Exposure Factors Handbook. Update to Exposure Factors Handbook. USEPA/600/8-89/043 - May 1989. Office of Research and Development.

USEPA, 2001. Fact Sheet. Correcting the Henry's Law Constant for Soil Temperature, from website: http://www.USEPA.gov/superfund/programs/risk/airmodel/factsheet.pdf

USEPA, 2002a: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10.

USEPA, 2002b: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

USEPA, 2006: Recommended by Region 3 EPA.

Foster, S. A. and P.C. Chrostowski. 1987. Inhalation Exposures to Volatile Organic Contaminants in the Shower. Presented at the 80th Annual Meeting of the Air Pollution Control Association. New York, NY. June.

Default Henry's Law Constants (HLCs) at 25 degrees C obtained from EPA, 1996. See appendix for conversion of HLCs to showering temperature using EPA, 2001.

APPENDIX H

EPA COMMENTS ON DRAFT FEASIBILITY STUDY

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 2
290 BROADWAY
NEW YORK, NY 10007-1866

NOV 20 2007

Mr. Roberto Pagtalunan, Project Manager
Naval Facilities Engineering Command, Mid-Atlantic
9742 Maryland Avenue
Norfolk, VA 23511-3095

Re: Feasibility Study for Site 7 (OU-10), July, 2006

Dear Mr. Pagtalunan,

The Environmental Protection Agency (EPA) in accordance with our Federal Facility Agreement with the Navy, has reviewed the above referenced report prepared by Tetra Tech Nus, Inc. Attached are our comments.

If you have any questions, please contact me at (212) 637-3921.

Sincerely,

Jessica Mollin

Jessica Mollin, Remedial Project Manager
Federal Facilities Section

cc: E. Helms, Naval Weapons Station Earle
G. Lipsius, NJDEP

Comments on Feasibility Study – Marian Olsen – Human Health Risk

Executive Summary

1. Page ES-1. It is suggested that in Paragraph 3, that the discussion of unacceptable rish should indicate the risk range i.e., 1 X 10-6 to 1 X 10-4 and an HI>1.

2. Page ES-3. Top of Page. This section should clarify that the cover on the current landfill does not meet state landfill requirements.

3. Sediment and Groundwater Sections. The source of the background sample and procedure for comparing site concentrations to background should be clarified in the section.

4. Last paragraph. This section should clarify the number of samples taken. Where the section indicates that a contaminant was detected, the total number of samples should be identified. Typically, if the detection was 1 sample in 20, it would not be evaluated further in a risk assessment except in those cases where the chemical is a known human carcinogen. To avoid confusion, the number of detections and total number of samples should be identified.

5. Page ES-4, Surface Water Section.

a) This section should clarify the source of the background sample.

b) Summary of Site Risks – last paragraph. This section should clarify if the concentration of phthalate in the 1993 sample was below the screening level.

c) 2005 Groundwater Sampling – The last sentence regarding secondary standards requires clarification. The secondary standards are typically based on odor, staining and other criteria. The statement regarding risk should be based on a comparison to a risk based value.

6. Page ES-10, Site 7, Alternative 3, Paragraph 1. Clarify that the soil cover does not meet the state criteria for landfill closure.

7. Page ES-11, Long-Term Monitoring. Identify the relative locations of the wells related to the landfill.

8. Page ES-11, Alternative 4. Clarify that the landfill cover does not meet the state landfill requirements for closure.

9. Page ES-18, last paragraph. Provide a table that summarizes the alternatives and the associated costs for each individual alternative.

Section 1

10. Page 1-17. Clarify the basis for the determination that acetone and phthalate were laboratory contaminants. As discussed in the Risk Assessment Guidance for Superfund, we typically consider the sample concentration and compare that concentration to the concentration to the blank and make a determination regarding whether it is a lab contaminant. The current presentation does not provide this detail.

11. Page 1-20. As described above, this section requires further clarification regarding how it was determined that the contaminants were below background concentrations. This can be linked to Section 1.4.

12. Page 1-26, Section 1.4.6. This section should identify how this analysis applied EPA's background policy. A reference should be provided here.

13. Page 1-39. The discussion of lead should be highlighted in the Executive Summary as well.

Section 2

14. Table 2-1, first line. The discussion of the use of the MCL to derive potential soil cleanup levels should be clarified.

15. Table 2-2, Page 2, first line. Indicate the industrial remedial level of lead of 800 ppm from the Lead TRW homepage.

16. Page 2, lines 3 and 4. This information should be replaced by PRG or RBC. The calculation of the PRGs and RBCs include both exposure and toxicity values yet only toxicity values are listed. These sections should be combined and listed as PRGs or RBCs and not toxicity values alone.

17. Page 2, line 5. Clarify if these are drinking water health advisories. If so, this should be listed.

18. Page 3, line 4. Clarify the date of the NJ Soil Cleanup Criteria.

19. Page 2-14, Section 2.3.1. Update the lead guidance to include the adult lead value from the Lead TRW homepage.

20. Section 2.3.2. This section requires clarification. Was RAGS-Part B used in the calculation of the PRG? Consistent with guidance the PRGs are developed based on the point of departure of 10-6 and an HI=1. Based on land use a PRG can be developed for industrial purposes if the land use is industrial.

21. Page 2-18, paragraph 3. Clarify that institutional controls are not in place to prevent potential future drilling of wells.

22. Page 2-20. The discussion of the frequency of detection of thallium should include the number of samples taken as described above.

23. Table 2-7, footnote --. Clarify that the risks are within or below the risk range. The statement "no risk" is not appropriate. Footnote (2) – the table does not include a statement with this footnote.

24. Table 2-8. The discussion of the background concentrations requires further clarification. This table suggests that the ARAR will not be met since the New Jersey GWQS is below background.

25. Table 2-9. The second MCL is not a PRG. The PRG should be based on a risk calculation at an HI=1. The table title should be updated to indicate that this concentration is the GWQS and not a PRG.

Section 3

26. Page 3-5, Section 3.1.2.3. This section should indicate that the soil cover does not meet state closure requirements.

27. Page 3-8, Section 3.1.2.4. The section of existing features should be copied and placed in Section 3.1.2.3.

Section 4

28. Page 4-7, first paragraph. The discussion regarding the failure of the remedial options to meet the N.J.A.C. 7:26 should be highlighted.

Appendix A

29. Several codes are not defined including: P, A and K.

Appendix B

30. Clarify that these are the results for the amended risk assessment.

Appendix E

31. Page 1, last paragraph. Change to: (NCEA) Superfund Technical Support Center.

32. Page 2, Table. Explain what is meant by "Adjusted RBC". Also include a table title.

33. Page 4, Table. Explain the term "Adjusted RBC" and also include a title. Second paragraph – the last sentences in this paragraph are confusing.

Comments on Feasibility Study – Mindy Pensak - BTAG

1) The Summary of Site Risks (page ES-4) indicates that at the request of EPA, the Navy has performed a review of the human health risk based on current EPA risk assessment guidelines and risk factors. It is recommended that a screening level ecological risk assessment (SLERA) be completed following the *Ecological Risk Assessment Guidelines* [ERAGs] (EPA 1997). The "wet soil" sample collected should be considered a soil sample, rather than a sediment sample. Surface soil data should be compared to appropriate ecological soil screening levels. Comparisons to background values may be done following the SLERA, as part of refining the contaminants of concern list. Data should not be compared to 2x background (Table 1-7 Occurrence and Distribution of Inorganics in Sediment). In the description of the ecological risk assessment conducted (Section 1.9 Ecological Risk Assessment) it appears that one "sediment" sample and two soil samples were collected from the test pits. It is unclear whether samples were collected from the top 12" (the recommended sampling depth for ecological risk assessments) and whether or not contaminants were present at concentrations exceeding ecological soil screening levels. Further, it is unclear why the assessment endpoint for the landfill is the protection of plants and animals inhabiting the wetlands and marsh areas and the watershed areas (Section 2.3.3 Ecological Risk Basis). The assessment endpoint(s) should be specific to soil invertebrate and terrestrial receptors most likely to frequent this particular habitat. ERAGs and *Generic Ecological Risk Assessment Endpoints for Ecological Risk Assessment* (EPA 2003) should be consulted for the development of appropriate assessment endpoints.

2) There is a small depression (approximately 150' by 30') on top of the landfill which is a wetland area. The description of this wetland and the plants it supports are inconsistent throughout the document. The executive summary (page ES-3) indicates that this is a "small marginal wetland area ... with heavy grasses and tall reeds," while Section 1.9 Ecological Risk Assessment alternately describes the small wetland on the site as providing excellent wetland habitat (page 1-40) and a marginal wetland (page 1-41). Further, Table 3-2 Screening of Remedial Alternatives, notes the presence of phragmites growing in this area, although this is not discussed in any other section of the document. These conflicting statements should be addressed and a better description of this wetland area should be provided.

3) As the document concludes that ecological risk is negligible, it is unclear why the discussions of Alternative 2 & 3 (page ES-9 & ES-10) indicate that the remedies offer limited protection to the environment.

4) A figure clearly showing all background locations and the types of samples collected as well as the resultant data should be provided (Section 1.4 Background Environmental Sampling). The discussion of soil background samples (Section 2.3.5 Background Concentrations Basis) notes that eight samples were collected; however this is not consistent with Section 1.4 which indicates that four background samples

were collected for each media. These sections should be consistent. It should also be noted whether these were surface soil or subsurface soil samples. It may not be appropriate to combine soil data from different depths.

5) Section 2.2 Method Used for Development of Remedial Action Objectives, page 2-13: It is noted that ecological RAOs are formulated to reduce or prevent the detrimental effects of site-related contaminants on environmental media or to address contaminant concentration that exceed regulatory standards. While this summary is correct, the examples (degradation of groundwater quality and New Jersey (GWQS) are not applicable to ecological receptors. Appropriate media are surface water, sediment and surface soils, and appropriate guidelines are NJDEP Surface Water Quality Standards, NJDEP Guidance for Sediment Quality Evaluations (November 1998), and EPA Ecological Soil Screening Levels.

Comments on the Feasibility Study – Nikolaus Wirth – Fish and Wildlife Service

Wetlands

Page ES-3 in the FS notes a small depression on top of the landfill characterized as a marginal wetland area with heavy grass and tall reeds. Table 3-2 in the FS notes that there is a depression in the middle of the landfill with phragmites growing. Section 1.9 in the FS notes that a small wetland within the landfill that provides an excellent wetland habitat. This discrepancy should be clarified. The wetland(s) within the vicinity of Site 7 boundary area should be delineated utilizing the 1987 Corps of Engineers Wetlands Delineation Manual, if this has not been done in the past. This will assist with wetland identification/characterization.

Implementing Preferred Alternatives 3 through 5 will impact the wetland on the landfill, therefore Executive Order 11990, "Protection of Wetlands," is a potential ARAR as noted in Table 2-3 in the FS. It appears that the wetland to the west of Site 7 will not be impacted by any of the preferred remedial alternatives. In future project documents, delineated wetlands within the project area should be shown on a figure in relation to the selected activities to determine the impacts. If the selected action will be implemented within wetland(s), a wetland assessment will be needed. Additionally, a Statement of Findings for wetland(s) to be impacted may be required to document this decision in the ROD.

Endangered Species

Page 1-8 of Section 1.1 in the FS report explains that there is a rich diversity of ecological systems and habitats at the NWS Earle. Further, the federally endangered Knieskern's beaked-rush (*Rynchospora knieskirnii*) has been seen at the station and the swamp pink (*Helonias bullata*) may be present. The tidal wetland/marsh bordering the Waterfront Area is an environmentally useful resource that serves as a nursery for many marine and shore animals. According to my review of the project correspondence folder,

there is no information from the U.S. Fish and Wildlife Service (FWS) on threatened or endangered species and their critical habitats that may be present at the NWS Earle. To comply with the Endangered Species Act, the U.S. Navy should initiate and maintain Section 7 informal consultation with the U.S. Fish and Wildlife Service (FWS), if this has not been done in the past five years. The FWS may request the Navy to conduct the required assessments and/or surveys to determine if threatened and/or endangered species and their critical habitats are present in the project area.

Cultural Resources

According to my review of the records in the project correspondence folder and as outlined in Table 2-3 in the FS, the National Historic Preservation Act may be a potential ARAR. Further, Table 2-3 also notes that no such artifacts have been encountered to date at OU10. No documentation has been provided in the FS report to support this.

Other ARARs and TBCs

There are no wild and scenic rivers, coastal barriers, wilderness areas, or significant agricultural lands in the vicinity of Site 7. Site 7 does not lie within the 100- or 500-year floodplain or the coastal zone of the state of New Jersey. Therefore, the Wild and Scenic Rivers Act, the Coastal Barrier Resource Act, the Wilderness Act, the Farmland Protection Policy Act, Executive Order 11988 (Floodplain Management), and the Coastal Zone Management Act are not ARARS for this project.