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NWS EARLE
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PHIL-17718

Project Number 2128

January 20, 2004

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

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

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

Subject: Final Feasibility Study (FS) Report for Sites 6, 12, 15 and 17 (OU 9)
NWS Earle - Colts Neck, New Jersey

Dear Ms. DiGeambeardino:

Tetra Tech NUS, Incorporated (TtNUS) is pleased to provide copies of revised pages for the subject Final FS report dated November 2003. The changed pages enclosed include blue 'breaker' pages of instructions for removal of the old and placement of the new changed pages.

Three sets of copies and instructions have been sent to Jessica Mollin at EPA, Region 2, three copies have been sent to Bob Marcolina at NJDEP, two copies have been sent to Larry Burg at NWS Earle, and three copies are enclosed for your use. Each set of copies pertains to one original report (in three ring binders) distributed in November 2003.

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

Sincerely,

Russ Turner

Russell E. Turner
Project Manager

RET/vh

Enclosures

c: Larry Burg (NWS Earle)
Jessica Mollin (EPA, Region 2)
Bob Marcolina (NJDEP)
Garth Glenn (TtNUS) (without enclosures)
File

REPLACEMENT FOR TABLE 1-11 (Page 1-33)

Please remove page 1-32/1-33 from your copy of the FS for OU 9 and place the following page in its' place.

Changes to the footnotes of Table 1-11 have been made to satisfy requirements of EPA Region 2.

Discard this sheet

TABL 10
OCCURRENCE AND DISTRIBUTION OF INORGANICS IN SEDIMENT AT SITE 6
OU-9 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY
(mg/kg)

	BACKGROUND***				SITE-RELATED					
SUBSTANCE	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	UTL**	2 X AVERAGE CONCENTRATION	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	AVERAGE CONCENTRATION	MEAN > 2 X BKGD?	MEAN > BACK UTL?	REPRESENTATIVE CONCENTRATION
ALUMINUM	6 / 6	639 - 3940	8.1E+07	5459.67	10 / 10	2050 - 14500	5491.00	YES	NO	7578.17
ANTIMONY *	NOT DETECTED	-	-	-	2 / 10	0.51 - 12.4	2.42	YES	-	4.63
ARSENIC *	5 / 6	2.4 - 9.9	2.9E+02	11.23	10 / 10	1.9 - 36.3	13.93	YES	NO	21.60
BARIUM	6 / 6	3.2 - 15.8	2.9E+02	16.80	10 / 10	5 - 138	42.69	YES	NO	72.47
BERYLLIUM	4 / 6	0.34 0.57	3.3E-01	0.72	9 / 10	0.11 - 1.2	0.42	NO	YES	0.64
CADMIUM	2 6	0.44 - 0.46	1.1E+00	0.93	2 / 10	1.5 - 1.8	0.41	NO	NO	0.80
CALCIUM	6 / 6	179 - 518	6.7E+05	690.83	10 / 10	92.4 - 8820	1890.64	YES	NO	3522.28
CHROMIUM	6 / 6	4.3 - 56	2.6E+03	40.42	7 / 7	14.4 - 77.2	34.64	NO	NO	50.89
COBALT	4 / 6	0.51 2.1	6.4E+00	2.85	9 / 10	0.33 - 8.2	2.62	NO	NO	4.38
COPPER *	6 / 6	1 - 13	1.9E+01	9.08	10 / 10	0.75 - 228	39.85	YES	YES	82.70
IRON	6 / 6	228 - 21400	7.2E+09	23589	10 / 10	1790 - 52200	21524	NO	NO	32677
LEAD *	6 / 6	4 - 34.3	4.8E+01	21.07	10 / 10	3.8 - 445	80.28	YES	YES	163.62
MAGNESIUM	6 / 6	60.7 - 880	2.0E+06	809.90	9 / 10	401 - 2460	1165.04	YES	NO	2460.00
MANGANESE	6 / 6	3.9 - 63.1	8.9E+01	36.22	10 / 10	4.1 - 451	72.84	YES	NO	152.91
MERCURY *	1 / 6	0.068 0.068	8.5E-03	0.09	4 / 10	0.027 - 0.63	0.15	YES	YES	0.27
NICKEL	5 / 6	1.6 - 6	3.4E+01	6.90	10 / 10	0.93 - 43.8	9.09	YES	NO	17.03
POTASSIUM	5 / 6	86.1 - 2900	1.4E+07	1892.03	10 / 10	172 - 2630	1093.70	NO	NO	2411.68
SELENIUM	0 / 6	-	1.9E+00	-	4 / 10	1.2 - 3.4	1.22	YES	NO	1.88
SILVER	2 / 6	0.1125 0.15	2.8E+00	1.13	2 10	0.12 - 0.26	0.35	NO	NO	0.26
SODIUM	4 / 6	26.6 - 2280	2.9E+03	876.80	9 / 10	28.6 - 6960	1105.26	YES	NO	2320.44
THALLIUM *	NOT DETECTED	-	-	-	2 / 10	0.92 - 2.1	0.67	YES	-	0.98
VANADIUM	6 / 6	5.9 - 42.7	2.1E+03	39.42	10 / 10	3.9 - 104	37.67	NO	NO	104.00
ZINC	6 / 6	12.5 - 34.7	1.5E+03	41.23	10 / 10	4.5 - 1720	244.76	YES	NO	556.85

* - Selected as a COPC

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

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

TABLE 1-11
OCCURRENCE AND DISTRIBUTION OF ORGANICS IN SEDIMENT AT SITE 6
OU-9 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY
(ug/kg)

SUBSTANCE	BACKGROUND**			SITE-RELATED		
	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	REPRESENTATIVE CONCENTRATION	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	REPRESENTATIVE CONCENTRATION
4,4'-DDD *	2 / 6	4.9 - 21	11.98	4 / 9	2.4 - 230	80.01
4,4'-DDE *	1 / 6	1.7 - 1.7	1.7	5 / 10	3.6 - 66	24.62
4,4'-DDT *	1 / 6	19 - 19	10.64	4 / 10	9.3 - 110	47.12
ALPHA-CHLORDANE *	NOT DETECTED	-	-	3 / 9	9.8 - 48	19.64
DIELDRIN *	NOT DETECTED	-	-	2 / 10	0.31 - 1.6	1.6
ENDOSULFAN II *	NOT DETECTED	-	-	3 / 10	2.6 - 24	8.82
ENDRIN *	NOT DETECTED	-	-	1 / 10	1.6 - 1.6	1.6
ENDRIN KETONE *	1 / 5	1.6 - 1.6	1.6	1 / 10	7.3 - 7.3	7.3
GAMMA-CHLORDANE *	1 / 6	0.095 - 0.095	0.095	4 / 10	0.34 - 56	19.82
HEPTACHLOR *	NOT DETECTED	-	-	2 / 10	0.16 - 0.35	0.35
HEPTACHLOR EPOXIDE *	NOT DETECTED	-	-	4 / 10	0.2 - 2.3	2.30
ACENAPHTHYLENE *	NOT DETECTED	-	-	2 / 10	56 - 160	160.00
ANTHRACENE *	NOT DETECTED	-	-	3 / 10	88 - 260	260.00
BENZ(A)ANTHRACENE *	3 / 6	85 - 560	560	5 / 10	75 - 1700	676.58
BENZO(A)PYRENE *	3 / 6	110 - 590	393.60	6 / 10	100 - 2400	852.30
BENZO(B)FLUORANTHENE *	3 / 6	150 - 490	346.54	5 / 10	190 - 4800	1587.69
BENZO(G,H,I)PERYLENE *	3 / 6	51 - 380	380	4 / 10	150 - 2600	912.89
BENZO(K)FLUORANTHENE *	3 / 6	63 - 470	470	5 / 10	66 - 1100	451.37
BIS(2-ETHYLHEXYL)PHTHALATE	NOT DETECTED	-	-	2 / 10	96 - 880	521.76
BUTYLBENZYLPHTHALATE *	NOT DETECTED	-	-	1 / 10	300 - 300	300.00
CARBAZOLE *	NOT DETECTED	-	-	1 / 10	140 - 140	140
CHRYSENE *	3 / 6	130 - 940	577.87	5 / 10	130 - 2400	884.84
DIBENZ(A,H)ANTHRACENE *	NOT DETECTED	-	-	2 / 10	150 - 720	385.24
DIBENZOFURAN *	NOT DETECTED	-	-	1 / 10	78 - 78	78
FLUORANTHENE *	3 / 6	240 - 1800	1024.31	5 / 10	110 - 1600	819.64
FLUORENE *	1 / 6	190 - 190	190	2 / 10	65 - 83	83
INDENO(1,2,3-CD)PYRENE *	3 / 6	55 - 310	310	5 / 10	69 - 2300	800.89
NAPHTHALENE *	NOT DETECTED	-	-	1 / 10	90 - 90	90.00
PHENANTHRENE *	3 / 6	110 - 1900	1052.11	4 / 10	210 - 740	421.54
PYRENE *	3 / 6	200 - 1900	1076.74	5 / 10	130 - 2000	884.61
4-METHYL-2-PENTANONE *	NOT DETECTED	-	-	1 / 4	2 - 2	2
TOLUENE *	1 / 3	480 - 480	480	1 / 4	31 - 31	31
XYLENE (TOTAL) *	NOT DETECTED	-	-	1 / 4	3 - 3	3

* - Selected as a COPC

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

Background concentrations for any non-naturally occurring chemicals were not used as a basis for selection of COPCs. All organic compounds detected at the site were selected as COPCs.

REPLACEMENT FOR PAGE 1-45

Please remove pages 1-45/1-46 and 1-47/1-48 from your copy of the FS for OU 9 and place the following pages in their place.

Changes to paragraphs 3 and 4 of page 1-45 and paragraph 1 of page 1-46 have been made to clarify issues raised by EPA Region 2.

Discard this sheet

Only the maximum concentration of arsenic found in one groundwater sample, 26.8 ug/l, would result in calculated human health risk greater than the EPA acceptable risk range under the RME or CTE future residential exposure scenarios. Detected arsenic concentrations in the other Site 6 groundwater wells were 5.1 ug/l and 8.8 ug/l. These relatively low concentrations, as well as the average concentration in the four background groundwater samples, 10.6 ug/l, would also result in calculated risk levels within (at the upper end of) EPA's acceptable risk range.

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/FS. Lead was not found at levels exceeding 400 mg/kg in subsurface soil samples from previous investigations.

1.3.2.3.5 Ecological Risk Assessment

The results of the 1996 RI ecological risk assessment showed that several inorganics and organics, primarily PAH compounds were present in surface water and sediment near the sites in excess of screening values. Concentrations of lead, zinc, and several PAHs in sediment collected near the Site 6 landfill toe were significantly elevated. Because data from the 1993 SI and 1996 RI indicated minimal impacts to groundwater, erosion and overland runoff from the landfill toe were considered possible contaminant migration pathways. However, surface water and sediment samples had not been collected farther away from the site in the marsh. As a part of the 1997 Addendum RI investigation, after consultation with EPA Region 2 and NJDEP, the Navy collected additional surface water and sediment samples farther into the marsh to determine the extent of the impacts of landfill-related contaminants on the marsh. The results of the 1997 samples and the recalculated ecological risk assessment are discussed below.

In Site 6 surface water and sediments, only a few contaminants that had high frequencies of detection exceeded screening levels referenced in the RI report (B&R Environmental 1996) and the RI Addendum report (B&R Environmental 1998). Of these, the most significant exceedances in surface water were for aluminum, iron, lead, and vanadium. The high concentrations were confined to sample 06SW06, which was one of the samples collected farthest from the former landfill. Sediment concentrations at this location were not significantly elevated, and sediment contaminant concentrations in sample 06SD09, which was collected in the same area as 06SW06 but closer to the landfill, were also relatively low. In Site 6 sediments, the average concentrations of all metals were below threshold values. Concentrations of some inorganics for which no screening values were available were significantly elevated in sediment sample 06SD07. However, surface water concentrations at that location were not elevated, and sediment concentrations in sample 06SD10, which was taken in the same general area as sample 06SD07 but

closer to the landfill, were not significantly elevated. Frequencies of detection and hazard quotient (HQ) values for organics in Site 6 sediments were all low.

In summary, significantly elevated contaminant concentrations and exceedances of threshold values from the 1995 RI samples were not prevalent in surface water and sediment samples collected in 1997 farther into the marsh adjacent to Site 6. Therefore, impacts of contaminants from Site 6 on the marsh were considered to be minimal. Elevated concentrations of some inorganics were present but were confined primarily to ubiquitous metals in only a few samples collected relatively far from the landfill. This indicated that these elevated concentrations were most likely indicative of contaminant sources that were not related to the landfill. Additive impacts on the watershed and cumulative effects from contaminants from the site on marsh receptors are unlikely. Concentrations of contaminants that bioaccumulate and biomagnify were also relatively low. Thus, potential risks to organisms from exposure via the foodchain (e.g., wading birds) appeared to be highly unlikely. Concentrations of contaminants in surface water and sediments in the two samples collected upstream from the marsh were low and, as a result, impacts to the marsh from upstream sources appeared to be negligible.

The data indicate that the assessment endpoint chosen, the maintenance of receptor populations in the marsh, does not appear to be compromised from Site 6 or upstream contaminants; therefore, ecological risks to the marsh from Navy-related areas appear to be insignificant. Remedial action based on ecological risk concerns or additional, more focused ecological studies are therefore unwarranted.

Site-Specific Uncertainties

Significantly elevated concentrations of some metals (aluminum, beryllium, iron, lead, and silver), were present in surface water sample 06SW06. HQ values for these metals were also significantly elevated. However, sediment concentrations of those contaminants at the same sampling location were not elevated and were not elevated in sediment sample 06SD09, which was collected in the same drainageway, but closer to the landfill. Therefore, this area appears to be unrelated to the site. Although other RI sites are located in the Waterfront (Sites 15 and 16), they were determined to have minimal ecological impacts on the surrounding areas in the RI report. Although these constituents do not appear to be due to Site 6, their presence introduces uncertainty into the assessment.

Despite heavier than average rainfall, sampling conditions precluded the collection of surface water samples at the RI Addendum sampling locations closest to the landfills. Although the definitive nature of the remainder of the data set heavily mitigates the lack of surface water data at those sampling locations, uncertainty is introduced into the ecological risk assessment because of this data gap.

Potential risks were often considered to be low in the assessment if HQ values were low, although theoretically, the potential for risk exists if a threshold is exceeded at all. These conclusions were made because most threshold values are based on data from laboratory studies that do not take into account ameliorating physico-chemical factors in the environment. Although the HQ cannot be interpreted as a probabilistic indicator of risk (i.e., an HQ of 10 cannot be assumed to correlate to 10 times more risk than an HQ of 1), a slight exceedance of a threshold generally indicates less potential risk than a major exceedance of a threshold. It should be noted, however, that contaminants with low HQ values were assessed on an individual basis for their potential for risk. For these reasons, it is unlikely that significant potential risks exist from the contaminants that only slightly exceeded surface water or sediment thresholds. Nonetheless, the conclusions that minor exceedances result in low potential risks introduces uncertainty into the results of the ecological risk assessment.

1.3.3 Site 12

1.3.3.1 Initial Assessment and Confirmation Study

The 1983 IAS consisted of interviews and on-site inspection, and did not recommend Site 12 for a confirmation study based on the belief that any acids spilled would be buffered when they drained into the salt marsh.

During the 1993 SI, one surface water sample and one sediment sample were collected from the downstream side of the storm water culvert outflow. No surface water or sediment was present at the upgradient portion of the drainage culvert at the time these samples were taken. The sediment sample was analyzed for VOCs, SVOCs, pesticides, PCBs, metals, and cyanide. The surface water sample was analyzed for VOCs, metals, and cyanide. Sample analysis indicated that SVOCs, VOCs, pesticides, and metals were present in the sediment sample taken at the site. Metals were detected in the surface water sample. Cyanide was not detected in either sample.

An underground storage tank (UST) installed at the northeast corner of building R-10 and located approximately adjacent to the former battery storage area was removed in 1994. Visual contamination of the soil was not observed during the tank removal. Upon removal, the tank and associated piping were examined and found in good condition, free of holes, and with minor rust and pitting. Four confirmation soil samples were obtained from the excavation sidewalls, and two samples were taken from the excavated soils. The excavation sidewall samples were analyzed for total petroleum hydrocarbons (TPH), and all had concentrations less than method DLS or actual sample DLS detection limits of 56 to 61 mg/kg. The two soil pile samples had TPH concentrations of 460 mg/kg and 520 mg/kg. The soil was disposed as non-hazardous.

1.3.3.2 Remedial Investigation

In August 1995, B&R Environmental conducted sampling and analysis of surface soil and sediment and surveyed to establish the horizontal locations and vertical elevations of the surface soil and sediment sample locations.

No samples were obtained from the area labeled "Battery Storage Area" (Figure 1-6) because the asphalt would have been a barrier to infiltration of the spilled battery electrolyte solution. The RI attempted to obtain the "worst case" sediment samples in known low-lying areas of likely sedimentation.

The RI Addendum field investigation was designed to provide further data on the areal and vertical extent of metals contamination. On October 29, 1996, B&R Environmental conducted surface and subsurface soil sampling at Site 12 and surveyed to establish the horizontal locations and vertical elevations of the sample locations.

1.3.3.3 Summary of Results

Infiltration is limited by an asphalt parking lot that covers the site. Surface runoff is directed to a storm water collection basin that discharges through a concrete culvert to a drainage swale and eventually to a marsh north of the site. A UST was located in this general area, but it has been removed.

1.3.3.3.1 Site Geology and Hydrogeology

Geology

Regional mapping places Site 12 within the outcrop area of the Englishtown Formation. The Englishtown Formation ranges from 35 and 150 feet in thickness and consists of tan and gray, fine- to medium-grained quartz sand with local clay beds. The presence of the Englishtown Formation beneath Site 12 cannot be confirmed because no soil borings were drilled at the site. However, the lithology of the sediments encountered in borings at Sites 6, 15, and 17 generally agreed with the published description of the Englishtown Formation. Site 6 is located about 600 feet northeast, Site 15 is located about 1,000 feet south-southeast, and Site 17 is located about 700 feet south-southwest of Site 12. In general, the borings at these sites encountered fill material and sand, silty sand, and clayey sand.

Hydrogeology

Groundwater conditions beneath the site cannot be confirmed because no wells were installed. However, groundwater in the Englishtown aquifer beneath Sites 6 and 17, and presumably Site 12, occurs under

FEASIBILITY STUDY
for
SITES 6, 12, 15, AND 17 (OU 9)

NAVAL WEAPONS STATION EARLE
Colts Neck, New Jersey

Engineering Field Activity Northeast
Naval Facilities Engineering Command

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

NOVEMBER 2003

TETRA TECH NUS, INC.

PHIL-16938

FEASIBILITY STUDY
for
SITES 6, 12, 15, AND 17 (OU 9)

NAVAL WEAPONS STATION EARLE
Colts Neck, New Jersey

COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

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

Prepared and Submitted by:
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Contract No. N62467-94-D-0888
Contract Task Order 0843

November 2003

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ACRONYMS

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

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

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

EXECUTIVE SUMMARY

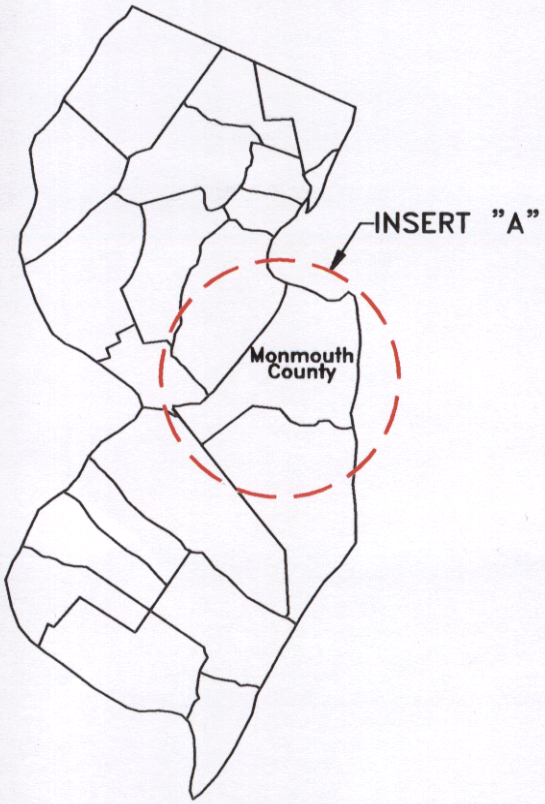
Under the Department of Defense's Installation Restoration Program (IRP), the Navy, in agreement with the United States Environmental Protection Agency (EPA) and in consultation with the state of New Jersey Department of Environmental Protection (NJDEP), is in the process of completing the remedial investigation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

This report presents the feasibility study (FS) performed for Sites 6 (Landfill West of Normandy Road), Site 12 (Battery Storage Area), Site 15 (Sludge Disposal Area), and Site 17 (Landfill) collectively designated as Operable Unit 9 (OU 9). The FS considered a range of remedial alternatives that address potential risks to human health and the environment posed by site-related contaminants identified previously under the RI. This report addresses the remedial alternatives developed for Sites 6, 12, 15 and 17. The OU 9 sites are located within the Waterfront area of NWS Earle. Figures ES-1, ES-2, and ES-3 show the orientation of NWS Earle in Monmouth County and details of the Waterfront and Mainside areas. Figure ES-4 shows the Waterfront area Installation Restoration (IR) program sites, including Sites 6, 12, 15, and 17.

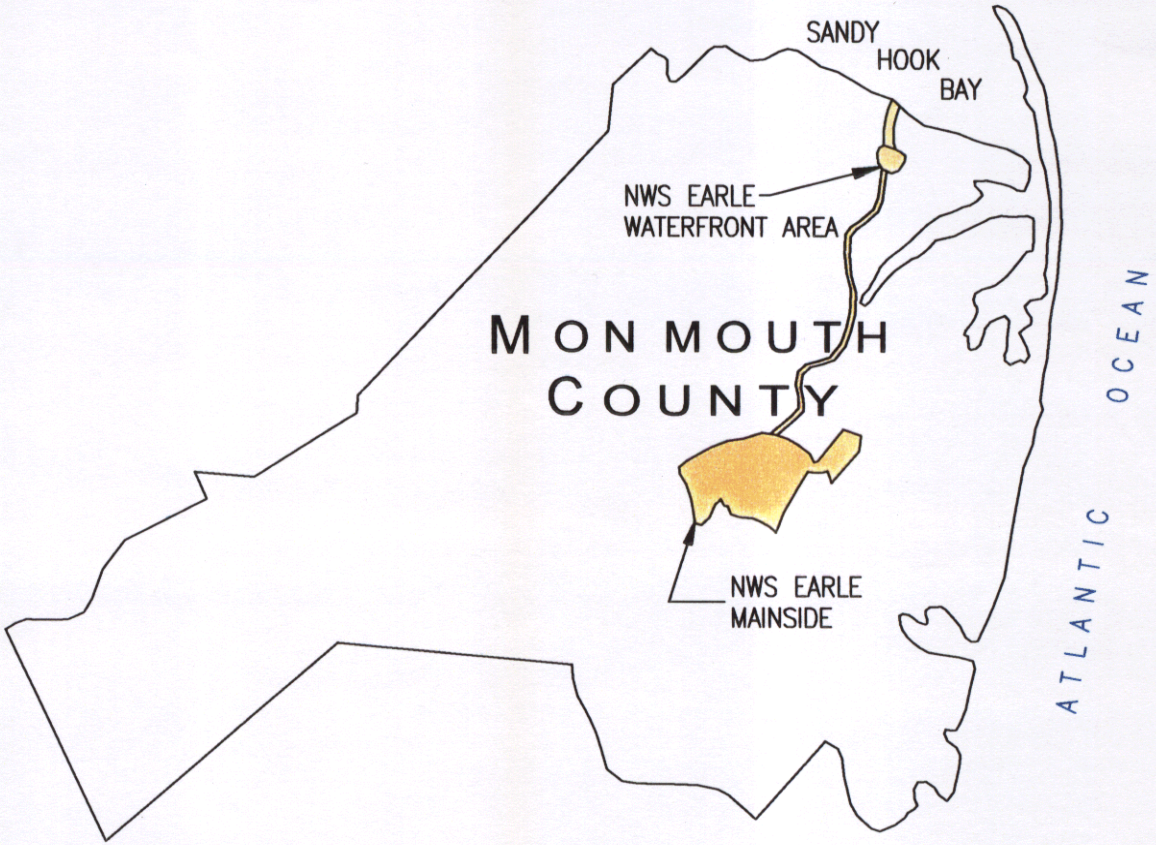
The remedial options developed in this document will be used by the Navy to select a preferred remedy for Sites 6, 12, 15 and 17. A Proposed Plan will then be prepared to present the preferred remedy for public comment. After the public comment period has concluded, all questions and concerns from the public will be addressed in a Responsiveness Summary, and the selected remedy will be documented in a Record of Decision.

NWS Earle Site Summary

NWS Earle is located in Monmouth County, New Jersey, approximately 47 miles southeast of New York City. This facility was commissioned in 1943 with the primary responsibility of supplying ammunition to the naval fleet. 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.



STATE OF NEW JERSEY



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

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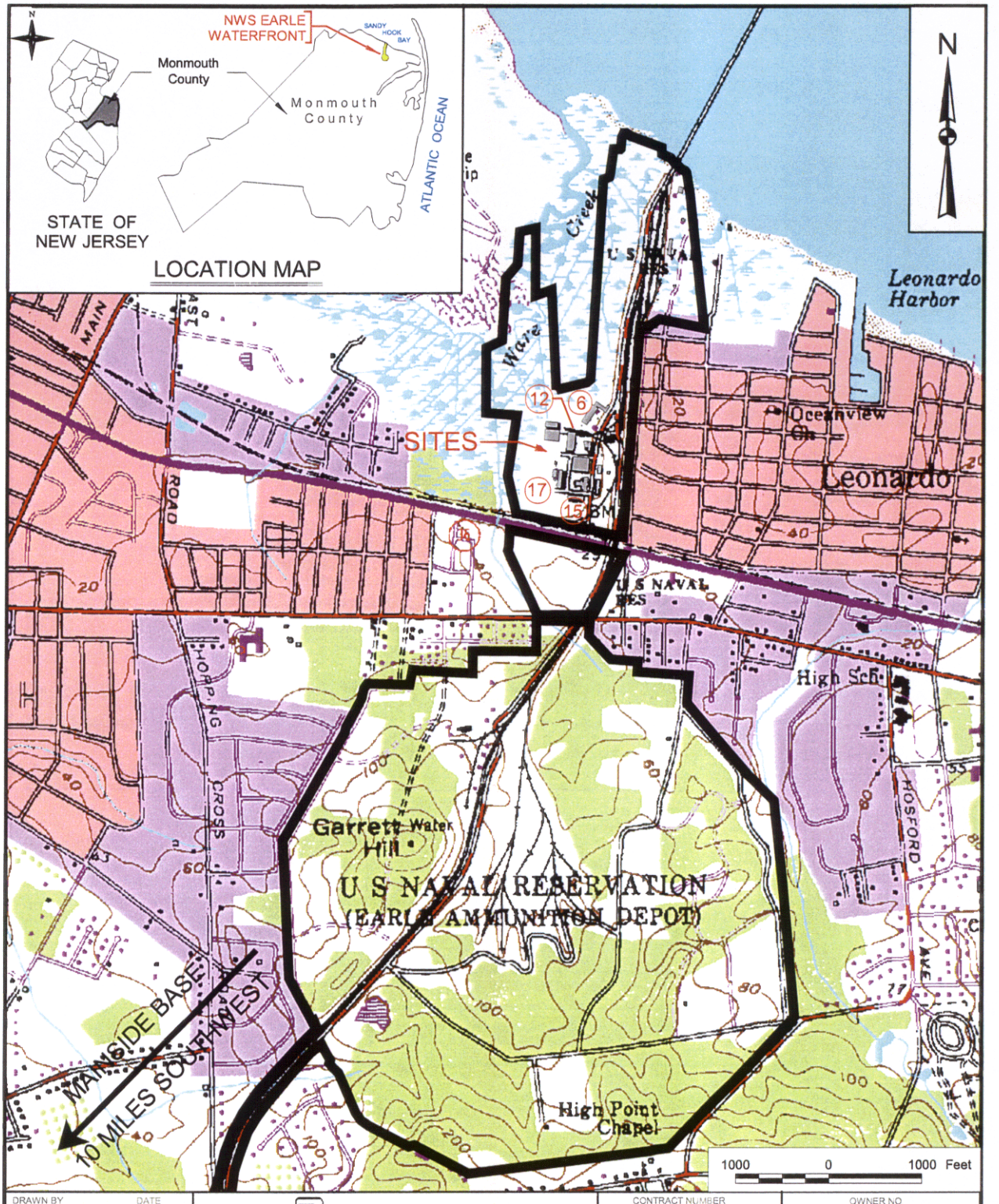
3/18/03 LDL PHL	
REV	DATE 3/18/03
FIGURE NUMBER	FIGURE ES-1



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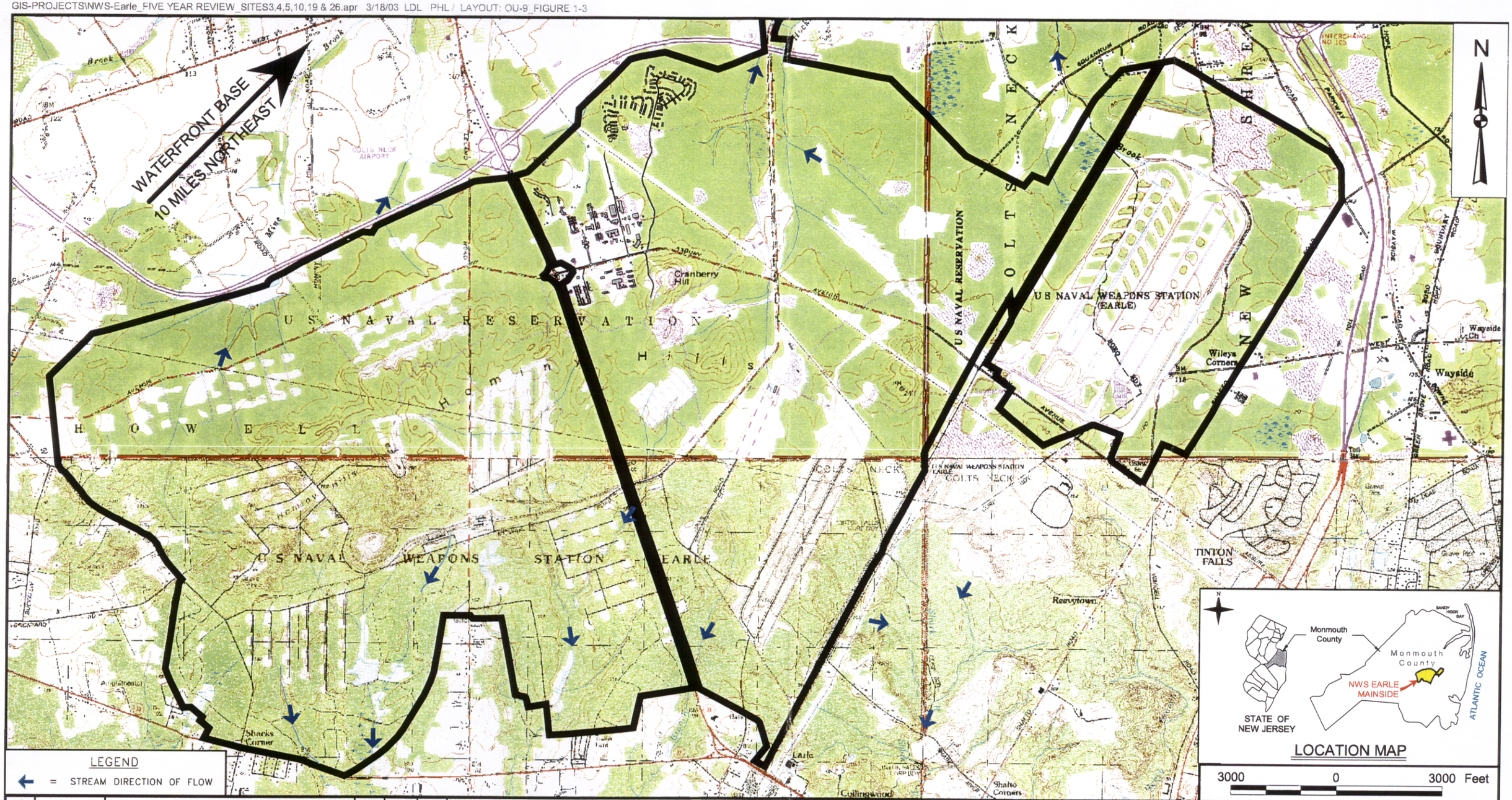
CHECKED BY	DATE	GENERAL LOCATION MAP WATERFRONT BASE SITES 6, 12, 15, & 17 NAVAL WEAPONS STATION EARLE COLTS NECK, NEW JERSEY	PROJECT FILE NWS-EARLE_FIVE-YEAR REVIEW.apr LAYOUT OU-9 WATERFRONT BASE
COST/SCHEDULE-AREA			APPROVED BY RET / DATE 3/18/03
SCALE AS NOTED			DRAWING NO FIGURE ES-2 / REV

GIS-PROJECTS\NWS-Earle_FIVE-YEAR REVIEW.apr\ 3/18/03 LDL PHL \ LAYOUT OU-9_FIGURE 1-2

GIS-PROJECTS\NWS-Earle_FIVE YEAR REVIEW_SITES3,4,5,10,19 & 26.apr 3/18/03 LDL PHL / LAYOUT: OU-9_FIGURE 1-3



NO	DATE	REVISIONS	BY	CHKD	APPD

REFERENCE MAPS

ASBURY PARK, N.J. 40074-B1 U.S.G.S. 7.5 MINUTE QUAD. MAP, 1989
FARMINGDALE, N.J. 40074-B2 U.S.G.S. 7.5 MINUTE QUAD. MAP, 1989
LONG BRANCH SW, N.J. 40073-C8 U.S.G.S. 7.5 MINUTE QUAD. MAP, 1988
MARLBORO, N.J. 40074-A2 U.S.G.S. 7.5 MINUTE QUAD. MAP, 1981

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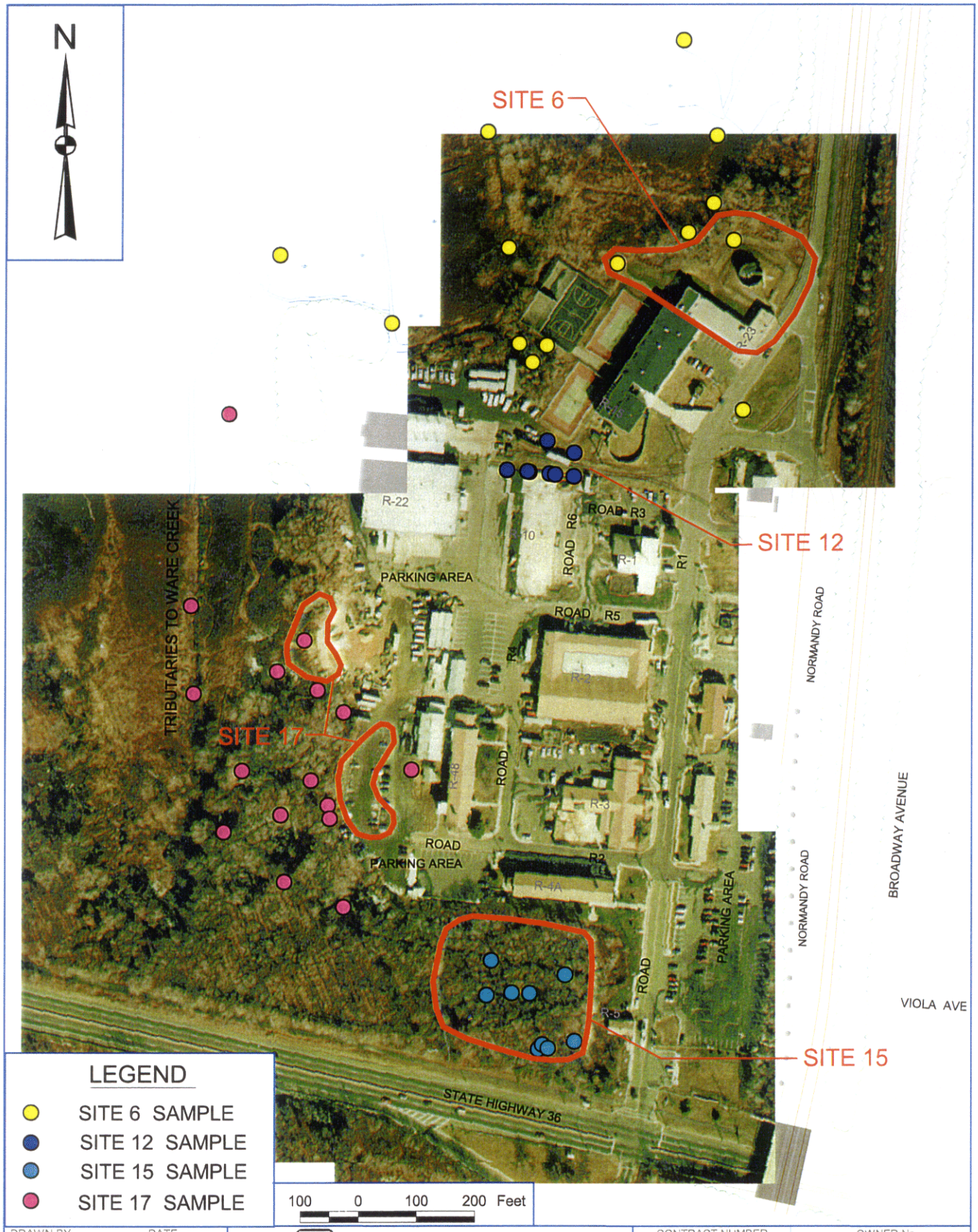
COST/SCHEDULE-AREA
SCALE AS NOTED

Tetra Tech NUS, Inc.

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

CONTRACT NUMBER 2128
OWNER NUMBER OU-9
PROJECT FILE NWS-EARLE_FIVE-YEAR REVIEW.apr
LAYOUT OU-9 MAINSIDE SITE
APPROVED BY RET DATE 3/18/03
DRAWING NO FIGURE ES-3
REV



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COST/SCHEDULE-AREA		SITES 6, 12, 15, & 17	LAYOUT: SITES 6, 12, 15 & 17 Sample Locations
		NAVAL WEAPONS STATION EARLE	APROVED BY RET / REV DATE 3/18/03 / DATE 8/16/02
SCALE AS NOTED		COLTS NECK, NEW JERSEY	DRAWING No FIGURE ES-4 / REV 1

Site 6 - Landfill West of Normandy Road

The Site 6 Landfill West of Normandy Road is a 4-acre site located in the Waterfront area (Figure ES-5). From 1943 to 1965, the site was used to dispose of refuse from the Waterfront area consisting of dunnage lumber, glass, paper, packing material, and small amounts of paint and solvent. It was reported that the wastes were burned before they were covered, and an estimated 2,500 tons of waste were deposited annually at the landfill. The landfill area may have been part of a salt marsh before disposal began. Currently, the majority of the landfill surface is paved or covered with buildings.

Slope stabilization work was performed at Site 6 in 1999. The work included delineation of adjacent wetlands to determine boundaries for the slope stabilization, clearing and grubbing brush and trees, backfilling, and regrading and seeding the area in order to stabilize the northern slope of the site. Existing debris was removed from the area and disposed of.

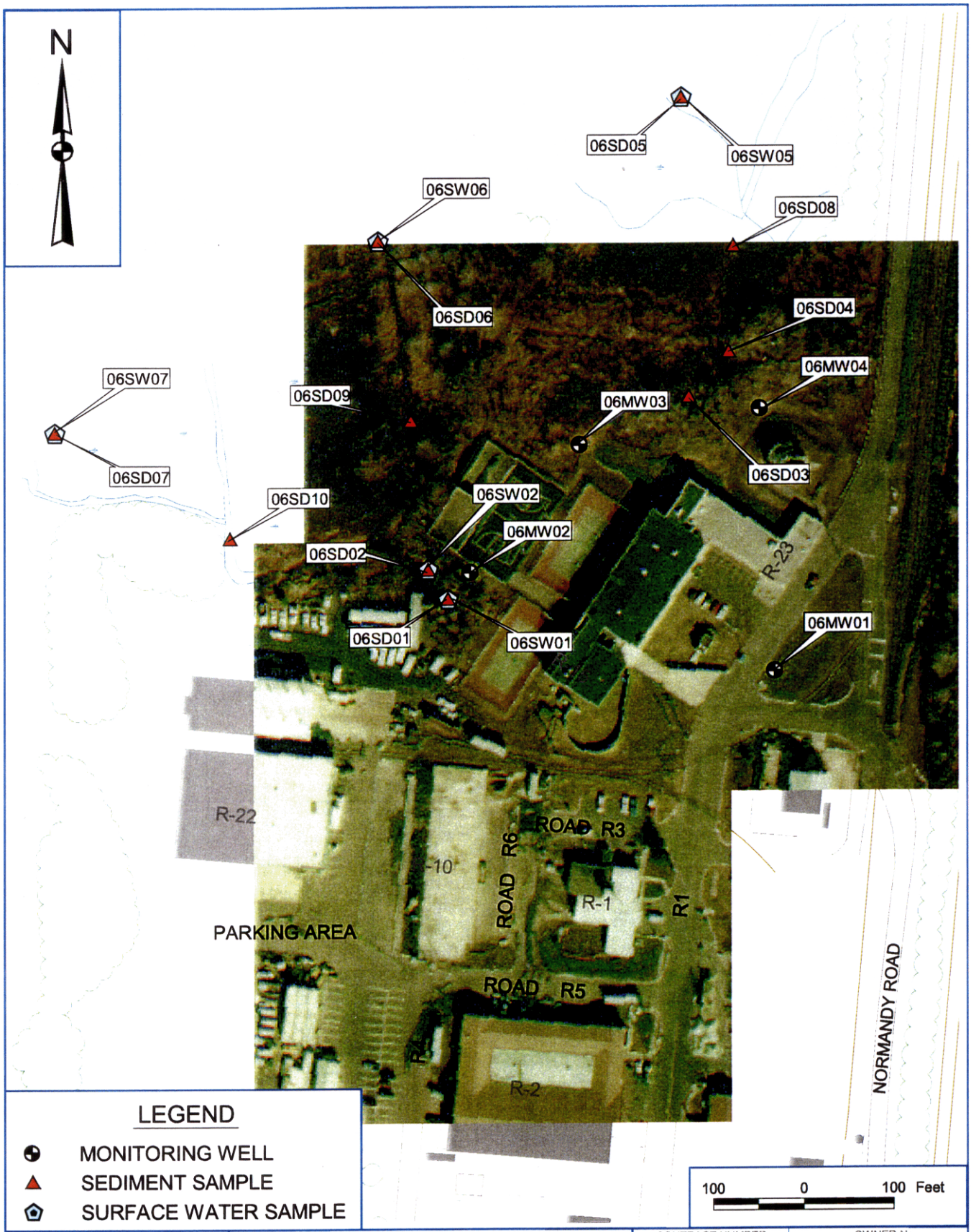
Site 12 - Battery Storage Area

The Site 12 Battery Storage Area was a paved area next to the loading dock east of Building R-10 (Figure ES-6) used as a temporary staging area for forklift batteries being sent off site to be reclaimed. The storage area occupied various portions of the paved area at different times but was generally limited to approximately 7,500 to 10,000 square feet at the northern end of the paved area adjacent to Building R-10. As reported in the 1993 Site Inspection (SI), batteries have not been stored at the site for several years.

Soil remediation was performed in the area immediately north of the loading dock at Site 12 in 1999. The work included excavation, removal and disposal of the railroad tracks, ties and cinder bedding in the area as well as contaminated soils. Confirmatory soil sample collection was performed to demonstrate that New Jersey Department of Environmental Protection (NJDEP) residential clean-up standards have been met. Restoration of the site after excavation included backfill using certified clean select fill. Based on the EPA and NJDEP approval, Site 12 has met the applicable requirements for closure and the remediation of Site 12 soils is complete.

Site 15 - Sludge Disposal Site

The Site 15 Sludge Disposal Site reportedly occupied a small area (approximately 1 acre) along the former railroad tracks near the main entrance to the Waterfront area (Figure ES-7). In the early 1970s, the site was used for disposal of an unknown amount of oily bilge sludge. It is estimated that over 5,000 gallons of sludge, which may have ranged from 1 percent to 25 percent oil, may have been disposed at the site. The exact location of the sludge disposal activities was not apparent during site inspections. The site is near an elevated railroad bed built approximately 6 feet above the surrounding ground surface. Although there are



LEGEND

- MONITORING WELL
- SEDIMENT SAMPLE
- SURFACE WATER SAMPLE

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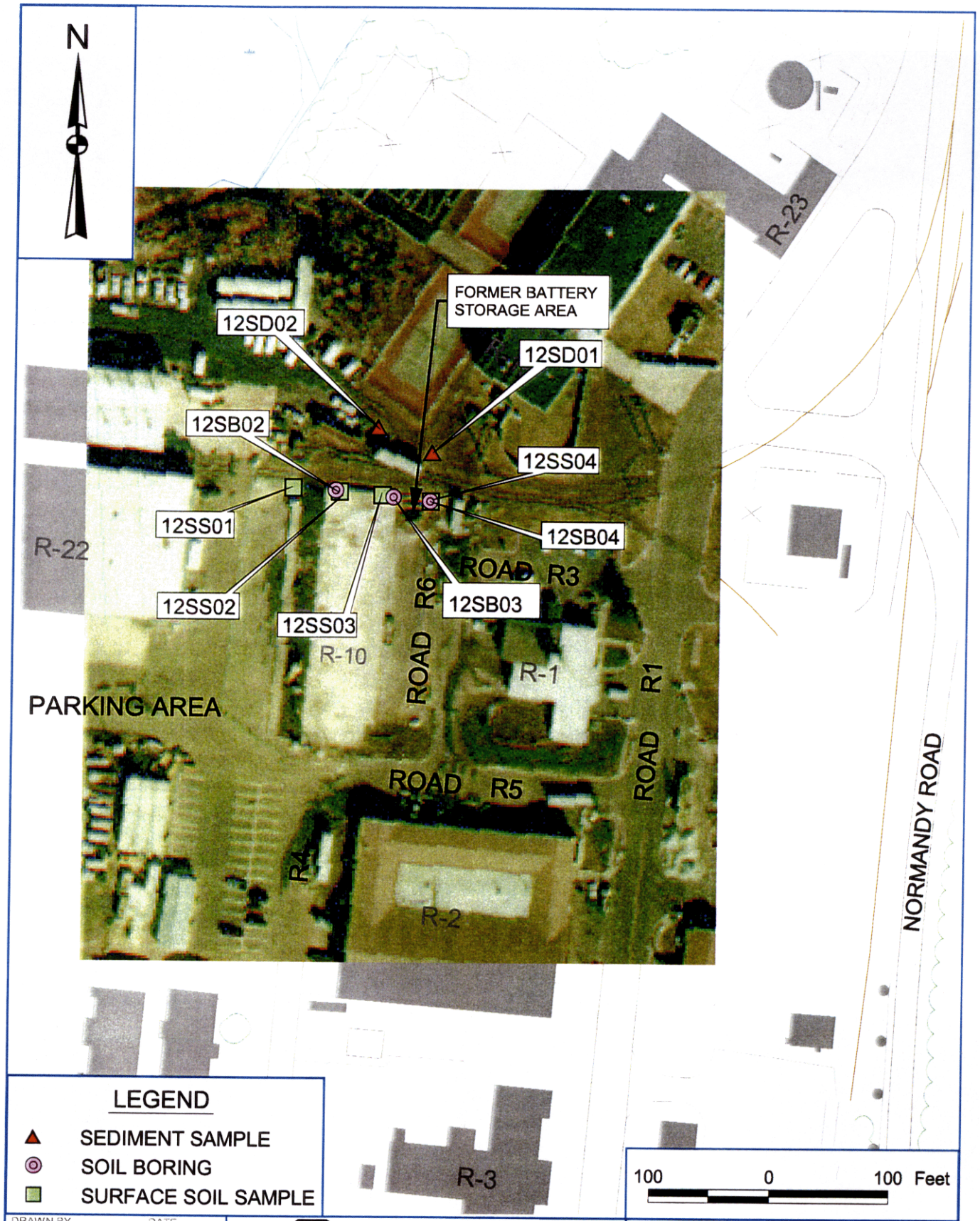
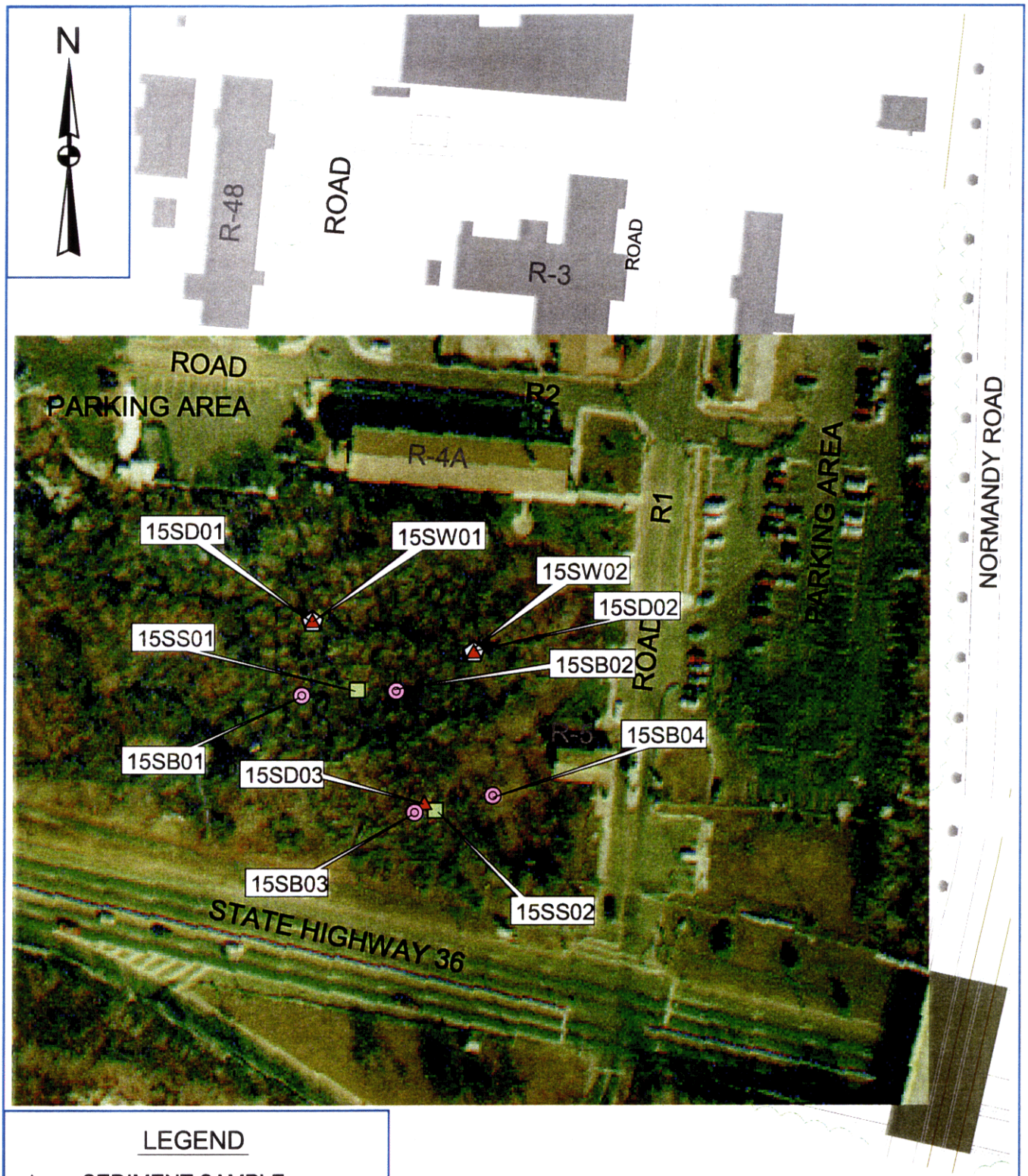
COST/SCHEDULE-AREA			APROVED BY RET / REV DATE 3/18/03 / DATE 8/16/02
SCALE AS NOTED			DRAWING No. FIGURE ES-5 / REV 1



DRAWN BY LDL	DATE 8/14/02	Tetra Tech NUS, Inc.	CONTRACT NUMBER 2128 / OWNER No. FS OU-9
CHECKED BY	DATE	SAMPLE LOCATIONS SITE 12 - BATTERY STORAGE AREA NAVAL WEAPONS STATION EARLE COLTS NECK, NEW JERSEY	PROJECT FILE: NWS-Earle-Sites 6, 12, 15&17-PHL.apr LAYOUT: SITE-12 Sample Locations
COST/SCHEDULE-AREA			APROVED BY RET / REV. DATE 3/18/03 / DATE 8/16/02
SCALE AS NOTED			DRAWING No. FIGURE ES-6 / REV 1



LEGEND

- ▲ SEDIMENT SAMPLE
- ◎ SOIL BORING
- ■ SURFACE SOIL SAMPLE
- ⬠ SURFACE WATER SAMPLE

100 0 100 Feet

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CHECKED BY	DATE	SAMPLE LOCATIONS SITE 15 - SLUDGE DISPOSAL SITE NAVAL WEAPONS STATION EARLE COLTS NECK, NEW JERSEY	PROJECT FILE: NWS-Earle-Sites 6, 12, 15&17-PHL.apr LAYOUT: SITE-15 Sample Locations
COST/SCHEDULE-AREA			APROVED BY RET / REV. DATE 3/18/03 / DATE 8/16/02
SCALE AS NOTED			DRAWING No. FIGURE ES-7 / REV 1

no known records available to document the area involved in the former oily waste disposal, the site is estimated to have been approximately 1 acre based on the best records and findings available.

Site 17 - Landfill

The Site 17 Landfill (Figure ES-8) occupies 3 acres in the Waterfront area, adjacent to a tidal marsh in the Ware Creek drainage basin. The site was reportedly used for the disposal of wood, heavy equipment, empty paint cans, and construction debris. The landfill surface is covered with gravel and pavement and is currently utilized as a parking area for Waterfront personnel.

In 1999, the western portion of the site was graded, covered with topsoil, and seeded. A heavy wooden fence-type barricade was installed on the flat portion of the site near the wetlands to the west, to prevent any future activities, like deposition of soils or debris piles and vehicle storage that could contribute to continued erosion of the sloped side area of Site 17.

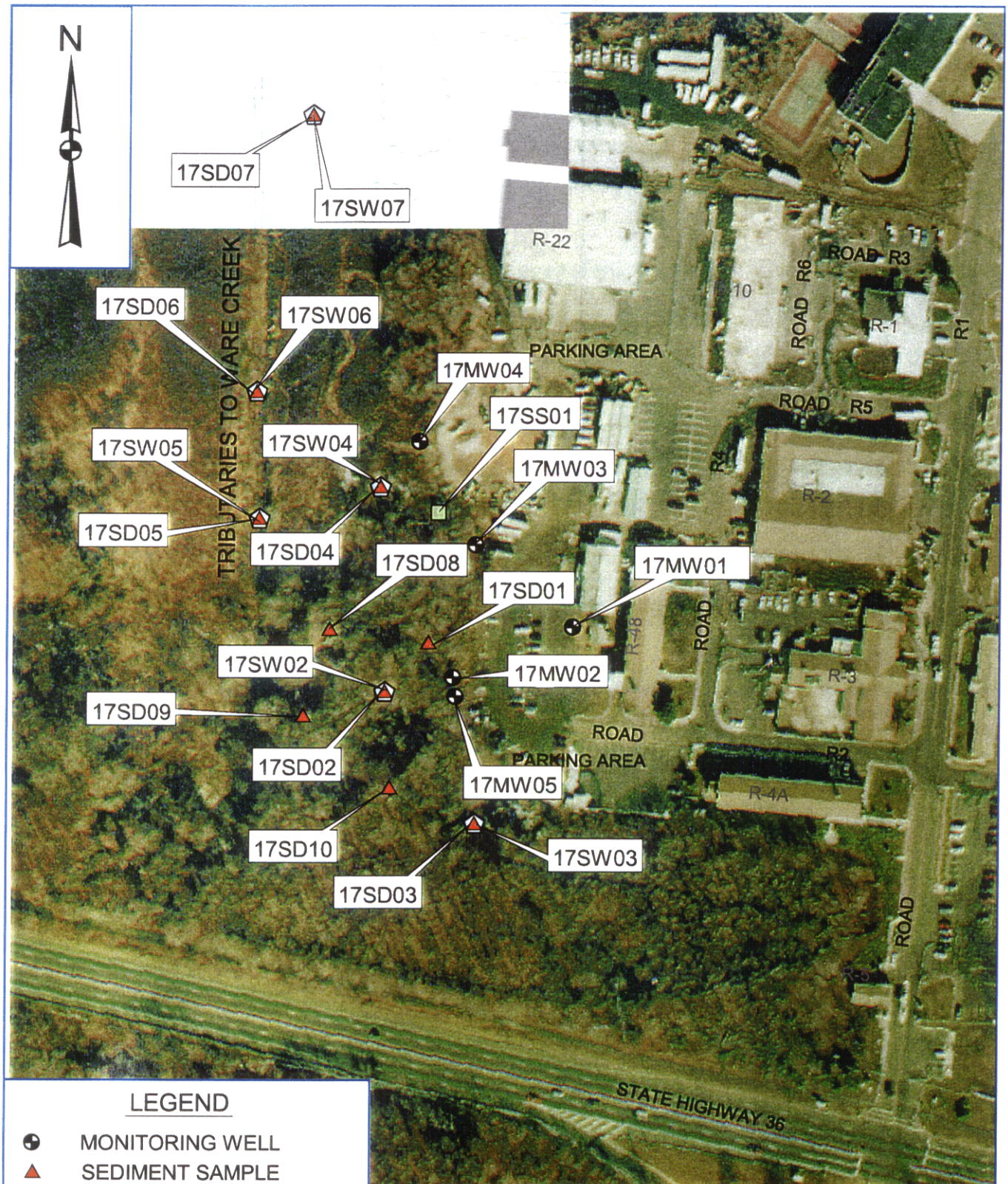
Regulatory History

An Initial Assessment Study conducted in 1982 identified 29 waste disposal areas at NWS Earle and led to the further investigation of 11 of those sites. Following the listing of NWS Earle on the National Priorities List (NPL) in 1990, site investigations were initiated at 16 sites (Sites 1, 6, 8, 9, 12, 13, 14, 15, 16, 17, 23, 24, 25, 27, 28 and 29). Two sites were not included in these investigations because they were permitted to operate under the Resource Conservation and Recovery Act. In 1992, EPA requested that Preliminary Assessments be performed on 17 of the sites. To date, the following investigations have been completed and are documented:

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

Summary of Site Risks

The results of the RIs were evaluated using EPA guidance and directives to gauge potential impacts from Sites 6, 12, 15 and 17 conditions on human health and the environment. The exact procedures used for the estimation of human health risk assessment and ecological risk screening are presented in the RI report (July 1996) and RI Addendum report (January 1998) and are summarized in subsection 1.3.1.9 of this document.



LEGEND

- MONITORING WELL
- SEDIMENT SAMPLE
- SURFACE WATER SAMPLE
- SURFACE SOIL SAMPLE

100 0 100 200 Feet

DRAWN BY LDL	DATE 8/16/02	Tetra Tech NUS, Inc.	CONTRACT NUMBER 2128 / OWNER No. FS OU-9
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COST/SCHEDULE-AREA			APROVED BY RET / REV. DATE 3/18/03 / DATE 8/16/02
SCALE AS NOTED			DRAWING No. FIGURE ES-8 / REV 1

At the request of EPA, since the RI human health risk assessment 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 (COPC's) for individual sites, but no major change, sufficient to redirect the findings of this feasibility study were found. The review process and results are presented in Section 1.4.

Site 6

Sediment, groundwater, and surface water samples obtained at Site 6 were used in assessing risks. The potential receptors considered for this site were future industrial, residential, and recreational receptors. Currently the majority of the landfill is covered by buildings or pavement, limiting the surface/subsurface contaminant transport and exposure pathway. Appendix B-1 contains summary tables of the estimated human health risks for Site 6.

The reasonable maximum exposure (RME) cancer risks associated with future residential groundwater exposure (6.1E-04) exceeded the upper end of EPA's target acceptable risk range (1E-04 to 1E-06). The RME cancer risks associated with future industrial groundwater exposure (1.4E-04) were at the upper bound of EPA's target risk range. Arsenic (via ingestion of and dermal contact with groundwater) is the principal chemical of potential concern (COPC) that contributed to the cancer risks for these exposure scenarios.

RME estimates for non-carcinogenic hazard index (HI) risk (5.7E00) associated with the future residential groundwater ingestion exposure scenario exceeded 1.0, the cutoff point below which adverse non-carcinogenic effects are not expected to occur. Arsenic is the COPC that contributed most to this exposure scenario. In addition, central tendency exposure (CTE) risk estimates for future residential exposure to groundwater yielded an HI greater than 1.0; the affected target organ is the skin. CTE risk estimations provide additional information, but RME calculation results are used for decision making in the EPA RI/FS process.

The estimated RME cancer risk for the future industrial employee and the future residential receptor exceeded 1E-04, based mainly on ingestion of groundwater. The estimated CTE cancer risk for the future residential receptor exceeded 1E-04, based mainly on ingestion of groundwater. The estimated RME non-cancer HI for the future residential receptor exceeds 1.0, based mainly on ingestion of groundwater. The estimated CTE cancer risk for the future residential receptor exceeds 1.0, based mainly on ingestion of groundwater.

Only the maximum concentration of arsenic found in one groundwater sample, 26.8 micrograms per litre

(ug/l) would result in calculated human health risk greater than the EPA acceptable risk range under the RME or CTE future residential exposure scenarios. Detected arsenic concentrations in the other Site 6 groundwater wells were 5.1 ug/l and 8.8 ug/l. These relatively low concentrations, as well as the average concentration in the four background groundwater samples, 10.6 ug/l, would also result in calculated risk levels within (at the upper end of) EPA's acceptable risk range.

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/FS. Lead was not found at levels exceeding 400 milligrams per kilogram (mg/kg) in subsurface soil samples from previous investigations.

Site 12

A remedial action consisting of excavation and removal of surface and subsurface soils in the vicinity of Site 12 was conducted by the Navy in 1999. Approximately 262 tons of excavated soil was shipped off site for disposal and recycling. Three rounds of confirmatory sampling were conducted to demonstrate compliance with NJDEP Residential Direct Contact Soil Cleanup Criteria. Appendix B-2 contains confirmation sampling summary tables. Restoration of the site after excavation included backfill using certified clean select fill.

The excavation of contaminated soils achieved the remedial action objective for protection of human health and the environment, including prevention of human exposure to contaminated surface and subsurface soils, and prevention of migration of contaminants to the adjacent marsh. Appendix C contains a summary of the remedial for activities performed in 1999 at Site 12.

The Navy evaluated the remaining lead in soil risk by performing blood lead modeling based on the soil remediation confirmation sampling results. Lead was not found at levels exceeding 400 mg/kg in any samples collected from soil or sediment remaining at Site 12. The average lead concentration remaining in site related soils after remediation was 14.1 mg/kg. Using the approach for estimating lead risks outlined in OSWER directive 9355.4-12 and the Integrated Exposure and Uptake Biokinetic (UEUBK) model (version 1.0), the Navy calculated a negligible risk (0 to 0.1%) to the potential residential child receptor. [The output from the IEUBK model is a probability histogram that represents the estimated percentage of the modeled receptor population that would develop blood lead levels above 10 micrograms per deciliter (ug/dl). When the percentage of the modeled population (residential children) estimated to have blood lead concentrations above 10 ug/dl is greater than five percent, then EPA considers the potential for adverse affects to be significant.] Appendix D presents the assumptions and results from the IEUBK model.

Based on EPA and NJDEP approval, Site 12 met all the applicable requirements for closure, and the remediation for which Foster Wheeler Environmental Corporation was contracted by the Navy was complete as documented in the Remedial Action Report for Soil Excavation at Site 12, Foster Wheeler Environmental Corporation (December 1999).

Site 15

Surface soil, subsurface soil, sediment, and surface water were sampled at Site 15. The potential receptors considered for this site were current industrial and future industrial, residential, and recreational receptors. Appendix B-3 contains summary tables of the estimated human health risks for Site 15. The cancer risks associated with surface and subsurface soil exposure for all exposure scenarios, including the future residential exposure scenario were within the 1E-04 to 1E-06 target risk range. Arsenic (via ingestion and dermal contact with surface and subsurface soil) was the major COPC that contributed to the cancer risks for these exposure scenarios.

Only the future residential (surface soil and subsurface soil) exposure scenario yielded total RME HIs (sum of HIs for ingestion, dermal, and inhalation of dusts) greater than 1.0, the cutoff point below which adverse effects are not expected to occur. However, these RME estimates are probably overly conservative because a central tendency calculation shows that non-cancer HIs are more likely to be below 1.0. Central tendency generates a lower risk estimate than RME because it assumes typical rather than upper range receptor behavior patterns related to the ingested dose. CTE analysis provides additional information, but RME scenario guideline assessments are used for decision making.

Lead soil and surface water concentrations at the site were below the EPA guidelines and are not expected to be associated with a significant increase in blood-lead levels based on the results of the IEUBK Lead Model (version 0.99). IEUBK lead model results indicate that less than five percent of the modeled population (resident child) would be expected to develop a blood lead concentration greater than 10 ug/dl.

Site 17

Surface soil, groundwater, sediment, and surface water were sampled at Site 17. The potential receptors considered for this site were current industrial and future industrial, residential, and recreational receptors. Appendix B-4 contains summary tables of the estimated human health risks for Site 17.

The RME cancer risks associated with a future residential exposure scenario were 4.5E-04, mainly from potential exposure to groundwater. The CTE cancer risks for the future residential receptor (2E-04) also

exceeded the upper end of the target acceptable risk range of 1E-04 to 1E-06. Arsenic (via ingestion) is the principal COPC that contributed to the cancer risks for this exposure scenario. The RME cancer risks associated with future industrial employee exposure were 1.0E-04, at the upper end of the target acceptable risk range of 1E-04 to 1E-06. Arsenic (via ingestion) is the principal COPC that contributed to the cancer risks for this exposure scenario.

RME estimates for non-carcinogenic HIs associated with a future residential (groundwater ingestion) exposure scenario was 4.2, exceeding 1.0, the cutoff point below which adverse non-carcinogenic effects are not expected to occur. Arsenic is the COPC that exceeded 1.0 for this exposure scenario. In addition, CTE risk estimates for future residential exposure to groundwater also yielded an HI greater than 1.0; the affected target organ was skin.

Arsenic was detected in three of four Site 17 groundwater samples at concentrations of 4.2 ug/l, 7.0 ug/l, and 19.7 ug/l. Arsenic was detected in one of three background groundwater samples at a concentration of 5.1 ug/l. One of the Site 17 concentrations, 19.7 ug/l, is clearly elevated above background. The other two concentrations are similar to the background concentration. The Site 17 average groundwater concentration for arsenic is greater than the average background concentration (8.14 ug/l versus 5.6 ug/l).

Lead concentrations in soils/sediments, detected at the site during the RI ranging from 5.2 mg/kg to 236 mg/kg, were all below the EPA guideline (400 mg/kg) and are not expected to be associated with a significant increase in blood-lead levels based on the results of the IEUBK Lead Model (v. 0.99). IEUBK lead model results indicate that less than five percent of the modeled population (resident child) would be expected to develop a blood lead concentration greater than 10 ug/dl.

Objective of the FS

The overall objective of this FS is to develop and evaluate remedial alternatives that address existing conditions at Sites 6, 12, 15 and 17. The general FS process is described below:

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

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

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

- Assemble and screen remedial alternatives from the retained technologies.

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

Remedial Action Objectives (RAOs)

Based on the baseline human health risk assessment, the ecological risk assessment, and the RI results, RAOs were developed to address contaminated environmental media (soils, groundwater) present at Sites 6, 12, 15 and 17.

Site 6

Protection of Human Health RAO

- Prevent potential human exposure to metals in groundwater.

Protection of the Environment RAO

- None.

Site 12

Protection of Human Health RAO

No human health RAO for Site 12 was selected.

The 1999 excavation and removal of surface soils and "sediments" in the vicinity of Site 12 to NJDEP residential cleanup standards, followed by cleanup verification sampling and analysis, removed the compounds of concern and any need for further action at Site 12.

Protection of the Environmental RAO

No environmental RAO for Site 12 was selected. No further action for Site 12 is warranted based on the confirmed site remediation.

Site 15

Protection of Human Health RAO

- Prevent potential human exposure to metals in surface and subsurface soils.

Protection of the Environment RAO

- None.

Site 17

Protection of Human Health RAO

- 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 soils and groundwater and the RAOs. These alternatives provide variable levels of protection to human health and the environment, as well as compliance with ARARs. Remedial alternatives for OU 9 included no action; and limited action (long-term monitoring and institutional controls). Summaries of remedial alternatives that passed the screening step for each site are presented in the following section.

Site 6 Remedial Alternatives

Site 6 - 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.

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 mitigate contaminant migration in the environment. Key components of Alternative 1 are identified on Table ES-1 and described below.

Existing Features - Currently, site features including the buildings, tennis courts, and other facilities provide significant protection of human health and the environment. The primary protective feature is that groundwater underlying Site 6 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: Institutional Controls and Long-Term Monitoring

Alternative 2 relies on institutional controls to limit potential exposure to contaminated groundwater. This alternative does not employ engineered treatment or containment to address groundwater contamination.

Institutional controls would be enacted to prohibit use of impacted groundwater. 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 5 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 6 features offer some limited protection of human health and the environment. Foster Wheeler Environmental Corporation conducted slope stabilization work at the site in 1999 that included removal of debris, backfilling, regrading, and seeding. Groundwater underlying Site 6 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 based

TABLE ES-1
SITE 6 - REMEDIAL ALTERNATIVE COMPONENTS
OPERABLE UNIT 9 FEASIBILITY STUDY
NAVY WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

	ALTERNATIVE	KEY COMPONENTS OF ALTERNATIVE
1	No Action	• No actions would be taken
2	Limited Action	• Fencing (fencing is already in place) • Institutional controls (land use restrictions, CEA*) • Long-term periodic groundwater monitoring • Five-year reviews

Notes:

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

on the improved vegetation, cover and improved surface drainage.

Security Fencing - Security fencing has been installed to deter human and animal entry into the landfill area to protect the integrity of the existing cover. The fence is an 8-foot-high chain-link fence with galvanized steel posts installed at 8-foot intervals. Current fencing at the site would be evaluated to see if it could be used in lieu of new fencing for this remedial alternative.

Institutional Controls - Under Alternative 2, land use restrictions would be incorporated into the Base Master Plan to restrict the future use of Site 6 groundwater until natural processes have reduced contaminant concentrations to acceptable levels (GWQSs). Use of untreated, contaminated Site 6 groundwater for drinking water would be prohibited.

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

Long-Term Monitoring - Under Alternative 2, one new well would be installed downgradient of Site 6. Groundwater would be sampled periodically to monitor the migration of contaminants from Site 6 and assess the potential impacts to downgradient receptors. The collected data would be evaluated during the five-year review period.

Groundwater samples would be collected from three existing monitoring wells and one new downgradient well. A total of six groundwater samples, including Quality Assurance/Quality Control (QA/QC) samples, would be collected annually 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.

Five-Year Reviews - Because contaminants would remain in Site 6 groundwater, a review of site conditions and risks would be conducted every 5 years, as required by CERCLA. The reviews would consist of evaluating analytical and hydrogeologic data and assessing whether contaminant migration has increased to determine whether human receptors or natural resources are at risk.

Site 12 Remedial Alternative- No Further Action

The no-further-action alternative is developed as a baseline case, as required by the NCP. No activities would be conducted under this alternative. The no-action alternative has been chosen for Site 12 based on soil excavation activities conducted by Foster Wheeler Environmental Corporation on behalf of the Navy at the site in 1999.

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 to mitigate contaminant migration in the environment.

Existing Features - The excavation and removal of surface soils in the vicinity of Site 12 conducted in 1999 was based on the RI delineation of lead concentrations. Cleanup and verification sampling of site soils was performed to the NJDEP Residential Direct Contact Soil Cleanup Criteria. Verification sampling was conducted to confirm post-removal soil levels. Therefore, no PRGs or remedial alternatives were developed in this FS for Site 12. Based on soil excavation work performed at Site 12 in 1999 by Foster Wheeler Environmental Corporation, it is recommended that no further action be taken at Site 12.

Remedial Action Summary

The objectives of the remedial action conducted in 1999 included minimizing the potential migration and mobilization of contaminants to surface water, groundwater, and adjacent soils at the site. Approximately 262 tons of excavated soil was shipped offsite for proper disposal and recycling. Three rounds of confirmatory sampling were conducted to demonstrate compliance with State of New Jersey direct contact residential cleanup standards. This prior excavation of contaminated soils achieves the remediation objectives developed for Site 12 for protection of human health and the environment, including prevention of human exposure to contaminated surface and subsurface soils, and migration of contaminants to the adjacent marsh.

Based on EPA and NJDEP approval, Site 12 has met all the applicable requirements for closure, and the remediation for which Foster Wheeler Environmental Corporation was contracted by the Navy is complete (Remedial Action Report for Soil Excavation at Site 12, Foster Wheeler, Environmental Corporation, December 1999).

Site 15 Remedial Alternatives

Alternative 1: No Action

The no-action alternative is developed as a baseline case, as required by the NCP. No activities would be conducted under this alternative. 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. 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 mitigate contaminant migration in the environment. Key components of Alternative 1 are identified on Table ES-2 and described below:

Existing Features - Currently, site features offer significant protection of human health and the environment. The primary protective feature is that the entire site is located within a red maple/sweetgum wetland and is fenced off from the remainder of the base by a double-fenced security buffer zone.

Alternative 2: Limited Action

Alternative 2 relies on institutional controls to limit exposures to contaminated soils. This alternative does not employ engineered treatment or containment to address soil contamination.

Institutional controls would be enacted to prohibit use of impacted soils. Site conditions and risks would be reviewed every 5 years because contaminants would be left in place. Key components of Alternative 2 are identified on Table ES-2 and described below.

Existing Features - Currently, site security fencing at Site 15 offers significant protection of human health and the environment. The site is fenced off from the remaining base property by a double-fenced security buffer zone.

Security Fencing - Current fencing at the site would be evaluated to see if it could be used in lieu of new fencing for this remedial alternative. If necessary, additional or more substantial security fencing would be installed to deter human and animal entry into the landfill area to protect the integrity of the existing cover. The fence is expected to be 8-foot-high chain-link fence, with galvanized steel posts installed at 8-foot intervals. A locking gate would be installed to allow controlled access to the site.

Institutional Controls - Under Alternative 2, land use restrictions would be incorporated into the Base Master Plan to restrict the future use of Site 15 to its present security buffer use.

TABLE ES-2
SITE 15 - REMEDIAL ALTERNATIVE COMPONENTS
OPERABLE UNIT 9 FEASIBILITY STUDY
NAVY WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

	ALTERNATIVE	KEY COMPONENTS OF ALTERNATIVE
1	No Action	• No actions would be taken
2	Limited Action	• Institutional controls (land use restrictions) • Fencing (fencing is already in place) • Five-year reviews (including sampling and analysis)

Five-Year Reviews - Because contaminants would remain in Site 15 soils, a review of site conditions and risks would be conducted every 5 years, as required by CERCLA. For the purpose of the five-year review, surface and subsurface soil samples would be collected every 5 years for metals concentration analysis. Analytical data from the soil sampling activity will be assessed to determine if human receptors or natural resources are at risk.

Site 17 Remedial Alternatives

Alternative 1: No Action

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

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. Key components of Alternative 1 are identified on Table ES-3 and described below.

Existing Features - Currently, site features offer limited protection of human health and the environment. The primary protective feature is that groundwater underlying Site 17 is not currently used as a potable water supply. There is currently no pathway for human exposure to metals-contaminated groundwater.

Work performed by Foster Wheeler Environmental Corporation in 1999 included grading of the flat portion of the site, topsoil cover, and seeding. A wooden barricade was also installed on the flat upper portion of the site to prevent any future deposition of soils or debris on the sloped area of Site 17. Currently, the site is fenced off from other base property.

No actions would be conducted under Alternative 1 to monitor the status of or to preclude potential contact with groundwater.

Alternative 2: Institutional Controls and Long-Term Monitoring

Alternative 2 relies on institutional controls to limit exposures to contaminated groundwater. This alternative does not employ engineered treatment or containment to address groundwater contamination.

Institutional controls would be enacted to prohibit use of groundwater contaminated with metals. 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 5 years because contaminants would be left in place. Key components of Alternative 2 are identified on Table ES-3 and described below.

Existing Features - Currently, Site 17 features offer some limited protection of human health and the environment. Foster Wheeler Environmental Corporation conducted work at the site in 1999 that included regrading, topsoil cover, seeding, and installation of a wooden barricade. Groundwater underlying Site 17 is not used as a potable water supply. As a result, there is currently no pathway for human exposure to contaminated groundwater. However, potable water supply wells are situated elsewhere on the base, and site groundwater could conceivably be used as a potable water supply in the future, posing a potential human health risk. Although active treatment of groundwater would not be conducted, a gradual reduction in concentrations of groundwater contaminants by dispersion, dilution, and degradation should occur.

Security Fencing - Security fencing was installed in 1999 to deter human and animal entry onto parts of the landfill area to protect the integrity of the existing cover. The existing fence is expected to be sufficient for the purposes of this remedial alternative. However, for cost estimating purposes, installation of fencing has been included in the cost estimate for this Alternative.

Institutional Controls - Under Alternative 2, land use restrictions would be incorporated into the Base Master Plan to restrict the future use of Site 17 groundwater until natural processes have reduced contaminant concentrations to acceptable levels (i.e., GWQSs). Use of untreated, contaminated Site 17 groundwater for drinking water would be prohibited.

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

Long-Term Monitoring - Under Alternative 2, one new well would be installed downgradient of Site 17. Groundwater would be sampled periodically to monitor the migration of contaminants from Site 17 and assess the potential impacts to downgradient receptors. The collected data would be evaluated during the five-year review period.

TABLE ES-3
SITE 17 - REMEDIAL ALTERNATIVE COMPONENTS
OPERABLE UNIT 9 FEASIBILITY STUDY
NAVY WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

	ALTERNATIVE	KEY COMPONENTS OF ALTERNATIVE
1	No Action	• No actions would be taken
2	Limited Action	• Institutional controls (land use restrictions, CEA*) • Fencing (fencing is already in place) • Five-year reviews (including sampling and analysis) • Periodic groundwater sampling and analysis

Notes:

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

Groundwater samples would be collected from three existing monitoring wells and one new downgradient well. A total of six groundwater samples, including QA/QC samples as well as groundwater level data for potentiometric mapping, would be collected annually. 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.

Five-Year Reviews - Because contaminants would remain in Site 17 groundwater, a review of site conditions and risks would be conducted every 5 years, as required by CERCLA. The reviews would consist of evaluating analytical and hydrogeologic data and assessing whether contaminant migration has increased to determine whether human receptors or natural resources are at risk.

Individual and Comparative Analysis of Alternatives

Detailed evaluations of remedial alternatives were performed for this FS in accordance with the requirements of the NCP and the EPA RI/FS Guidance Document. As part of the detailed analysis, the remedial alternatives were compared to identify differences and compare how site contaminant threats are addressed. The following seven criteria, as established by the NCP, were used for the detailed analysis of alternatives:

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

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

1.0 INTRODUCTION AND BACKGROUND INFORMATION

This feasibility study (FS) report consists of an executive summary (preceding this section), a summary of previous investigations for the OU 9 sites (Section 1.0), identification and screening of remedial technologies (Section 2.0), development and screening of remedial action alternatives (Section 3.0), and a detailed analysis of the alternatives, including a no-action alternative (Section 4.0).

Section 1.0 presents an overview of Naval Weapons Station (NWS) Earle operations and regional environmental conditions. A summary of previous investigative activities and results and a discussion of human health risk assessment methods and ecological risks for the site are also included. For a full understanding of site conditions, the Final Remedial Investigation (RI) Report (Brown & Root Environmental (B&R Environmental, 1996) and the Remedial Investigation Addendum (RIA) Report, (B&RE 1997) should be reviewed. The RI and RIA reports are essential companion documents to this FS because they were prepared as part of the prescribed Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) RI/FS development procedure.

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

Selected remedial alternatives for the sites 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 and comparison of the alternatives discussed in Section 3.0.

1.1 SITE DESCRIPTION AND SETTING

NWS Earle is located in Monmouth County in east-central New Jersey. It is situated on approximately 11,134 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 Operable Unit 9 (OU 9), which includes Site 6 (Landfill West of Normandy Road), Site 12 (Battery Storage Area), Site 15 (Sludge Disposal Area), and Site 17 (Landfill). The OU 9 sites are 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 Installation Restoration (IR) program sites, including Sites 6, 12, 15, and 17.

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

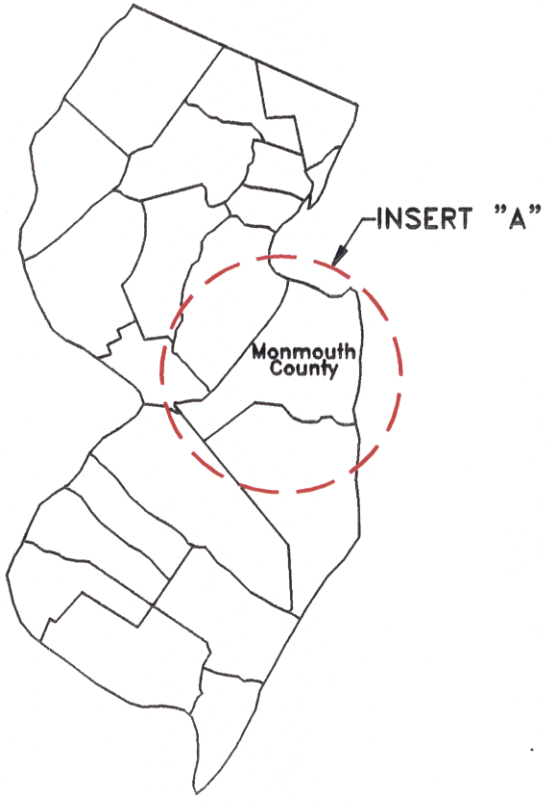
An estimated 2,500 people reside and/or work at NWS Earle. The total population of Monmouth County is approximately 550,000. Colts Neck Township, which is the location of the Mainside facility, has a total population of approximately 12,500 people. Middletown Township, which is the location of the Waterfront area, has a total population of approximately 68,200 people (United States Department of Commerce, 1990).

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.

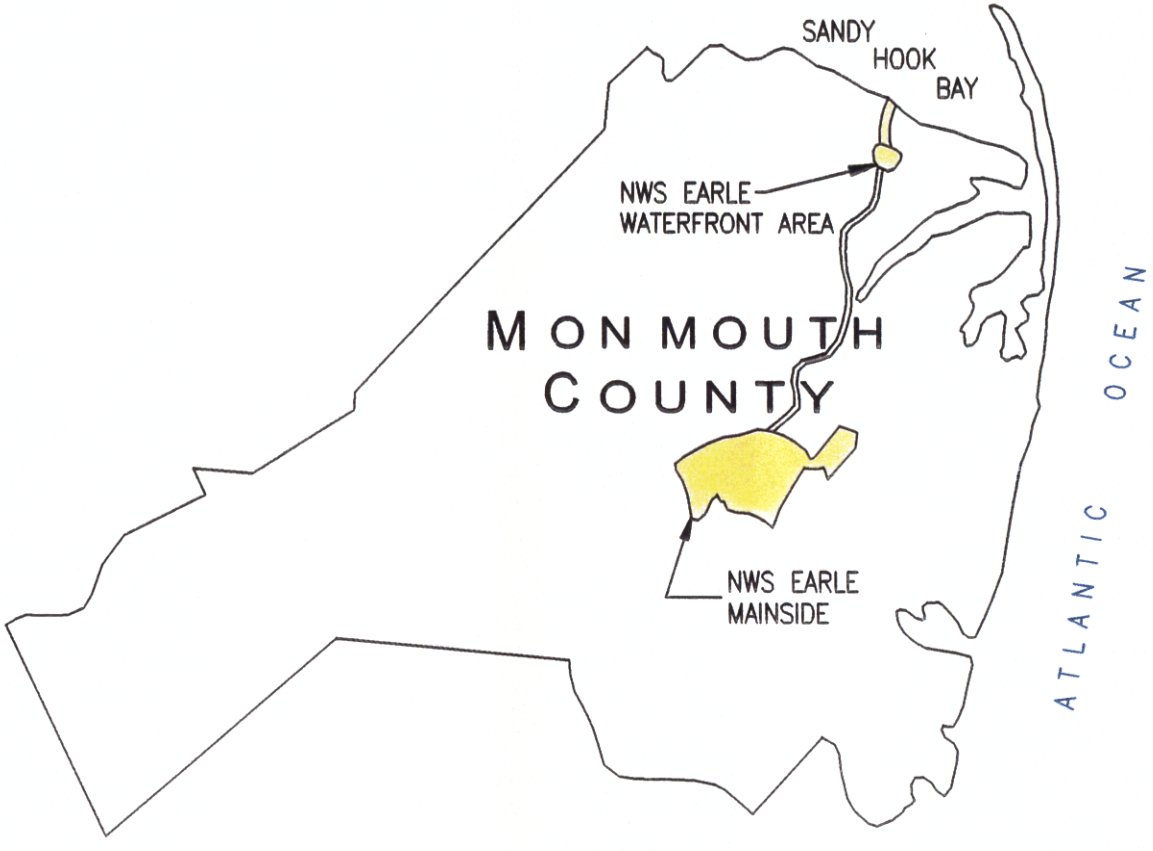
NWS Earle is located in the coastal lowlands of Monmouth County, New Jersey, within the Atlantic Coastal Plain Physiographic Province. The Waterfront area lies on the southern coast of Sandy Hook Bay on New Jersey's Atlantic shoreline, in an area known as the Bayshore Lowlands. The property and associated piers occupy a narrow strip of land running roughly perpendicular to the shoreline that serves as access from the ammunition depot (located 1 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 mean sea level (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. Site-specific hydrology is discussed in Section 1.3.

NWS Earle is situated in the Coastal Plain Physiographic Province of New Jersey. The New Jersey Coastal Plain is a seaward-dipping wedge of unconsolidated Cretaceous to Quaternary sediments that were deposited on a pre-Cretaceous basement-bedrock complex. The Coastal Plain sediments are primarily composed of clay, silt, sand, and gravel and were deposited in continental, coastal, and marine 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



STATE OF NEW JERSEY



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TETRA TECH NUS, INC.

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

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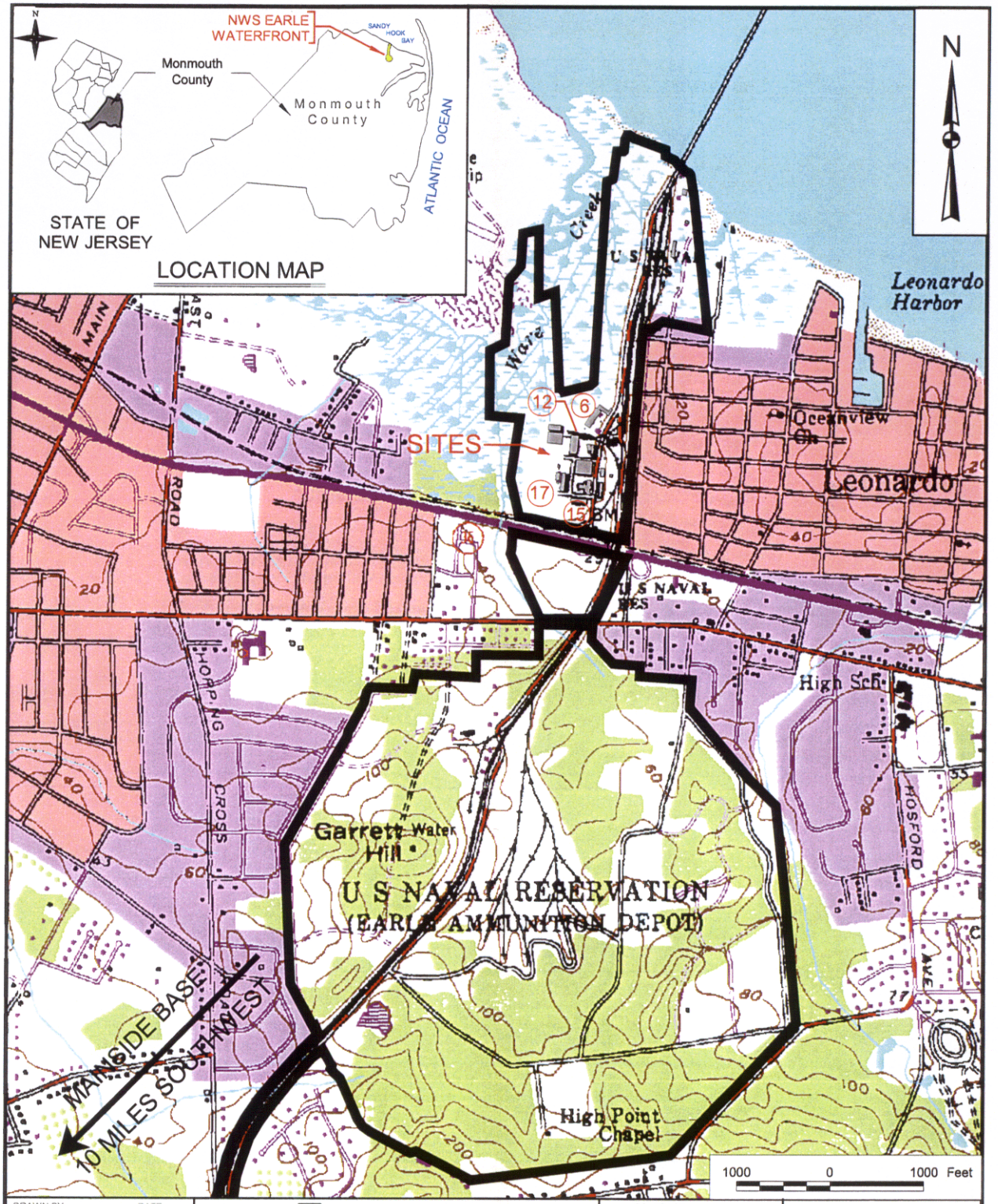
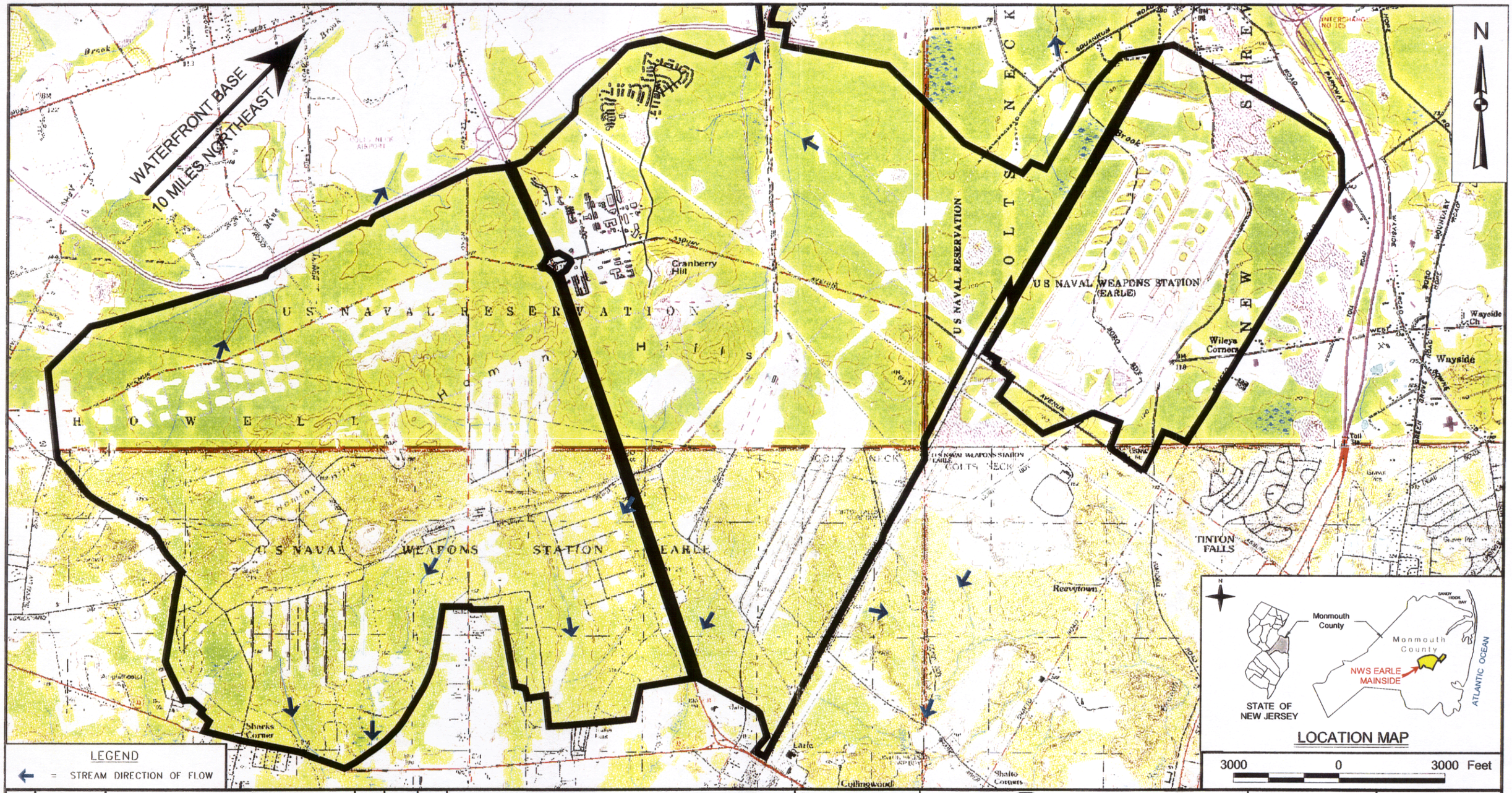
REV	DATE 3/18/03
FIGURE NUMBER	FIGURE 1-1



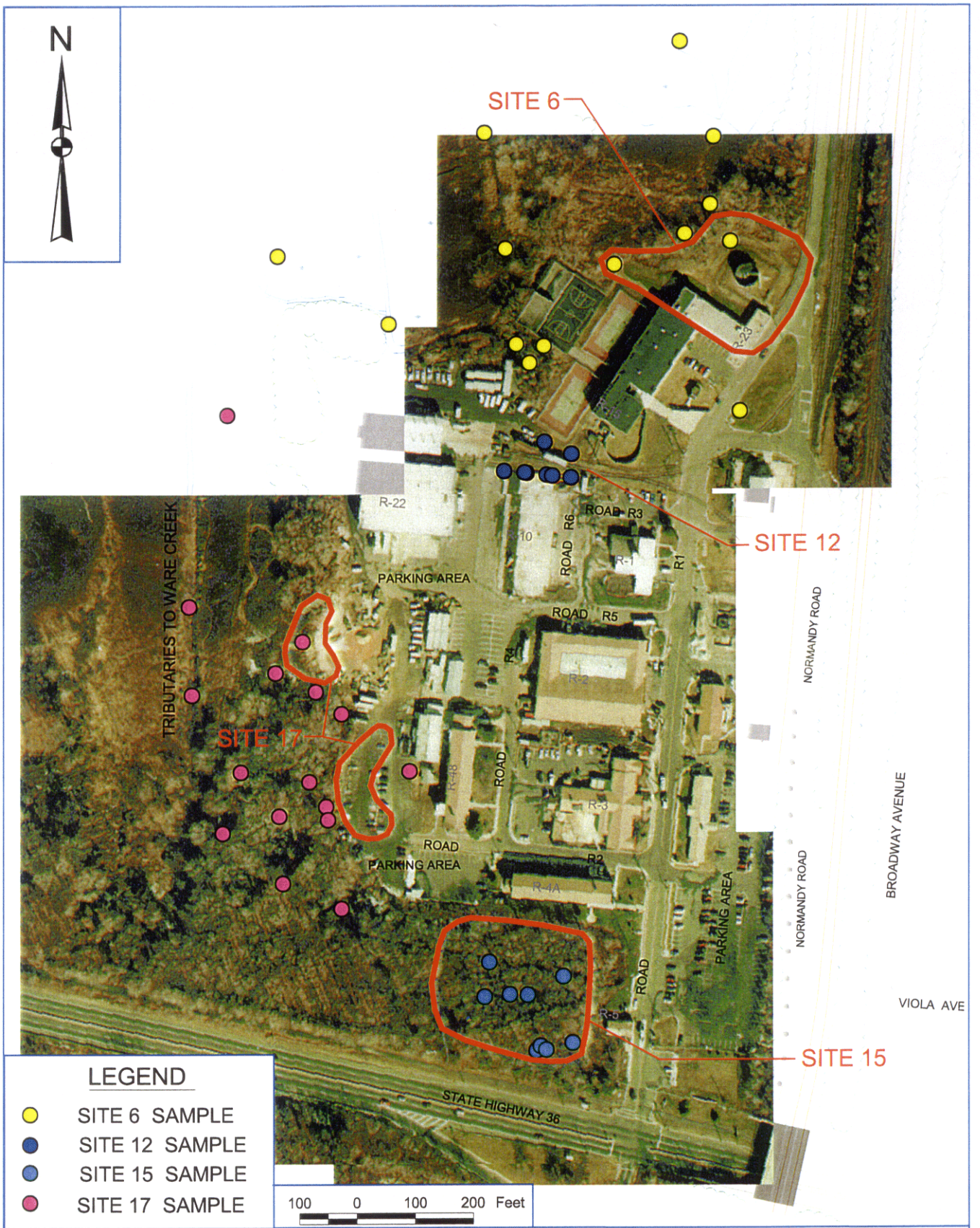
DRAWN BY	DATE	Tetra Tech NUS, Inc.	CONTRACT NUMBER	OWNER NO
LDL	3/18/03		2128	OU-9
CHECKED BY	DATE	GENERAL LOCATION MAP WATERFRONT BASE SITES 6, 12, 15, & 17 NAVAL WEAPONS STATION EARLE COLTS NECK, NEW JERSEY	PROJECT FILE NWS-EARLE_FIVE-YEAR REVIEW.apr LAYOUT OU-9 WATERFRONT BASE	
COST/SCHEDULE-AREA			APPROVED BY	DATE
			RET	3/18/03
SCALE			DRAWING NO	REV
AS NOTED			FIGURE 1-2	

GIS-PROJECTS\NWS-Earle_FIVE-YEAR REVIEW.apr\ 3/18/03 LDL PHL \ LAYOUT OU-9_FIGURE 1-2



							LDL	3/18/03	Tetra Tech NUS, Inc.
									GENERAL LOCATION MAP MAINSIDE BASE NAVAL WEAPONS STATION EARLE COLTS NECK, NEW JERSEY
						ASBURY PARK, N.J. 40074-B1 U.S.G.S. 7.5 MINUTE QUAD. MAP, 1989			
						FARMINGDALE, N.J. 40074-B2 U.S.G.S. 7.5 MINUTE QUAD. MAP, 1989			
						LONG BRANCH SW, N.J. 40073-C8 U.S.G.S. 7.5 MINUTE QUAD. MAP, 1988			
						MARLBORO, N.J. 40074-A2 U.S.G.S. 7.5 MINUTE QUAD. MAP, 1981	AS NOTED		

2128	OU-9
NWS-EARLE_FIVE-YEAR REVIEW.apr OU-9 MAINSIDE SITE	
RET	3/18/03
FIGURE 1-3	



DRAWN BY LDL	DATE 8/5/02	Tetra Tech NUS, Inc.	CONTRACT NUMBER 2128 / OWNER No. FS OU-9
CHECKED BY	DATE	SAMPLE LOCATIONS SITES 6, 12, 15, & 17 NAVAL WEAPONS STATION EARLE COLTS NECK, NEW JERSEY	PROJECT FILE: NWS-Earle-Sites 6,12,15&17-PHL.apr LAYOUT: SITES 6, 12, 15 & 17 Sample Locations
COST/SCHEDULE-AREA			APROVED BY RET / REV DATE 3/18/03 / DATE 8/16/02
SCALE AS NOTED			DRAWING No. FIGURE 1-4 / REV 1

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 the site summary sections (Section 1.3).

Groundwater classification areas were established in New Jersey under New Jersey Department of Environmental Projection (NJDEP) Water Technical Programs Groundwater Quality Standards in New Jersey Administrative Code (N.J.A.C.) 7:9-6. The 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 Englishtown aquifer is a significant source of water in Monmouth County and is developed in the sands of the Englishtown Formation. The four Waterfront sites that comprise OU 9 (Sites 6, 12, 15, and 17) are located in the recharge area of the Englishtown 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 public water supply from the New Jersey American Water Company serves businesses and residences in areas surrounding the Waterfront facilities. There are a number of private wells located within a 1-mile radius of NWS Earle and several within the NWS Earle Mainside boundaries. The majority of these wells are used for potable supplies; previous testing for drinking water parameters indicates these wells have not been adversely impacted.

There is a rich diversity of ecological systems and habitats at NWS Earle. Knieskern's beaked-rush (*Rynchospora knieskernii),* a sedge species on the federal and New Jersey State endangered lists, has been seen on the station, and the swamp pink (*Helonias bullata*), also on the federal and New Jersey State endangered lists, may be present. 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 sites investigated in the RI were summarized as follows (Source: National Oceanic and Atmospheric Administration (NOAA) in a letter from Environmental Protection Agency (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 sites; results are discussed in Section 1.3.

1.2 SITE OPERATING HISTORY

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

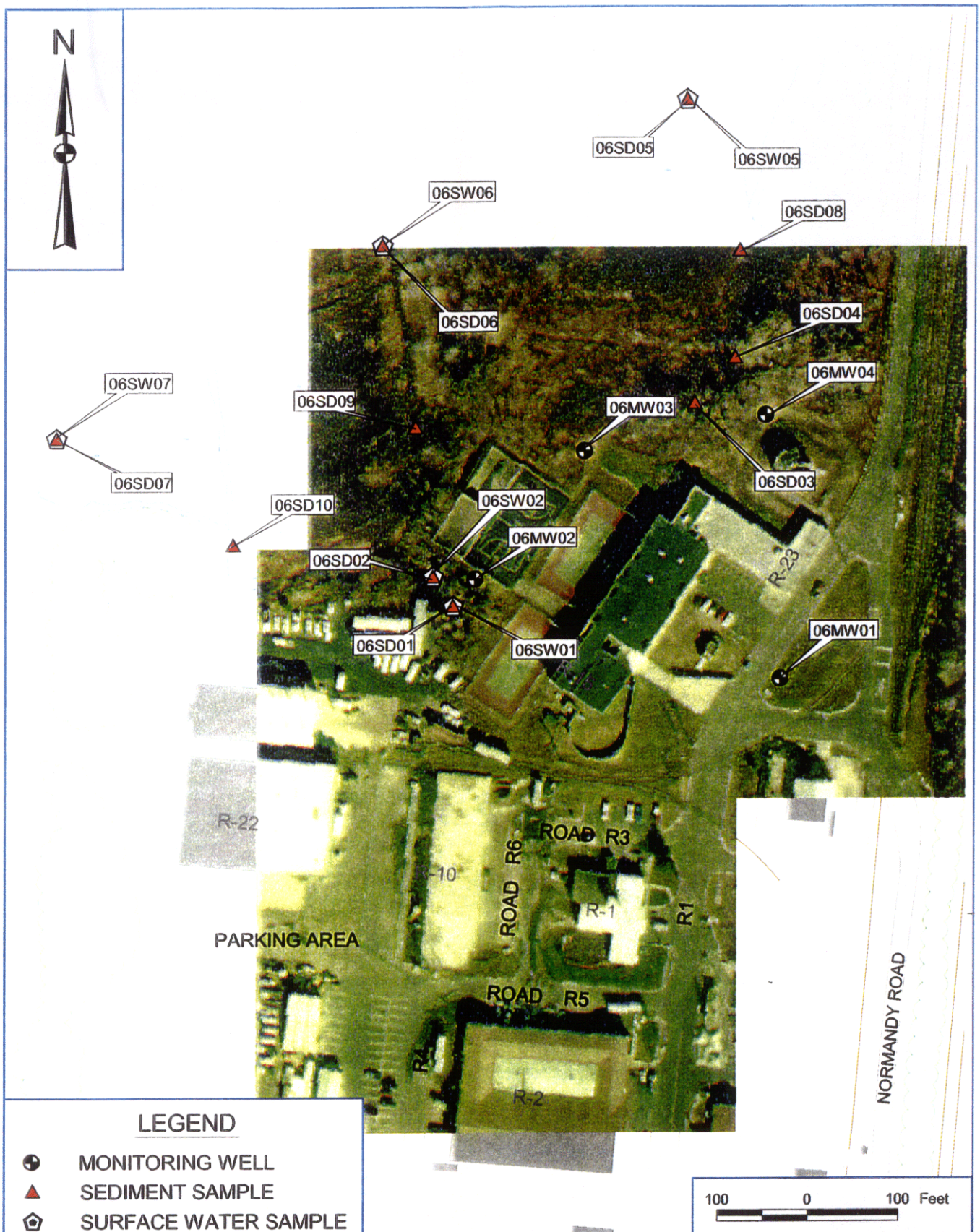
Over 90 percent of the acreage at NWS Earle is dedicated to its primary mission of storage and delivery of ordnance. The actual amount of land used for storage and distribution facilities is much less than this, but Explosive Safety Quality Distance (ESQD) arcs are established around each facility. Any 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. Sites 6, 12, 15, and 17, which constitute OU 9, are within the Waterfront Administration area. 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.

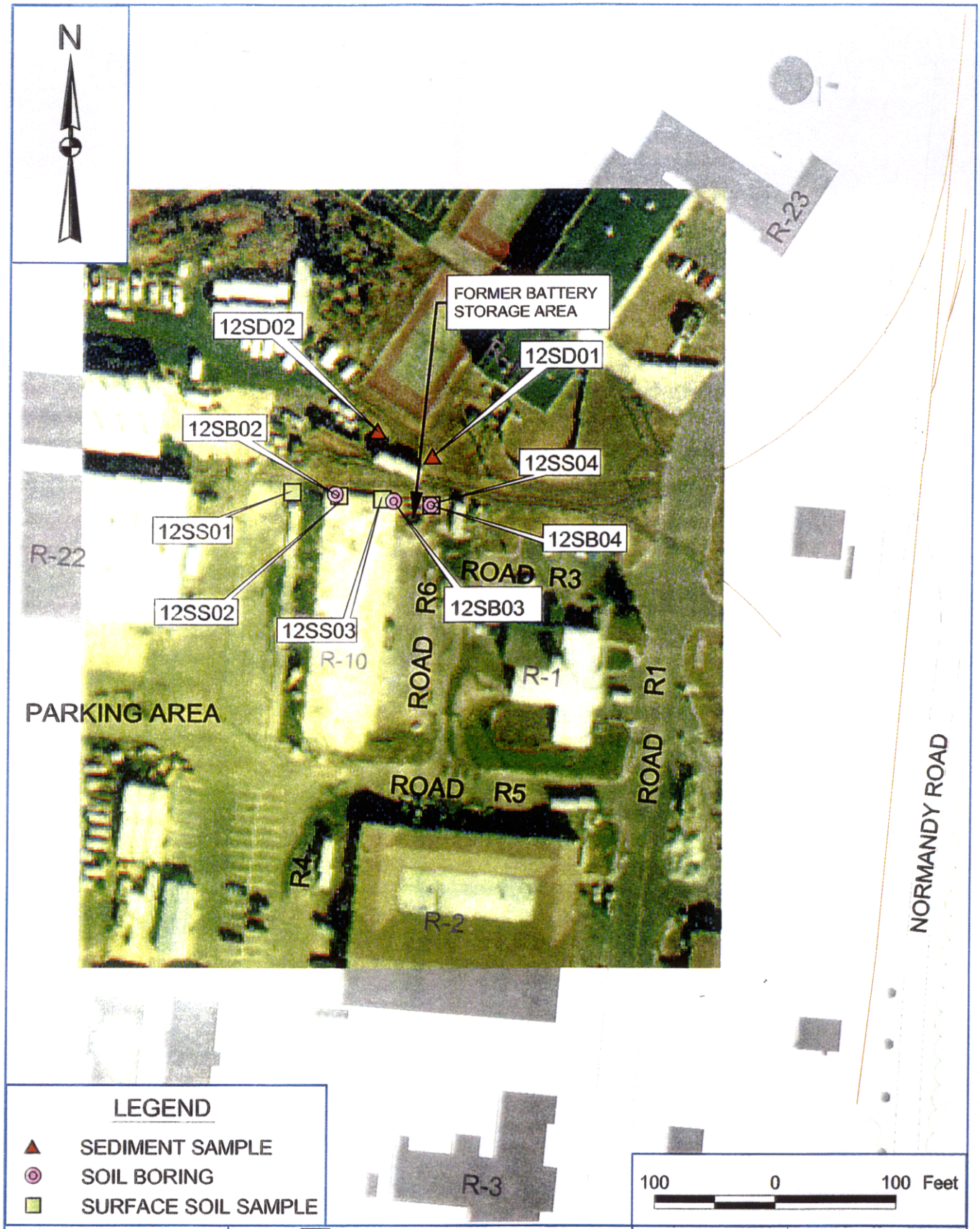
The sites were used for various purposes. The Site 6 Landfill West of Normandy Road is a 4-acre site located in the Waterfront area (Figure 1-5). From 1943 to 1965, the site was used to dispose of refuse from the Waterfront area consisting of dunnage lumber, glass, paper, packing material, and small amounts of paint and solvent. It was reported that the wastes were burned before they were covered, and an estimated 2,500 tons of waste were deposited annually at the landfill. The landfill area may have been part of a salt marsh before disposal began. Currently, the majority of the landfill surface is paved or covered with buildings.

The Site 12 Battery Storage Area was a paved area next to the loading dock east of Building R-10 (Figure 1-6) used as a temporary staging area for forklift batteries being sent off site to be reclaimed. The storage area occupied various portions of the paved area at different times but was generally limited to approximately 7,500 to 10,000 square feet at the northern end of the paved area adjacent to Building R-10. As reported in the 1993 Site Inspection (SI), batteries have not been stored at the site for several years.

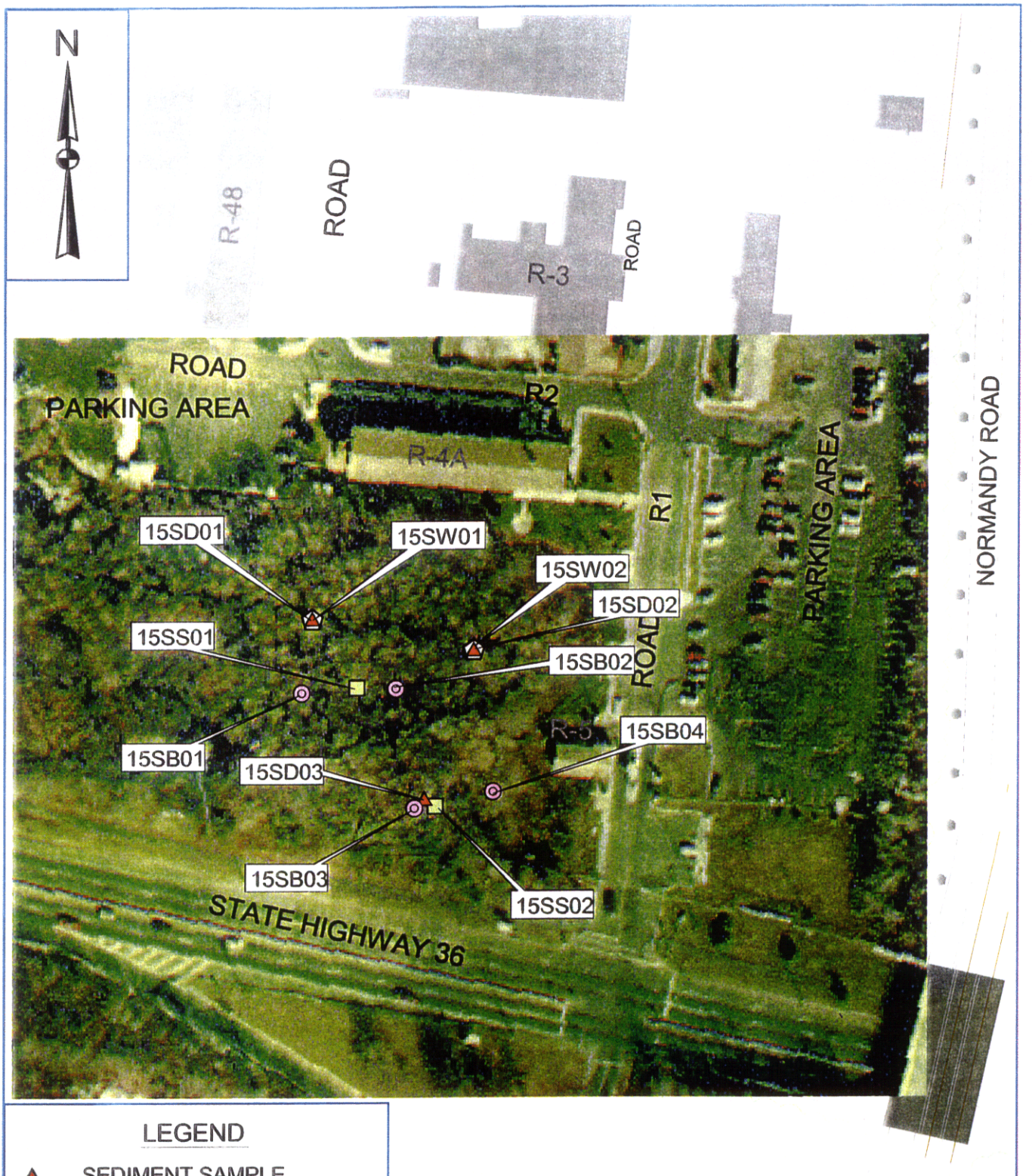
The Site 15 Sludge Disposal Site reportedly occupied a small area along the former railroad tracks near the main entrance to the Waterfront area (Figure 1-7). In the early 1970s, the site was used for disposal of an unknown amount of oily bilge sludge. It is estimated that over 5,000 gallons of sludge, which may have ranged from 1 percent to 25 percent oil, may have been disposed at the site. The exact location of the sludge disposal activities was not apparent during site inspections. The site is near an elevated railroad bed built approximately 6 feet above the surrounding ground surface.



DRAWN BY LDL	DATE 8/27/02	Tetra Tech NUS, Inc.	CONTRACT NUMBER 2128 / OWNER No FS OU-9
CHECKED BY	DATE	SAMPLE LOCATIONS SITE 6 - LANDFILL WEST OF NORMANDY ROAD NAVAL WEAPONS STATION EARLE COLTS NECK, NEW JERSEY	PROJECT FILE NWS-Earle-Sites 6, 12, 15&17-PHL.apr LAYOUT SITE-6 Sample Locations
COST/SCHEDULE-AREA			APPROVED BY RET / REV DATE 3/18/03 / DATE 8/16/02
SCALE AS NOTED			DRAWING No. FIGURE 1-5 / REV 1



DRAWN BY LDL	DATE 8/14/02	Tetra Tech NUS, Inc.	CONTRACT NUMBER 2128 / OWNER No FS OU-9
CHECKED BY	DATE	SAMPLE LOCATIONS SITE 12 - BATTERY STORAGE AREA NAVAL WEAPONS STATION EARLE COLTS NECK, NEW JERSEY	PROJECT FILE NWS-Earle-Sites 6, 12, 15&17-PHL.apr LAYOUT SITE-12 Sample Locations
COST SCHEDULE AREA			APROVED BY RET / REV DATE 3/18/03 / DATE 8/16/02
SCALE AS NOTED			DRAWING No. FIGURE 1-6 / REV 1



LEGEND

- ▲ SEDIMENT SAMPLE
- ◎ SOIL BORING
- ▣ SURFACE SOIL SAMPLE
- ⬠ SURFACE WATER SAMPLE

100 0 100 Feet

DRAWN BY LDL	DATE 8/27/02	Tetra Tech NUS, Inc.
CHECKED BY	DATE	SAMPLE LOCATIONS
POST SCHEDULE AREA		SITE 15 - SLUDGE DISPOSAL SITE
SCALE AS NOTED		NAVAL WEAPONS STATION EARLE
		COLTS NECK, NEW JERSEY

CONTRACT NUMBER 2128	OWNER No FS OU-9
PROJECT FILE NWS-Earle-Sites 6, 12, 15&17-PHL.apr	
LAYOUT SITE-15 Sample Locations	
APPROVED BY RET / REV DATE 3/18/03	DATE 8/16/02
DRAWING No FIGURE 1-7	REV 1

The Site 17 Landfill occupies 3 acres in the Waterfront area, adjacent to a tidal marsh in the Ware Creek drainage basin (Figure 1-8). The site was reportedly used for the disposal of wood, heavy equipment, empty paint cans, and construction debris. The landfill surface is covered with gravel and pavement and is currently utilized as a parking area for Waterfront personnel.

1.3 SITE INVESTIGATION SUMMARY

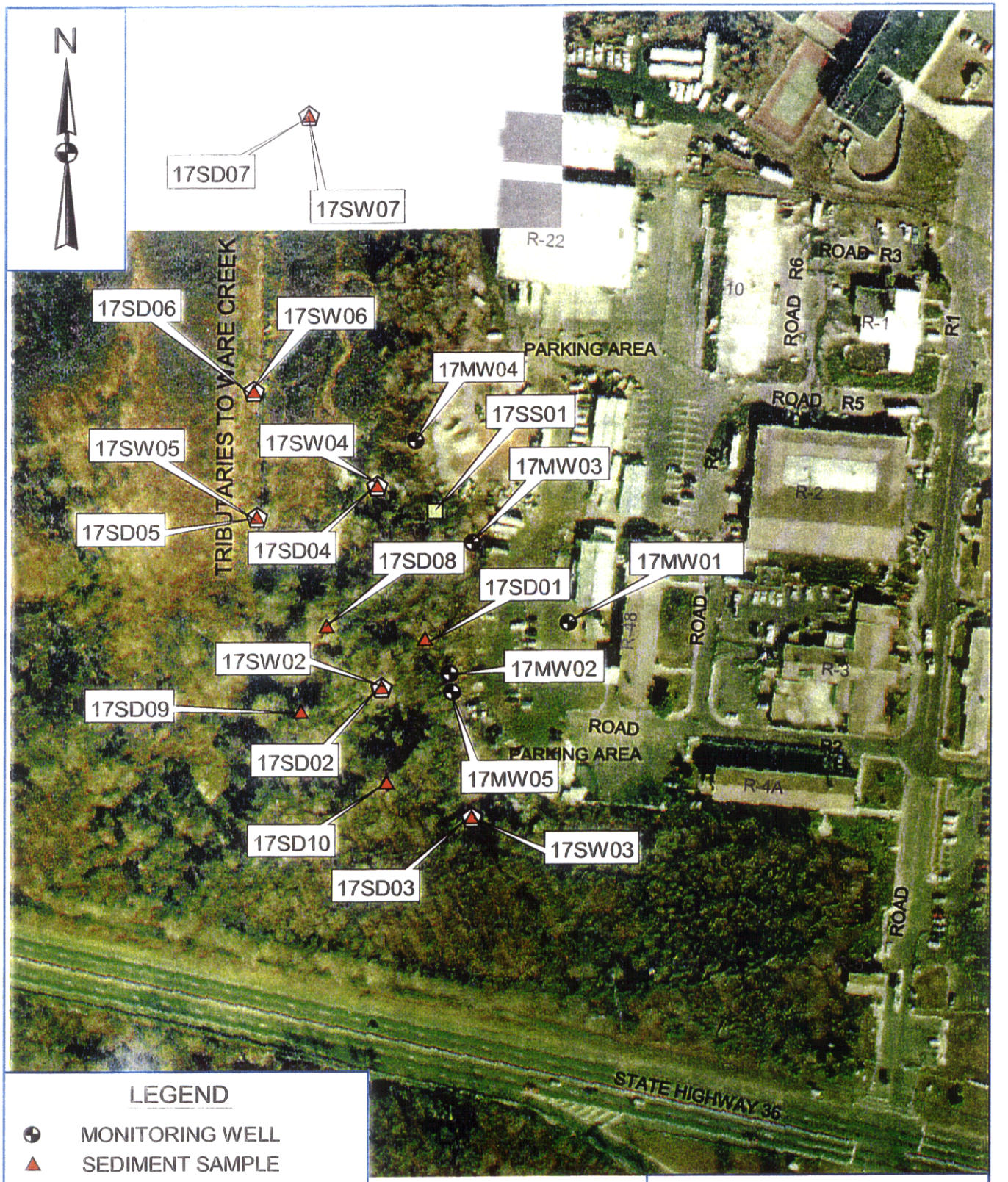
Site investigation activities related to areas of potential environmental concern at NWS Earle have been undertaken by the Navy since approximately 1982. Early work included an Initial Assessment Study (IAS) conducted by Fred C. Hart and Associates; the results are included in a report prepared in 1982.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

In 1995 and 1996, Brown & Root Environmental (B&R Environmental) conducted remedial investigations for 27 sites at NWS Earle (including all OU 9 sites). The RI included field investigations performed in 1995 and a review of data generated during previous investigations. Field investigations included a determination of base-wide background conditions. The final RI report was prepared in July 1996. Results of the RI indicated that further RI data collection activities were required at seven sites. The results of the additional RI data collection activities (including sites 6, 12, and 17 of OU 9) are presented in the final RI Addendum Report, dated January 1998.

Results of the background determination and previous investigations for Sites 6, 12, 15, and 17 are discussed below.

1.3.1 Background Sampling

In order to determine the background level of chemicals present in and around NWS Earle, B&R Environmental collected samples from media at locations throughout the station that were selected on the expectation that past or present operations have not impacted site media. The field team collected samples



LEGEND

- MONITORING WELL
- SEDIMENT SAMPLE
- SURFACE WATER SAMPLE
- SURFACE SOIL SAMPLE

100 0 100 200 Feet

DRAWN BY LDL	8/16/02	Tetra Tech NUS, Inc.	CONTRACT NUMBER 2128 / OWNER No FS OU-9
		SAMPLE LOCATIONS SITE 17 - LANDFILL NAVAL WEAPONS STATION EARLE COLTS NECK, NEW JERSEY	PROJECT FILE NWS-Earle-Sites 6, 12, 15&17-PHL.apr LAYOUT SITE-17 Sample Locations
			APROVED BY RET / REV DATE 3/18/03 / DATE 8/16/02
SCALE AS NOTED			DRAWING No FIGURE 1-8 / REV 1

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 station areas where industrial operations or other potential sources of contaminant accumulation in site media may have occurred. The results of the background sampling were used for comparison with analytical results obtained from the sampling activities at the RI sites. A total of four background samples were collected for each of the five media. The BG-4 suite of sampled background media was split between the Mainside (surface water and sediment) and Waterfront (groundwater and subsurface soils) areas because 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).

1.3.1.1 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) was collected at this location.

1.3.1.2 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) was collected at this location.

1.3.1.3 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.

1.3.1.4 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.

1.3.1.5 Background Well Geology

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

The four background monitoring wells were completed in distinct geological formations across the facility.

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 and 35 feet in thickness. The lithology of the sediments encountered in the soil boring generally agrees with the published description of the Cohansey Sand. However, because the boring reached a depth of 80 feet, it is likely that the boring also encountered the Kirkwood Formation. The Kirkwood Formation ranges between 60 and 100 feet in thickness. The well is 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.

TABLE 1-1
BACKGROUND MONITORING WELL CHARACTERISTICS SUMMARY
OPERABLE UNIT 9 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 1-2
BACKGROUND STATIC WATER LEVEL MEASUREMENT SUMMARY
OPERABLE UNIT 9 FEASIBILITY STUDY
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

	August 7, 1995			October 17, 1995		
Monitoring Well Number	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	21.93	96.31	74.38	22.70	96.31	73.61
BGMW-02	70.30	233.70	163.40	71.20	233.70	162.50
BGMW-03	63.38	203.80	140.42	64.89	203.80	138.91
BGMW-04	15.45	28.96	13.51	17.13	28.96	11.83

msl = Mean sea level.

1.3.1.6 Background Groundwater Statistical Analysis

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

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

1.3.1.7 Background Surface Soil Statistical Analysis

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

1.3.1.8 Background Subsurface Soil Statistical Analysis

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

TABLE 1-3
BACKGROUND WELLS AND UPGRADIENT WELLS GROUPED BY INTERPRETED AQUIFER
OU 9 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 1-4
STATISTICAL EVALUATION OF BACKGROUND GROUNDWATER METALS DATA
COHANSEY SAND, KIRKWOOD, AND VINCENTOWN FORMATIONS
OU 9 FEASIBILITY STUDY
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

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

Notes:
(1) Background statistics are based on the estimated distribution type (normal or lognormal).
(2) The tolerance limit defines the concentration range that, on the average, is estimated to contain 95 % of all data points from the background population.
(3) If a site-related sample exceeds the tolerance limit, statistical evidence suggests the sample comes from a population with a different distribution and higher concentrations than the background data.

TABLE 1-5
STATISTICAL EVALUATION OF BACKGROUND GROUNDWATER METALS DATA
RED BANK SAND AND NAVESINK FORMATIONS
OU 9 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 1-6
STATISTICAL EVALUATION OF BACKGROUND GROUNDWATER METALS DATA
FILL AND ENGLISHTOWN FORMATIONS
OU 9 FEASIBILITY STUDY
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

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

Notes:

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

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

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

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

TABLE 1-7
STATISTICAL EVALUATION OF BACKGROUND SURFACE SOIL METALS DATA
OU 9 FEASIBILITY STUDY
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

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

Notes:

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

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

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

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

TABLE 1-8
STATISTICAL EVALUATION OF BACKGROUND SURFACE SOIL METALS DATA
OU 9 FEASIBILITY STUDY
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

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

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

1.3.1.9 Human Health Risk Assessment Method

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 Remedial Investigation Report (July 1996). This section provides a summary description of the human health risk assessment 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 each NWS Earle site. 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 for each NWS Earle site. The risk assessment processes used at NWS Earle was in accordance with current (at the time - 1996) EPA risk assessment guidance (EPA, 1989a; EPA, 1991a).

The human health risk assessment 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 human health risk assessment 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 reasonable maximum exposure (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.

1.3.2 Site 6

1.3.2.1 Initial Assessment and Confirmation Study

The 1983 IAS consisted of interviews and on-site observations and did not recommend Site 6 for a confirmation study.

During the 1993 SI, four soil borings were drilled and completed as monitoring wells at Site 6. Two soil samples were analyzed for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), pesticides, polychlorinated biphenyl (PCBs), and metals. Low levels of VOCs and two pesticides were detected in soil samples from the 06MW02 and 06MW03 well borings. Low levels of metals were also detected. Four sediment samples were collected from the marsh area downgradient of the site. Elevated levels of metals, pesticides, semivolatiles, and PCBs were detected. Groundwater samples were collected from the four monitoring wells and analyzed for metals, organics, and landfill parameters. Elevated levels of metals, one SVOC, and two miscellaneous parameters were detected. Concentrations of typical landfill parameter concentrations encountered in Site 6 groundwater samples were relatively low compared to typical groundwater concentrations found beneath active solid waste landfills.

1.3.2.2 Remedial Investigation

Between June and October 1995, B&R Environmental conducted the following field investigation activities at Site 6:

- Sampling and analysis of surface water
- Sampling and analysis of sediment
- Sampling and analysis of groundwater from the four existing monitoring wells
- Measurement of static water levels in the four monitoring wells

A survey was conducted to establish the horizontal locations and vertical elevations of the sediment sample locations, the surface water sample locations, and existing monitoring wells.

Based on previous investigations including the 1995 RI, it was determined that further data were required to assess the ecological impacts on the adjacent wetlands. On October 29, 1996 and November 1, 1996, B&R Environmental conducted additional surface water and sediment sampling and analysis at Site 6.

A survey was also conducted to establish horizontal locations and vertical elevations of these sampling locations.

1.3.2.3 Summary of Results

Currently, the majority of the landfill surface is paved or covered with buildings. The landfill surface is 3 to 10 feet higher than the adjacent marsh and wetland areas, and the toe of the landfill is covered with vegetation. Infiltration is limited, and overland flow drains toward the salt marsh and eventually into Sandy Hook Bay. Groundwater flow is to the north and northwest based on measured groundwater levels.

Slope stabilization work was performed by Foster Wheeler Environmental Corporation at Site 6 in 1999. The work included delineation of adjacent wetlands to determine boundaries for the stabilization, clearing and grubbing of brush and trees, backfilling, and regrading and seeding of the area in order to stabilize the northern slope of the site.

1.3.2.3.1 Site Geology and Hydrogeology

Geology

Regional mapping places Site 6 within the outcrop area of the Englishtown Formation. The Englishtown Formation ranges from 35 and 150 feet in thickness, and the soil borings are no more than 23 feet deep. The lithology of the sediments encountered in the on-site borings generally agrees with the published description of the Englishtown Formation. In general, the borings encountered fill material, yellowish-brown clay, yellowish-brown, olive, and gray sand and silty sand, and gray silt. Based upon the boring log descriptions, the wells at Site 6 penetrated fill material and the Englishtown Formation.

Hydrogeology

Groundwater in the fill material and Englishtown aquifer beneath the site occurs under unconfined conditions, and the fill material and formation are interpreted to be hydraulically interconnected. Static water level measurements and water table elevations are summarized in Table 1-9. Groundwater elevations for August 1995 and October 1995 are contoured on Figures 1-9 and 1-10, respectively. The direction of shallow groundwater flow in the aquifer, as indicated by both the August and October groundwater contour maps, is toward the north and northwest. There does not appear to be a significant seasonal variation in groundwater flow direction. Based on the boring log descriptions, the wells are screened across the contact between the fill material and the Englishtown Formation. 1.3.2.3.2

Nature and Extent of Contamination

This section evaluates the sampling data for the 1995 RI and 1996 RI Addendum. Tables 1-10 through 1-14 compare the results of background samples to samples collected at Site 6. Figures 1-11a and 1-11b show

TABLE 1-9
SITE 6 STATIC WATER-LEVEL MEASUREMENT SUMMARY
OU 9 FEASIBILITY STUDY
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

Monitoring Well Number	August 7, 1995			October 17, 1995		
	Depth to Water Table[1] (feet)	Top of PVC Riser[2]	Elevation of Water Table[2]	Depth to Water Table[1] (feet)	Top of PVC Riser[2]	Elevation of Water Table[2]
MW6-01	12.29	17.75	5.46	12.68	17.75	5.07
MW6-02	8.36	12.68	4.32	8.58	12.68	4.10
MW6-03	9.35	13.64	4.29	9.88	13.64	3.76
MW6-04	10.29	14.58	4.29	10.68	14.58	3.90

(1) In feet below top of riser.

(2) In feet above mean sea level.

TABLE 1-10
OCCURRENCE AND DISTRIBUTION OF INORGANICS IN SEDIMENT AT SITE 6
OU-9 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY
(mg/kg)

	BACKGROUND***				SITE-RELATED					
SUBSTANCE	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	UTL**	2 X AVERAGE CONCENTRATION	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	AVERAGE CONCENTRATION	MEAN > 2 X BKGD?	MEAN > BACK UTL?	REPRESENTATIVE CONCENTRATION
ALUMINUM	6 / 6	839 - 3940	8.1E+07	5459.67	10 / 10	2050 - 14500	5491.00	YES	NO	7578.17
ANTIMONY *	NOT DETECTED	-	-	-	2 / 10	0.51 - 12.4	2.42	YES	-	4.63
ARSENIC *	5 / 6	2.4 - 9.9	2.9E+02	11.23	10 / 10	1.9 - 36.3	13.93	YES	NO	21.60
BARIUM	6 / 6	3.2 - 15.8	2.9E+02	16.80	10 / 10	5 - 138	42.69	YES	NO	72.47
BERYLLIUM	4 / 6	0.34 0.57	3.3E-01	0.72	9 / 10	0.11 - 1.2	0.42	NO	YES	0.64
CADMIUM	2 6	0.44 - 0.46	1.1E+00	0.93	2 / 10	1.5 - 1.8	0.41	NO	NO	0.80
CALCIUM	6 / 6	179 - 518	6.7E+05	690.83	10 / 10	92.4 - 8820	1890.64	YES	NO	3522.28
CHROMIUM	6 / 6	4.3 - 56	2.6E+03	40.42	7 / 7	14.4 - 77.2	34.64	NO	NO	50.89
COBALT	4 / 6	0.51 2.1	6.4E+00	2.85	9 / 10	0.33 - 8.2	2.62	NO	NO	4.38
COPPER *	6 / 6	1 - 13	1.9E+01	9.08	10 / 10	0.75 - 228	39.85	YES	YES	82.70
IRON	6 / 6	228 - 21400	7.2E+09	23589	10 / 10	1790 - 52200	21524	NO	NO	32677
LEAD *	6 / 6	4 - 34.3	4.8E+01	21.07	10 / 10	3.8 - 445	80.28	YES	YES	163.62
MAGNESIUM	6 / 6	60.7 - 880	2.0E+06	809.90	9 / 10	401 - 2460	1165.04	YES	NO	2460.00
MANGANESE	6 / 6	3.9 - 63.1	8.9E+01	36.22	10 / 10	4.1 - 451	72.84	YES	NO	152.91
MERCURY *	1 / 6	0.068 0.068	8.5E-03	0.09	4 / 10	0.027 - 0.63	0.15	YES	YES	0.27
NICKEL	5 / 6	1.6 - 6	3.4E+01	6.90	10 / 10	0.93 - 43.8	9.09	YES	NO	17.03
POTASSIUM	5 / 6	86.1 - 2900	1.4E+07	1892.03	10 / 10	172 - 2630	1093.70	NO	NO	2411.68
SELENIUM	0 / 6	-	1.9E+00	-	4 / 10	1.2 - 3.4	1.22	YES	NO	1.88
SILVER	2 / 6	0.1125 0.15	2.8E+00	1.13	2 10	0.12 - 0.26	0.35	NO	NO	0.26
SODIUM	4 / 6	26.6 - 2280	2.9E+03	876.80	9 / 10	28.6 - 6960	1105.26	YES	NO	2320.44
THALLIUM *	NOT DETECTED	-	-	-	2 / 10	0.92 - 2.1	0.67	YES	-	0.98
VANADIUM	6 / 6	5.9 - 42.7	2.1E+03	39.42	10 / 10	3.9 - 104	37.67	NO	NO	104.00
ZINC	6 / 6	12.5 - 34.7	1.5E+03	41.23	10 / 10	4.5 - 1720	244.76	YES	NO	556.85

* - Selected as a COPC

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

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

TABLE 1-11
OCCURRENCE AND DISTRIBUTION OF ORGANICS IN SEDIMENT AT SITE 6
OU-9 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY
(ug/kg)

SUBSTANCE	BACKGROUND**			SITE-RELATED		
	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	REPRESENTATIVE CONCENTRATION	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	REPRESENTATIVE CONCENTRATION
4,4'-DDD *	2 / 6	4.9 - 21	11.98	4 / 9	2.4 - 230	80.01
4,4'-DDE *	1 / 6	1.7 - 1.7	1.7	5 / 10	3.6 - 66	24.62
4,4'-DDT *	1 / 6	19 - 19	10.64	4 / 10	9.3 - 110	47.12
ALPHA-CHLORDANE *	NOT DETECTED	-	-	3 / 9	9.8 - 48	19.64
DIELDRIN *	NOT DETECTED	-	-	2 / 10	0.31 - 1.6	1.6
ENDOSULFAN II *	NOT DETECTED	-	-	3 / 10	2.6 - 24	8.82
ENDRIN *	NOT DETECTED	-	-	1 / 10	1.6 - 1.6	1.6
ENDRIN KETONE *	1 / 5	1.6 - 1.6	1.6	1 / 10	7.3 - 7.3	7.3
GAMMA-CHLORDANE *	1 / 6	0.095 - 0.095	0.095	4 / 10	0.34 - 56	19.82
HEPTACHLOR *	NOT DETECTED	-	-	2 / 10	0.16 - 0.35	0.35
HEPTACHLOR EPOXIDE *	NOT DETECTED	-	-	4 / 10	0.2 - 2.3	2.30
ACENAPHTHYLENE *	NOT DETECTED	-	-	2 / 10	56 - 160	160.00
ANTHRACENE *	NOT DETECTED	-	-	3 / 10	88 - 260	260.00
BENZ(A)ANTHRACENE *	3 / 6	85 - 560	560	5 / 10	75 - 1700	676.58
BENZO(A)PYRENE *	3 / 6	110 - 590	393.60	6 / 10	100 - 2400	852.30
BENZO(B)FLUORANTHENE *	3 / 6	150 - 490	346.54	5 / 10	190 - 4800	1587.69
BENZO(G,H,I)PERYLENE *	3 / 6	51 - 380	380	4 / 10	150 - 2600	912.89
BENZO(K)FLUORANTHENE *	3 / 6	63 - 470	470	5 / 10	66 - 1100	451.37
BIS(2-ETHYLHEXYL)PHTHALATE	NOT DETECTED	-	-	2 / 10	96 - 880	521.76
BUTYLBENZYLPHTHALATE *	NOT DETECTED	-	-	1 / 10	300 - 300	300.00
CARBAZOLE *	NOT DETECTED	-	-	1 / 10	140 - 140	140
CHRYSENE *	3 / 6	130 - 940	577.87	5 / 10	130 - 2400	884.84
DIBENZ(A,H)ANTHRACENE *	NOT DETECTED	-	-	2 / 10	150 - 720	385.24
DIBENZOFURAN *	NOT DETECTED	-	-	1 / 10	78 - 78	78
FLUORANTHENE *	3 / 6	240 - 1800	1024.31	5 / 10	110 - 1600	819.64
FLUORENE *	1 / 6	190 - 190	190	2 / 10	65 - 83	83
INDENO(1,2,3-CD)PYRENE *	3 / 6	55 - 310	310	5 / 10	69 - 2300	800.89
NAPHTHALENE *	NOT DETECTED	-	-	1 / 10	90 - 90	90.00
PHENANTHRENE *	3 / 6	110 - 1900	1052.11	4 / 10	210 - 740	421.54
PYRENE *	3 / 6	200 - 1900	1076.74	5 / 10	130 - 2000	884.61
4-METHYL-2-PENTANONE *	NOT DETECTED	-	-	1 / 4	2 - 2	2
TOLUENE *	1 / 3	480 - 480	480	1 / 4	31 - 31	31
XYLENE (TOTAL) *	NOT DETECTED	-	-	1 / 4	3 - 3	3

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

Background concentrations for any non-naturally occurring chemicals were not used as a basis for selection of COPCs. All organic compounds detected at the site were selected as COPCs.

TABLE 1-12
OCCURRENCE AND DISTRIBUTION OF INORGANICS IN GROUNDWATER AT SITE 6
OU-9 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY
(ug/L)

	BACKGROUND***				SITE-RELATED					
SUBSTANCE	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	UTL**	2 X AVERAGE CONCENTRATION	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	AVERAGE CONCENTRATION	MEAN > 2 X BKGD?	MEAN > BACK UTL?	REPRESENTATIVE CONCENTRATION
ALUMINUM	3 / 3	1320 - 2090	1.6E+11	3386.67	4 / 4	145 - 1320	518.75	NO	NO	1320.00
ARSENIC *	1 / 3	5.1 - 5.1	1.7E+02	5.60	3 / 4	5.1 - 26.8	10.59	YES	NO	26.80
BARIUM	3 / 3	30.4 - 78.1	2.5E+06	105.47	4 / 4	30.4 - 64.9	47.13	NO	NO	64.90
BERYLLIUM	2 / 3	0.23 - 4.5	7.7E+01	3.19	1 / 4	0.21 - 0.21	0.09	NO	NO	0.21
CADMIUM	3 / 3	0.43 - 7	2.2E+01	5.29	4 / 4	1.2 - 7	3.90	NO	NO	7.00
CALCIUM	3 / 3	11000 - 24100	9.4E+14	38067	4 / 4	5670 - 89800	31440	NO	NO	89800
CHROMIUM *	NOT DETECTED	-	-	-	1 / 4	1.2 - 1.2	0.66	YES	-	1.20
COBALT	3 / 3	3.2 - 24.7	4.2E+04	23.67	3 / 4	0.81 - 7.6	3.18	NO	NO	7.60
IRON	3 / 3	1400 - 95200	2.4E+16	66847	4 / 4	13400 - 95200	50025	NO	NO	95200
MAGNESIUM	3 / 3	8610 - 17300	2.5E+14	26940	4 / 4	3120 - 53000	19660	NO	NO	53000
MANGANESE	3 / 3	720 - 3040	7.3E+11	3720	4 / 4	61.3 - 1820	754.08	NO	NO	1820.00
NICKEL	3 / 3	3.7 - 43.2	2.7E+05	38.33	4 / 4	0.76 - 5	2.61	NO	NO	5.00
POTASSIUM	3 / 3	3000 - 3620	1.1E+12	6780	4 / 4	2250 - 9270	4395	NO	NO	9270
SODIUM	3 / 3	15800 - 92500	1.9E+17	127600	4 / 4	20800 - 83100	40925	NO	NO	83100
ZINC	2 / 2	18.9 - 30.9	7.3E+11	49.80	3 / 4	3.3 - 18.9	10.55	NO	NO	18.90

* - Selected as a COPC

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

*** - Background samples are as follows: MW4-04, BGMW-02, BGMW-01, MW26-03, MW3-06, MW5-02, MW5-03, MW19-01, MW1-03, MW5-08, MW11-03

TABLE 1-13
OCCURRENCE AND DISTRIBUTION OF ORGANICS IN GROUNDWATER AT SITE 6
OU-9 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY
(ug/L)

	BACKGROUND**			SITE-RELATED		
SUBSTANCE	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	REPRESENTATIVE CONCENTRATION	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	REPRESENTATIVE CONCENTRATION
ENDOSULFAN I *	NOT DETECTED	-	-	1 / 4	0.0021	0.0021
GAMMA-BHC (LINDANE) *	NOT DETECTED	-	-	1 / 4	0.0008	0.0008

* - Selected as a COPC

** - Background samples are as follows: MW4-04, BGMW-02, BGMW-01, MW26-03, MW3-06, MW5-02, MW5-03, MW19-01, MW1-03, MW5-08, MW11-03

TABLE 1-14
OCCURRENCE AND DISTRIBUTION OF INORGANICS IN SURFACE WATER AT SITE 6
OU-9 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY
(ug/L)

	BACKGROUND***				SITE-RELATED					
SUBSTANCE	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	UTL **	2 X AVERAGE CONCENTRATION	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	AVERAGE CONCENTRATION	MEAN > 2 X BKGD?	MEAN > BACK UTL?	REPRESENTATIVE CONCENTRATION
ALUMINUM *	5 / 6	102 - 1540	2.2E+03	904.20	5 / 5	213 - 15100	3310.40	YES	YES	9594.70
ANTIMONY *	NOT DETECTED	-	-	-	1 / 5	3.3 3.3	2.99	YES	YES	3.30
ARSENIC *	1 / 6	9 - 9	1.3E+01	5.32	4 / 5	4.4 - 42.4	12.34	YES	NO	28.49
BARIUM	6 / 6	16.3 - 36.4	2.4E+03	55.05	5 / 5	30.1 - 468	127.78	YES	NO	309.61
BERYLLIUM	3 / 6	0.22 - 1.2	1.7E+00	0.70	4 / 5	0.14 - 2.4	0.81	YES	NO	2.40
CADMIUM *	1 / 6	0.18 0.18	3.2E-01	0.23	1 / 5	2.7 - 2.7	0.62	YES	YES	1.73
CALCIUM	6 / 6	462 - 177000	2.3E+05	71114	5 / 5	20000 - 159000	55140	NO	NO	111621
CHROMIUM	3 / 5	0.72 - 2.6	4.4E+00	1.78	1 / 4	1.1 - 1.1	1.44	NO	NO	1.10
COBALT	6 / 6	0.81 - 2	5.2E+00	3.10	4 / 5	0.79 - 6.6	2.51	NO	NO	4.73
COPPER	5 / 6	1.1 - 17.8	3.0E+02	11.92	5 / 5	6.6 - 102	29.16	YES	NO	68.16
IRON *	6 / 6	160 - 23100	3.0E+04	9576.67	5 / 5	2060 - 349000	75894	YES	YES	221526
LEAD *	2 / 6	4.4 - 16	2.2E+01	7.31	5 / 5	1.2 - 506	103.84	YES	YES	318.18
MAGNESIUM	6 / 6	369 - 559000	7.0E+05	190703	5 / 5	5360 - 447000	129810	NO	NO	447000
MANGANESE	6 / 6	14 - 203	3.8E+02	172.43	5 / 5	170 - 338	261.40	YES	NO	338.00
MERCURY	2 / 6	0.023 - 0.028	2.3E-01	0.12	3 / 5	0.043 - 0.29	0.12	NO	NO	0.29
NICKEL	6 / 6	2.1 - 7.9	8.2E+01	10.23	4 / 5	1.8 - 27.2	8.45	NO	NO	18.54
POTASSIUM	5 / 6	251 - 259000	3.2E+05	88923	5 / 5	3250 - 207000	60552	NO	NO	207000
SELENIUM	2 / 6	3.5 - 9.2	1.4E+01	6.27	3 / 5	3.9 - 8.5	4.08	NO	NO	8.50
SILVER	1 / 6	0.86 - 0.86	1.3E+00	0.75	1 / 5	0.74 - 0.74	0.46	NO	NO	0.71
SODIUM	3 / 3	11150 - 4340000	1.3E+07	2912233	5 / 5	53900 - 3480000	1043320	NO	NO	3480000
THALLIUM	3 / 6	3.5 - 5.5	2.8E+01	5.90	4 / 5	5.1 - 10.7	7.06	YES	NO	10.70
VANADIUM	4 / 6	0.225 - 9	1.2E+01	3.79	4 / 5	0.92 - 40.5	9.79	YES	NO	26.20
ZINC	5 / 5	7.6 - 29.4	1.5E+03	30.60	2 / 2	55.4 - 323	189.20	YES	NO	323.00

* - Selected as a COPC

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

*** - Background samples are as follows: BGSW01, BGSW02, BGSW04 through BGSW07

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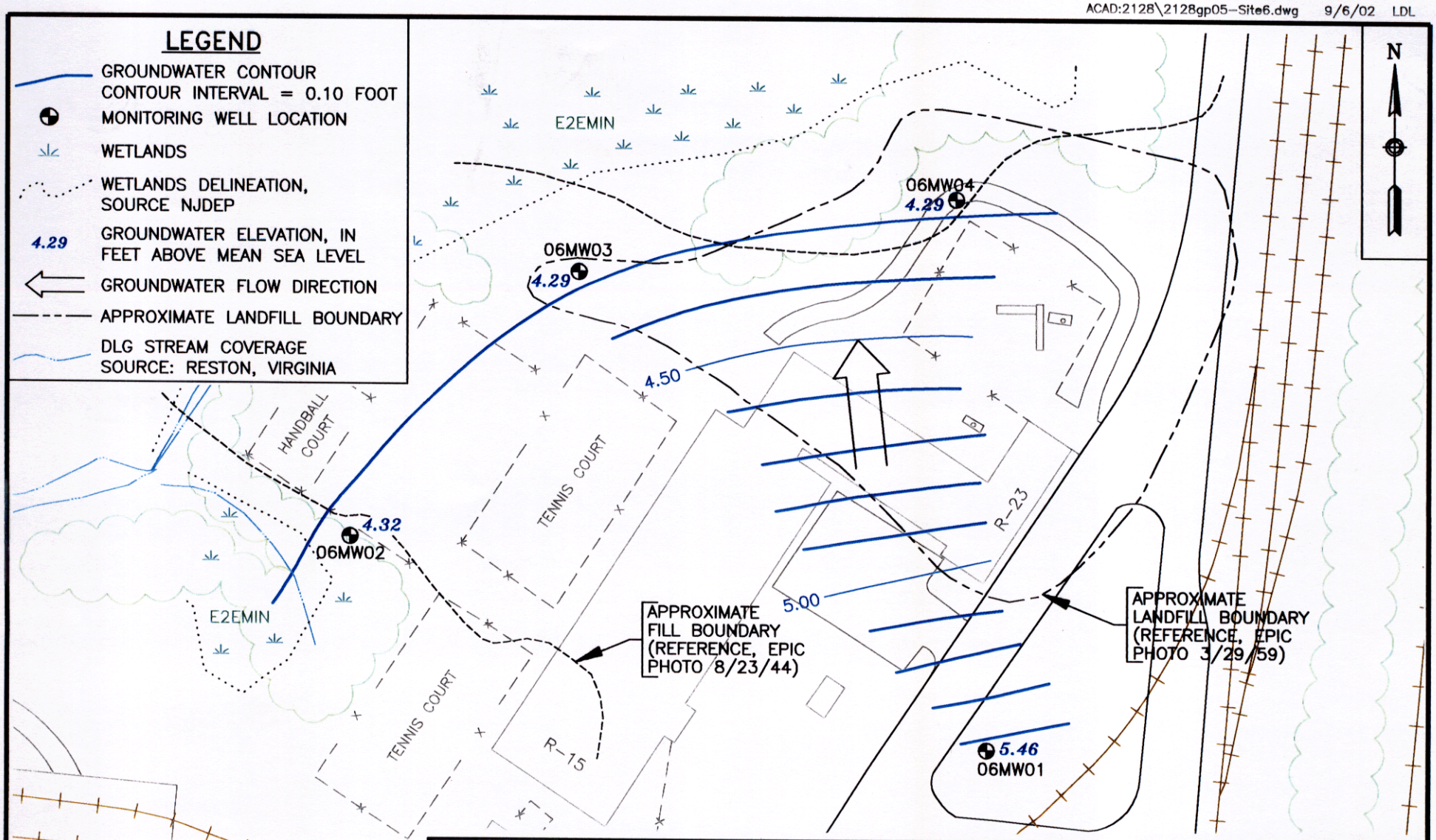


0 75 150

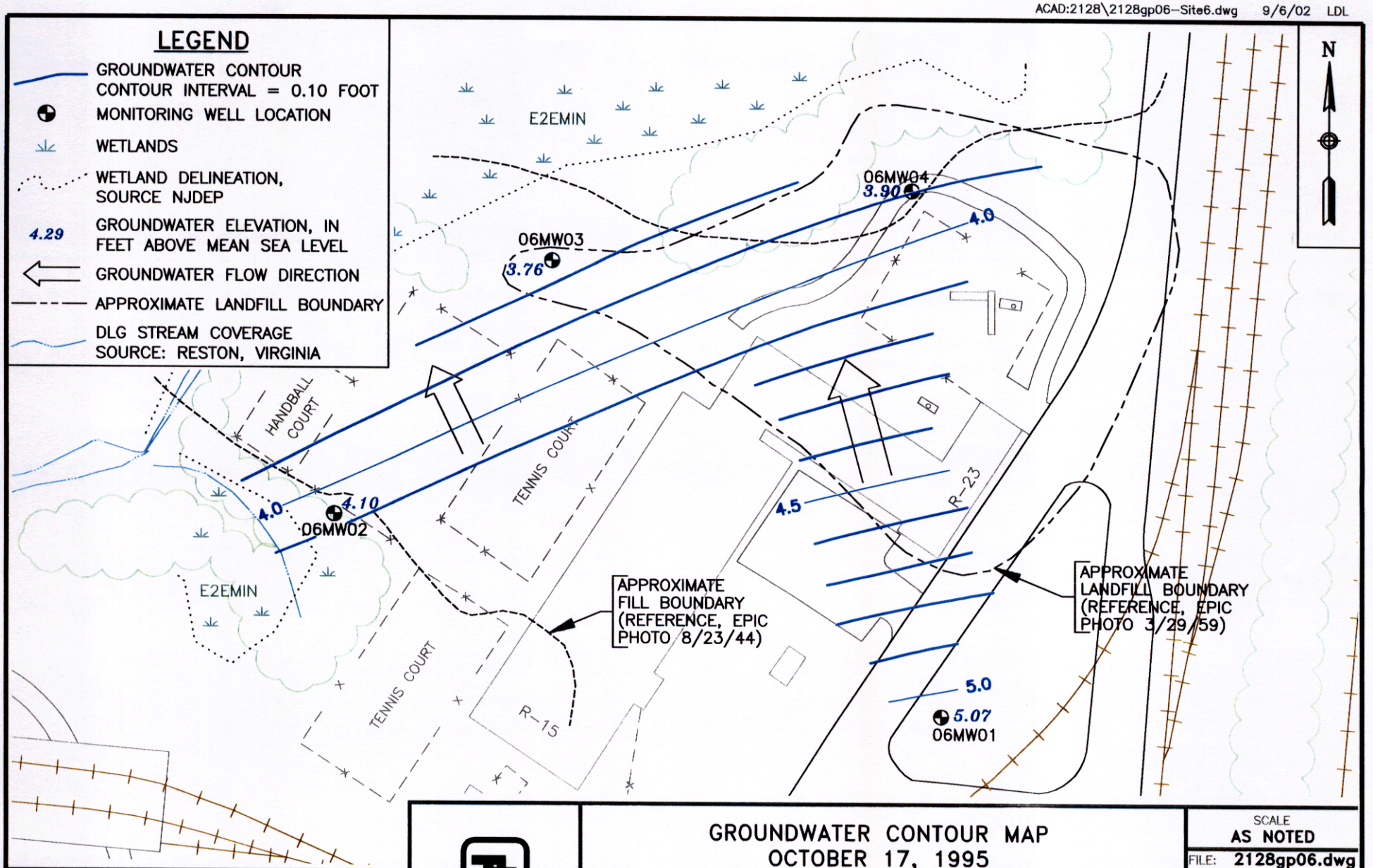
SCALE IN FEET

TETRA TECH NUS, INC.

GROUNDWATER CONTOUR MAP
AUGUST 7, 1995
SITE 6 – LANDFILL WEST OF NORMANDY ROAD
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

SCALE	AS NOTED
FILE:	2128gp05.dwg
3/18/03 LDL	PHL
REV 1	DATE 9/6/02
FIGURE NUMBER	FIGURE 1–9

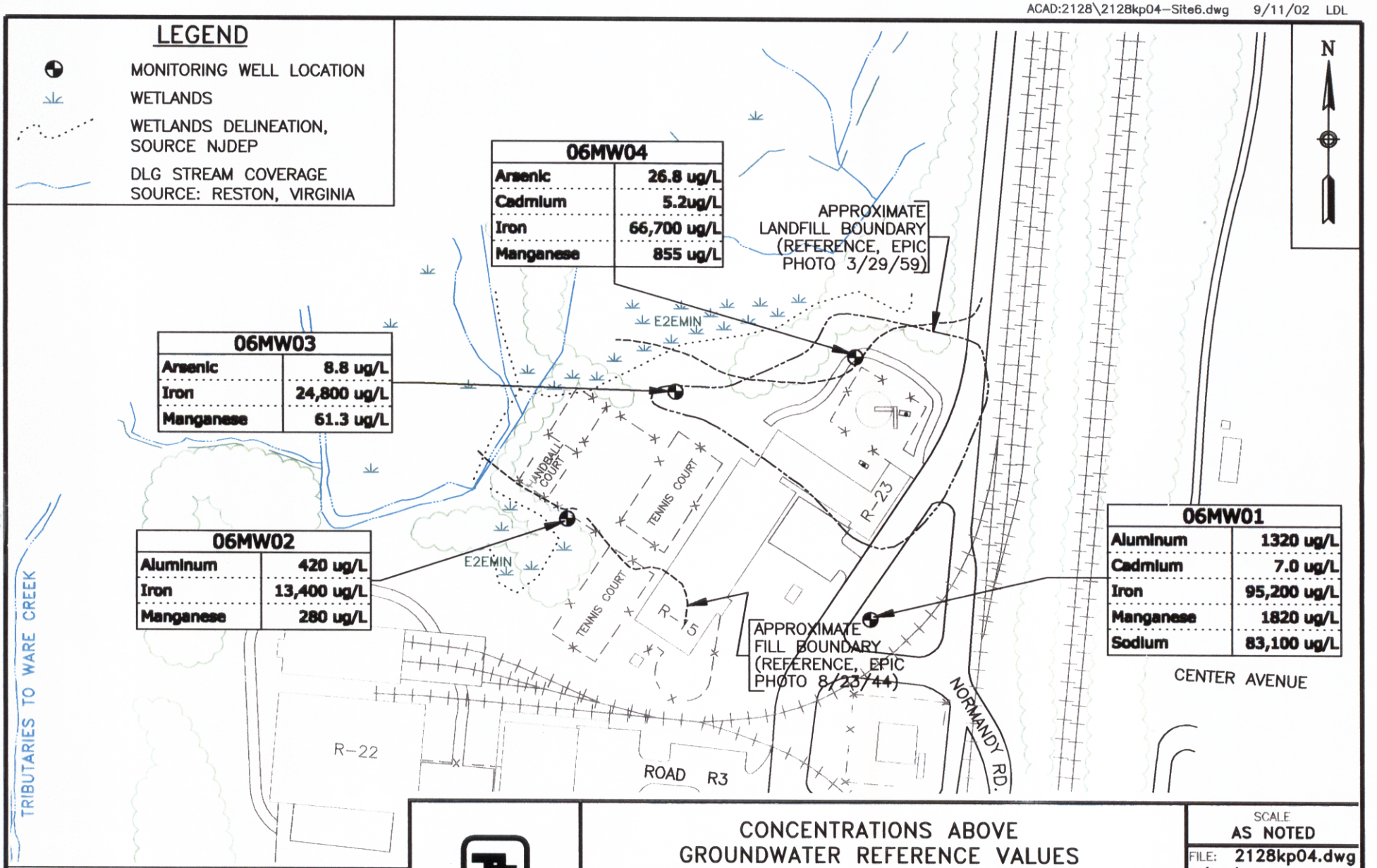
ACAD:2128\2128gp06-Site6.dwg 9/6/02 LDL



TETRA TECH NUS, INC.

GROUNDWATER CONTOUR MAP
OCTOBER 17, 1995
SITE 6 – LANDFILL WEST OF NORMANDY ROAD
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

SCALE	AS NOTED
FILE:	2128gp06.dwg
3/18/03 LDL	PHL
REV	DATE
1	9/6/02
FIGURE NUMBER	FIGURE 1-10



TETRA TECH NUS, INC.

CONCENTRATIONS ABOVE GROUNDWATER REFERENCE VALUES

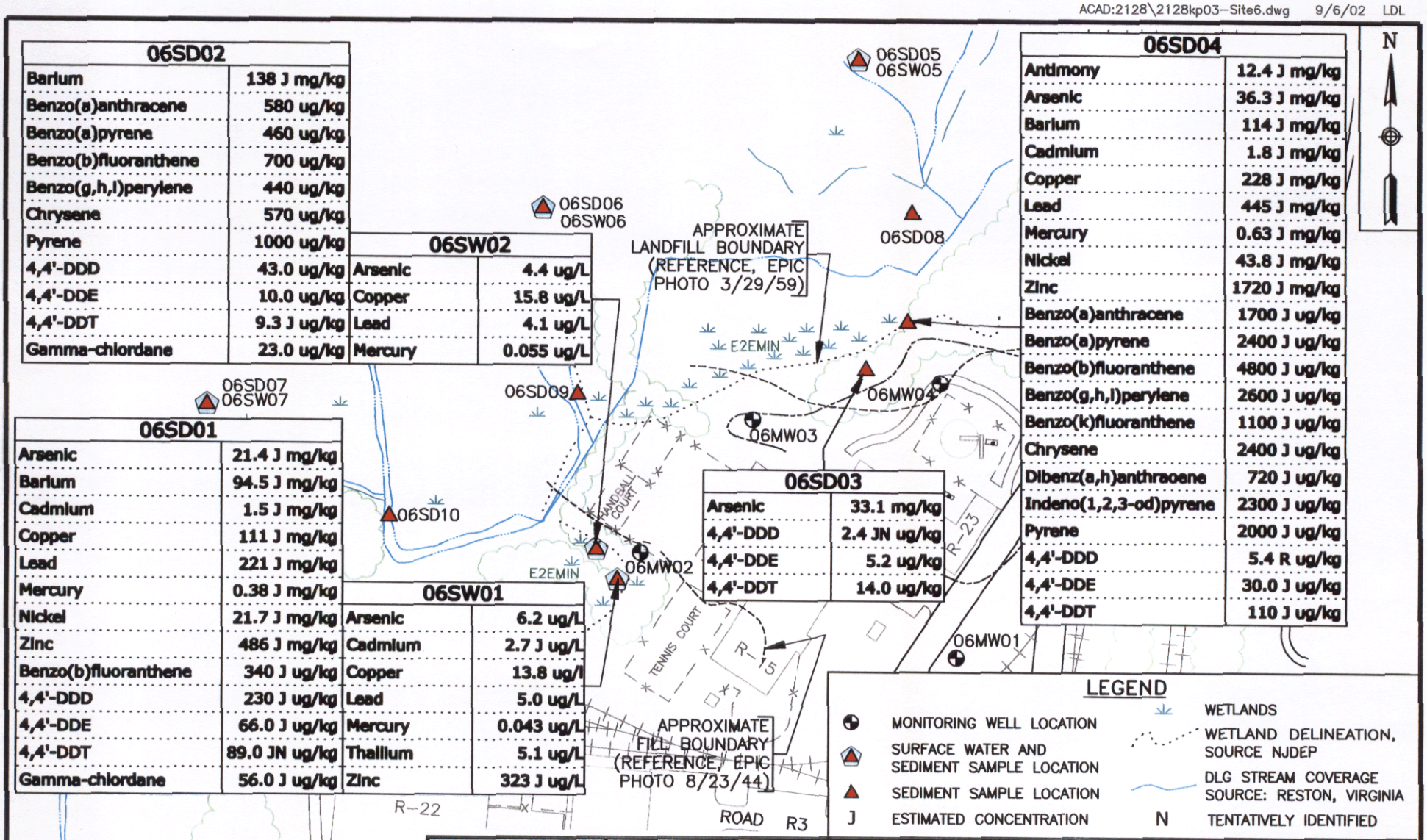
SITE 6 – LANDFILL WEST OF NORMANDY ROAD

NAVAL WEAPONS STATION EARLE

COLTS NECK, NEW JERSEY

SCALE	AS NOTED
FILE:	2128kp04.dwg
3/18/03	LDL PHL
REV	DATE
1	9/13/02
FIGURE NUMBER	FIGURE 1-11a

ACAD:2128\2128kp03-Site6.dwg 9/6/02 LDL



06SD02	
Barium	138 J mg/kg
Benzo(a)anthracene	580 ug/kg
Benzo(a)pyrene	460 ug/kg
Benzo(b)fluoranthene	700 ug/kg
Benzo(g,h,i)perylene	440 ug/kg
Chrysene	570 ug/kg
Pyrene	1000 ug/kg
4,4'-DDD	43.0 ug/kg
4,4'-DDE	10.0 ug/kg
4,4'-DDT	9.3 J ug/kg
Gamma-chlordane	23.0 ug/kg

06SW02	
Arsenic	4.4 ug/L
Copper	15.8 ug/L
Lead	4.1 ug/L
Mercury	0.055 ug/L

06SD01	
Arsenic	21.4 J mg/kg
Barium	94.5 J mg/kg
Cadmium	1.5 J mg/kg
Copper	111 J mg/kg
Lead	221 J mg/kg
Mercury	0.38 J mg/kg
Nickel	21.7 J mg/kg
Zinc	486 J mg/kg
Benzo(b)fluoranthene	340 J ug/kg
4,4'-DDD	230 J ug/kg
4,4'-DDE	66.0 J ug/kg
4,4'-DDT	89.0 JN ug/kg
Gamma-chlordane	56.0 J ug/kg

06SW01	
Arsenic	6.2 ug/L
Cadmium	2.7 J ug/L
Copper	13.8 ug/l
Lead	5.0 ug/L
Mercury	0.043 ug/L
Thallium	5.1 ug/L
Zinc	323 J ug/L

06SD03	
Arsenic	33.1 mg/kg
4,4'-DDD	2.4 JN ug/kg
4,4'-DDE	5.2 ug/kg
4,4'-DDT	14.0 ug/kg

06SD04	
Antimony	12.4 J mg/kg
Arsenic	36.3 J mg/kg
Barium	114 J mg/kg
Cadmium	1.8 J mg/kg
Copper	228 J mg/kg
Lead	445 J mg/kg
Mercury	0.63 J mg/kg
Nickel	43.8 J mg/kg
Zinc	1720 J mg/kg
Benzo(a)anthracene	1700 J ug/kg
Benzo(a)pyrene	2400 J ug/kg
Benzo(b)fluoranthene	4800 J ug/kg
Benzo(g,h,i)perylene	2600 J ug/kg
Benzo(k)fluoranthene	1100 J ug/kg
Chrysene	2400 J ug/kg
Dibenz(a,h)anthraoene	720 J ug/kg
Indeno(1,2,3-od)pyrene	2300 J ug/kg
Pyrene	2000 J ug/kg
4,4'-DDD	5.4 R ug/kg
4,4'-DDE	30.0 J ug/kg
4,4'-DDT	110 J ug/kg

TETRA TECH NUS, INC.

CONCENTRATIONS ABOVE
SURFACE WATER AND SEDIMENT REFERENCE VALUES
SITE 6 – LANDFILL WEST OF NORMANDY ROAD
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

SCALE: AS NOTED
FILE: 2128kp03.dwg
3/18/03 LDL PHL
REV 1 DATE 9/13/02
FIGURE NUMBER
FIGURE 1-11b

sample locations and concentrations of compounds that exceed screening levels. Surface water and sediment sample analysis results were compared to NWS Earle site-wide background samples. Groundwater at Site 6, found in the fill and Englishtown Formation, was compared to samples taken from the fill and Englishtown Formation grouping of background groundwater samples taken at NWS Earle.

Sediment

Four site-related sediment samples (06SD01 through 06SD04) were collected at Site 6 during the 1995 RI and six additional sediment samples (06SD05 through 06SD10) were collected during the 1996 RI Addendum field activities (See Figure 1-11b). Tables 1-10 and 1-11 present the occurrence and distribution of inorganic and organic chemicals, respectively, detected in Site 6 sediment samples and compare them to background concentrations. The background samples for sediment were BGSD01, BGSD02, and BGSD04 through BGSD07.

Higher concentrations of metals in comparison to background were seen in site-related samples, particularly at sample locations 06SD01 and 06SD04 and, to a lesser extent, at sample locations 06SD02 and 06SD07. Samples contained aluminum (up to 14,500 mg/kg at 06SD07), arsenic (up to 36.3 mg/kg at 06SD04), barium (up to 138 mg/kg at 06SD02), cadmium (up to 1.8 mg/kg at 06SD04), cobalt (up to 8.2 mg/kg at 06SD01), copper (up to 228 mg/kg at 06SD04), iron (up to 52,200 mg/kg at 06SD01), lead (up to 445 mg/kg at 06SD04), magnesium (up to 2,460 mg/kg at 06SD01), manganese (up to 451 mg/kg at 06SD04), mercury (up to 0.63 mg/kg at 06SD04), nickel (up to 43.8 mg/kg at 06SD04), selenium (up to 3.4 mg/kg at 06SD04), vanadium (up to 104 mg/kg at 06SD07), and zinc (up to 1,720 mg/kg at 06SD04). Antimony and thallium were detected at two locations at levels up to 12.4 mg/kg and 2.1 mg/kg, respectively. These two compounds were not detected in background samples.

Polynuclear aromatic hydrocarbons (PAHs) including benz(a)anthracene, benzo(a)pyrene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, indeno(1,2,3-cd)pyrene, fluoranthene, fluorene, and pyrene were detected in background sediment samples at levels ranging from 110 to 1,900 ug/kg. The maximum concentrations of individual PAHs detected in the Site 6 sediment samples occurred in sample 06SD04 and ranged from one to 10 times higher than the concentrations in background sediment. Background samples contained the pesticide DDT and its analogs at the following concentrations: 19 ug/kg 4,4'-DDT, 1.7 ug/kg 4,4'-DDE and 21 ug/kg 4,4'-DDD. These pesticides were detected in the sediment samples at Site 6 with 4,4'-DDT concentrations ranging from 9.3 to 110 ug/kg, 4,4'-DDE concentrations ranging from 3.6 to 66 ug/kg, and 4,4'-DDD concentrations ranging from 2.4 to 230 ug/kg. Several additional pesticides detected in Site 6 sediment samples were not present in background sediments or were present at much lower levels. The highest levels of pesticides were at sample locations 06SD01, 06SD02, and 06SD04. Trace levels of xylene (3 ug/kg) and 4-methyl-2-pentanone (2 ug/kg) were each detected in one sediment sample, 06SD01, but were not found in background sediments. Bis(2-Ethylhexyl) phthalate was present in two sediment samples at concentrations up to 880 ug/kg. Butylbenzyl phthalate was detected in one sample, 06SD08, at 300 ug/kg but was not detected in background samples. Toluene was detected in one sediment sample at a

level (31 ug/kg) considerably lower than the concentration detected in a background sediment sample (480 ug/kg). Since organic compounds are not considered to be naturally occurring, all organic compounds were noted in Table 1-11 as COPC's for risk assessment evaluation purposes.

The Site 6 sediment samples were also analyzed for pH and total organic carbon (TOC). TOC levels in sediment did not exceed background.

Groundwater

Four groundwater samples (06GW01 through 06GW04) were collected from monitoring wells 06MW01 through 06MW04, respectively6. Tables 1-12 and 1-13 present the occurrence and distribution of inorganic and organic chemicals detected in Site 6 groundwater samples and compare them to background. Concentrations of most metals in Site 6 groundwater were similar to the ranges detected in background samples. The following metals exhibited concentrations greater than background: cadmium (1.2 to 7.0 ug/L) and iron (13,400 to 95,200 ug/L) in samples 06GW01, 06GW02, 06GW03, and 06GW04 and manganese (1820 ug/L) in sample 06GW01.

Endosulfan I and gamma-BHC were each detected in one groundwater sample collected at Site 6 at concentrations of 0.0021 and 0.0008 ug/L, respectively. Neither of these compounds was detected in background groundwater samples. Explosives and related degradation products were analyzed for but not detected in groundwater samples.

Miscellaneous parameter analyses of four groundwater samples at Site 6 consisted of ammonia, biological oxygen demand (BOD), chemical oxygen demand (COD), chlorides, nitrates, sulfates, TOC, phosphates, and turbidity. Most indicator parameters revealed lower concentrations in all downgradient wells than in upgradient well 06MW01. Downgradient concentrations were slightly greater than upgradient levels and greater than background ranges for ammonia and TOC in 06MW04 and for sulfate in 06MW03. Upgradient well MW6-01 revealed chloride, BOD, COD, and TOC at concentrations greater than background. The wells containing maximum detected concentrations of miscellaneous parameters were generally consistent with the results of the previous 1993 investigation. 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).

Surface Water

Two surface water samples were collected in Site 6 at 1995 (06SW01 and 06SW02), and three surface water samples (06SW05 through 06SW07) were collected in 1996. Table 1-14 presents the occurrence and distribution of inorganic chemicals in Site 6 surface water samples and compares them to background. No organic chemicals were detected in Site 6 surface water samples.

The highest levels of metals were primarily at locations 06SW01 and 06SW06. Metals exceeding two times the background concentrations included aluminum (up to 15,100 ug/L), arsenic (up to 42.4 ug/L), barium (up to 468 ug/L), cadmium (2.7 ug/L at 06 SW 01), cobalt (up to 6.6 ug/L), copper (up to 102 ug/L), iron (up to 349,000 ug/L), lead (up to 506 ug/L), mercury (up to 0.29 ug/L), nickel (up to 27.2 ug/L), vanadium (up to 40.5 ug/L), and zinc (up to 323 ug/L). Antimony was also detected at location 06 SW 06 (3.3 ug/L), but was not detected in background samples. No analytes exceeding two times background were detected in 06 SW 02, 06 SW 05, or 06 SW 07.

Miscellaneous parameter analyses of the five surface water samples taken at Site 6 consisted of ammonia, BOD, COD, chlorides, total water hardness (hardness), TOC, phosphate, and turbidity. Although several surface water indicator parameters were detected at levels greater than background (chloride, phosphate, nitrate, and ammonia), none were considered to be within a range typically associated with concentrated landfill leachate.

1.3.2.3.3 Contaminant Fate and Transport

The behavior of contaminants in the environment at Site 6 is described in this subsection. Analytical results for the media sampled at Site 6 indicated a wide variety of semivolatile and pesticide compounds, in addition to several inorganics, present in the groundwater and sediment. Only inorganics were present in surface water samples.

Low levels of two pesticides were detected in groundwater samples. Endosulfan I (downgradient) and gamma-BHC (upgradient) are considered somewhat mobile in groundwater, because their solubilities and organic carbon partition coefficient (K_{oc}) values are more favorable for transport than those of organic compounds that are considered highly immobile (for example, PCBs and PAHs). These pesticides may have originated at source locations not identified in this investigation or from source locations that have since been depleted of these compounds. Downgradient samples 06GW02, 06GW03, and 06GW04 revealed elevated concentrations of cadmium, iron, and manganese. However, these data do not suggest migration of inorganic contaminants from the site because upgradient sample 06GW01 exhibited the same metals at higher concentrations.

No organics were detected in surface water. Surface water samples at Site 6 did not indicate chemical migration impact from the landfill. The detected sediment contamination could have been the result of runoff and erosional dispersion. Organic compounds in sediment fall into three classes: PAHs (considered relatively immobile), pesticides (having varying degrees of mobility), and volatiles (considered mobile). Of these classes, the detected levels of PAHs are the highest, although the overall potential for PAH migration impacts is low due to the organic carbon, to which they bind, present in most sediments at this site.

Runoff and erosional dispersion may have allowed limited migration of contaminated sediments, although the compounds found in the sediments may not have originated at Site 6. The highest levels of inorganic and organic contaminants were primarily detected in sediment samples nearest the site, indicating that contaminants have not been dispersed into the marshland to a significant degree. An attempt to obtain surface water samples/sediments from landfill seeps was not possible despite much heavier than average rainfall over the period (1996 activities only), indicating that landfill seeps either do not exist or flow only rarely. Detected chemicals in the groundwater indicated the possibility of limited groundwater impacts for certain metals and Endosulfan I at a very low level.

1.3.2.3.4 Baseline Human Health Risk Assessment

Sediment, groundwater, and surface water were sampled at Site 6. The potential receptors considered for this site were future industrial, residential, and recreational receptors. Currently the majority of the landfill is covered by buildings or pavement, limiting the surface/subsurface contaminant transport and exposure pathway. Appendix B-1 contains summary tables of the estimated human health risks for Site 6.

The reasonable maximum exposure (RME) cancer risks associated with future residential groundwater exposure (6.1E-04) exceeded the upper end of EPA's target acceptable risk range. The RME cancer risks associated with future industrial groundwater exposure (1.4E-04) were at the upper bound of EPA's target risk range. In addition, central tendency exposure (CTE) cancer risks for future residential receptor groundwater exposure (2.7E-04) were in the upper bound of EPA's target risk range. Arsenic (via ingestion of and dermal contact with groundwater) is the principal chemical of potential concern (COPC) that contributed to the cancer risks for these exposure scenarios.

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

The estimated RME cancer risk for the future industrial employee and the future residential receptor exceeded 1E-04, based mainly on ingestion of groundwater. The estimated CTE cancer risk for the future residential receptor exceeded 1E-04, based mainly on ingestion of groundwater. The estimated RME non-cancer HI for the future residential receptor exceeds 1.0, based mainly on ingestion of groundwater. The estimated CTE cancer risk for the future residential receptor exceeds 1.0, based mainly on ingestion of groundwater.

Only the maximum concentration of arsenic found in one groundwater sample, 26.8 ug/l, would result in calculated human health risk greater than the EPA acceptable risk range under the RME or CTE future residential exposure scenarios. Detected arsenic concentrations in the other Site 6 groundwater wells were 5.1 ug/l and 8.8 ug/l. These relatively low concentrations, as well as the average concentration in the four background groundwater samples, 10.6 ug/l, would also result in calculated risk levels within (at the upper end of) EPA's acceptable risk range.

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/FS. Lead was not found at levels exceeding 400 mg/kg in subsurface soil samples from previous investigations.

1.3.2.3.5 Ecological Risk Assessment

The results of the 1996 RI ecological risk assessment showed that several inorganics and organics, primarily PAH compounds were present in surface water and sediment near the sites in excess of screening values. Concentrations of lead, zinc, and several PAHs in sediment collected near the Site 6 landfill toe were significantly elevated. Because data from the 1993 SI and 1996 RI indicated minimal impacts to groundwater, erosion and overland runoff from the landfill toe were considered possible contaminant migration pathways. However, surface water and sediment samples had not been collected farther away from the site in the marsh. As a part of the 1997 Addendum RI investigation, after consultation with EPA Region 2 and NJDEP, the Navy collected additional surface water and sediment samples farther into the marsh to determine the extent of the impacts of landfill-related contaminants on the marsh. The results of the 1997 samples and the recalculated ecological risk assessment are discussed below.

In Site 6 surface water and sediments, only a few contaminants that had high frequencies of detection exceeded screening levels referenced in the RI report (B&R Environmental 1996) and the RI Addendum report (B&R Environmental 1998). Of these, the most significant exceedances in surface water were for aluminum, iron, lead, and vanadium. The high concentrations were confined to sample 06SW06, which was one of the samples collected farthest from the former landfill. Sediment concentrations at this location were not significantly elevated, and sediment contaminant concentrations in sample 06SD09, which was collected in the same area as 06SW06 but closer to the landfill, were also relatively low. In Site 6 sediments, the average concentrations of all metals were below threshold values. Concentrations of some inorganics for which no screening values were available were significantly elevated in sediment sample 06SD07. However, surface water concentrations at that location were not elevated, and sediment concentrations in sample 06SD10, which was taken in the same general area as sample 06SD07 but

closer to the landfill, were not significantly elevated. Frequencies of detection and hazard quotient (HQ) values for organics in Site 6 sediments were all low.

In summary, significantly elevated contaminant concentrations and exceedances of threshold values from the 1995 RI samples were not prevalent in surface water and sediment samples collected in 1997 farther into the marsh adjacent to Site 6. Therefore, impacts of contaminants from Site 6 on the marsh were considered to be minimal. Elevated concentrations of some inorganics were present but were confined primarily to ubiquitous metals in only a few samples collected relatively far from the landfill. This indicated that these elevated concentrations were most likely indicative of contaminant sources that were not related to the landfill. Additive impacts on the watershed and cumulative effects from contaminants from the site on marsh receptors are unlikely. Concentrations of contaminants that bioaccumulate and biomagnify were also relatively low. Thus, potential risks to organisms from exposure via the foodchain (e.g., wading birds) appeared to be highly unlikely. Concentrations of contaminants in surface water and sediments in the two samples collected upstream from the marsh were low and, as a result, impacts to the marsh from upstream sources appeared to be negligible.

The data indicate that the assessment endpoint chosen, the maintenance of receptor populations in the marsh, does not appear to be compromised from Site 6 or upstream contaminants; therefore, ecological risks to the marsh from Navy-related areas appear to be insignificant. Remedial action based on ecological risk concerns or additional, more focused ecological studies are therefore unwarranted.

Site-Specific Uncertainties

Significantly elevated concentrations of some metals (aluminum, beryllium, iron, lead, and silver), were present in surface water sample 06SW06. HQ values for these metals were also significantly elevated. However, sediment concentrations of those contaminants at the same sampling location were not elevated and were not elevated in sediment sample 06SD09, which was collected in the same drainageway, but closer to the landfill. Therefore, this area appears to be unrelated to the site. Although other RI sites are located in the Waterfront (Sites 15 and 16), they were determined to have minimal ecological impacts on the surrounding areas in the RI report. Although these constituents do not appear to be due to Site 6, their presence introduces uncertainty into the assessment.

Despite heavier than average rainfall, sampling conditions precluded the collection of surface water samples at the RI Addendum sampling locations closest to the landfills. Although the definitive nature of the remainder of the data set heavily mitigates the lack of surface water data at those sampling locations, uncertainty is introduced into the ecological risk assessment because of this data gap.

Potential risks were often considered to be low in the assessment if HQ values were low, although theoretically, the potential for risk exists if a threshold is exceeded at all. These conclusions were made because most threshold values are based on data from laboratory studies that do not take into account ameliorating physico-chemical factors in the environment. Although the HQ cannot be interpreted as a probabilistic indicator of risk (i.e., an HQ of 10 cannot be assumed to correlate to 10 times more risk than an HQ of 1), a slight exceedance of a threshold generally indicates less potential risk than a major exceedance of a threshold. It should be noted, however, that contaminants with low HQ values were assessed on an individual basis for their potential for risk. For these reasons, it is unlikely that significant potential risks exist from the contaminants that only slightly exceeded surface water or sediment thresholds. Nonetheless, the conclusions that minor exceedances result in low potential risks introduces uncertainty into the results of the ecological risk assessment.

1.3.3 Site 12

1.3.3.1 Initial Assessment and Confirmation Study

The 1983 IAS consisted of interviews and on-site inspection, and did not recommend Site 12 for a confirmation study based on the belief that any acids spilled would be buffered when they drained into the salt marsh.

During the 1993 SI, one surface water sample and one sediment sample were collected from the downstream side of the storm water culvert outflow. No surface water or sediment was present at the upgradient portion of the drainage culvert at the time these samples were taken. The sediment sample was analyzed for VOCs, SVOCs, pesticides, PCBs, metals, and cyanide. The surface water sample was analyzed for VOCs, metals, and cyanide. Sample analysis indicated that SVOCs, VOCs, pesticides, and metals were present in the sediment sample taken at the site. Metals were detected in the surface water sample. Cyanide was not detected in either sample.

An underground storage tank (UST) installed at the northeast corner of building R-10 and located approximately adjacent to the former battery storage area was removed in 1994. Visual contamination of the soil was not observed during the tank removal. Upon removal, the tank and associated piping were examined and found in good condition, free of holes, and with minor rust and pitting. Four confirmation soil samples were obtained from the excavation sidewalls, and two samples were taken from the excavated soils. The excavation sidewall samples were analyzed for total petroleum hydrocarbons (TPH), and all had concentrations less than method DLS or actual sample DLS detection limits of 56 to 61 mg/kg. The two soil pile samples had TPH concentrations of 460 mg/kg and 520 mg/kg. The soil was disposed as non-hazardous.

1.3.3.2 Remedial Investigation

In August 1995, B&R Environmental conducted sampling and analysis of surface soil and sediment and surveyed to establish the horizontal locations and vertical elevations of the surface soil and sediment sample locations.

No samples were obtained from the area labeled "Battery Storage Area" (Figure 1-6) because the asphalt would have been a barrier to infiltration of the spilled battery electrolyte solution. The RI attempted to obtain the "worst case" sediment samples in known low-lying areas of likely sedimentation.

The RI Addendum field investigation was designed to provide further data on the areal and vertical extent of metals contamination. On October 29, 1996, B&R Environmental conducted surface and subsurface soil sampling at Site 12 and surveyed to establish the horizontal locations and vertical elevations of the sample locations.

1.3.3.3 Summary of Results

Infiltration is limited by an asphalt parking lot that covers the site. Surface runoff is directed to a storm water collection basin that discharges through a concrete culvert to a drainage swale and eventually to a marsh north of the site. A UST was located in this general area, but it has been removed.

1.3.3.3.1 Site Geology and Hydrogeology

Geology

Regional mapping places Site 12 within the outcrop area of the Englishtown Formation. The Englishtown Formation ranges from 35 and 150 feet in thickness and consists of tan and gray, fine- to medium-grained quartz sand with local clay beds. The presence of the Englishtown Formation beneath Site 12 cannot be confirmed because no soil borings were drilled at the site. However, the lithology of the sediments encountered in borings at Sites 6, 15, and 17 generally agreed with the published description of the Englishtown Formation. Site 6 is located about 600 feet northeast, Site 15 is located about 1,000 feet south-southeast, and Site 17 is located about 700 feet south-southwest of Site 12. In general, the borings at these sites encountered fill material and sand, silty sand, and clayey sand.

Hydrogeology

Groundwater conditions beneath the site cannot be confirmed because no wells were installed. However, groundwater in the Englishtown aquifer beneath Sites 6 and 17, and presumably Site 12, occurs under

unconfined conditions. The direction of shallow groundwater flow in the aquifer beneath Site 6, as indicated by both the August and October groundwater elevation data is north/northwest. The direction of groundwater flow in the aquifer beneath Site 17, as indicated by both the August and October groundwater elevation data, is northwest.

1.3.3.3.2 Soil Removal Action

A remedial action consisting of excavation and removal of surface and subsurface soils in the vicinity of Site 12 was conducted by the Navy in 1999. The objectives of the remedial action included minimizing the potential migration and mobilization of the contaminants to surface water, groundwater, and soils at the site. Approximately 262 tons of excavated soil was shipped offsite for disposal and recycling. Three rounds of confirmatory sampling were conducted to demonstrate compliance with NJDEP Residential Direct Contact Soil Cleanup Criteria. The excavation of contaminated soils achieved the remedial action objective for protection of human health and the environment, including prevention of human exposure to contaminated surface and subsurface soils, and prevention of migration of contaminants to the adjacent marsh.

Based on EPA and NJDEP approval, Site 12 met all the applicable requirements for closure, and the remediation for which Foster Wheeler Environmental Corporation was contracted by the Navy was complete as documented in the Remedial Action Report for Soil Excavation at Site 12, Foster Wheeler Environmental Corporation, December 1999.

1.3.4 Site 15

Although there are no known records available to document the area involved in the former oily waste disposal or of specific conditions of disposal, the site is estimated to have been approximately 1 acre based on the best records and findings available.

1.3.4.1 Initial Assessment and Confirmation Study

The 1983 IAS consisted of interviews and visual inspection. Site 15 was not recommended for confirmation study because the exact location of disposal could not be determined and typical bilge water contained a low percentage of oil.

During the 1993 SI, two subsurface soil samples, four sediment samples, and one groundwater (hydropunch) sample were collected and two soil borings were drilled at the site. The subsurface soil samples were collected at 8 feet bgs from Soil Boring 1 and at 7 feet bgs from Soil Boring 2. The soil samples were analyzed for SVOCs; four SVOCs were detected at low concentrations. The sediment samples were

collected from 0 to 0.5 feet bgs from the drainage swale northeast of the site. The sediment samples were analyzed for SVOCs; four SVOCs were detected at low concentrations. One groundwater sample was collected from a hydropunch location between the two soil borings. The groundwater sample was analyzed for TAL metals and TCL VOCs, SVOCs, pesticides, and PCBs. Analysis indicated that elevated levels of metals were present in groundwater.

1.3.4.2 Remedial Investigation

Between June and July 1995, B&R Environmental conducted sampling and analysis of surface water, sediment, surface, and subsurface soil at Site 15 and conducted a survey to establish the horizontal locations and vertical elevations of the sample locations.

1.3.4.3 Summary of Results

A small drainage swale runs parallel to the railroad bed on the north side of the site, and surface water from the site and the adjacent paved parking area flows toward this swale. This swale contains water only after precipitation events. Wetlands are present north and south of the site.

1.3.4.3.1 Site Geology and Hydrogeology

Geology

Regional mapping places Site 15 within the outcrop area of the Englishtown Formation. The Englishtown Formation ranges between 35 and 150 feet in thickness. The lithology of the sediments encountered in the on-site borings generally agrees with the published description of the Englishtown Formation and the Woodbury Clay. Assuming a portion of the Englishtown Formation was removed by erosion, it is possible that at least one of the soil borings penetrated the underlying Woodbury Clay. In general, the borings encountered fill material, yellowish-brown and brown silty sand and clayey sand (probably representative of the Englishtown Formation), and black silt (possibly representative of the Woodbury Clay).

Based on the boring log descriptions from the SI field work performed in May 1992, boring HP15-2 penetrated fill material and the Englishtown Formation, boring BH15-1 penetrated fill material, the Englishtown Formation, and the Woodbury Clay, and boring HP15-1 penetrated the Englishtown Formation and the Woodbury Clay.

Hydrogeology

Groundwater conditions beneath the site cannot be confirmed because no wells were installed at the site. However, groundwater in the Englishtown aquifer beneath Sites 6 and 17, and presumably Site 15, occurs under unconfined conditions. Site 6 is located about 1,400 feet south, and Site 17 is located 600 feet northwest of Site 15. The direction of shallow groundwater flow in the aquifer beneath Site 6, as indicated by both the August and October groundwater elevations is north/northwest. The direction of groundwater flow in the aquifer beneath Site 17, as indicated by both the August and October groundwater elevations is northwest.

1.3.4.3.2 Nature and Extent of Contamination

This section evaluates the occurrence and distribution of samples from the 1995 RI and 1996 RI Addendum field activities. Tables 1-15 through 1-22 compare the results of samples collected at Site 15 to background samples. Figure 1-12 shows sample locations and concentrations of compounds that exceed surface and subsurface soil screening levels, and Figure 1-13 shows samples and contaminants that exceeded surface water and sediment screening levels.

Surface Soils

Two surface soil samples 15SS01 and 15SS02 were collected at Site 15. Tables 1-15 and 1-16 present the occurrence and distribution of inorganic and organic chemicals in Site 15 samples and compare them to background.

Concentrations of most metals in Site 15 samples were similar to background. Concentrations slightly greater than background were observed for cadmium in sample 15SS02 and lead in sample 15SS01. Antimony was detected in 15SS01 at a low level, near the instrument detection limit, but was not detected in background samples.

Site 15 surface soil samples exhibited low levels of PAHs including benz(a)anthracene (71 ug/kg), benzo(a)pyrene (58 to 69 ug/kg), benzo(b)fluoranthene (120 to 160 ug/kg), fluoranthene (130 to 180 ug/kg), phenanthrene (69 to 100 ug/kg), and pyrene (140 to 210 ug/kg). 4,4'-DDE (13 to 43 ug/kg) and 4,4'-DDT (12 ug/kg) were detected in Site 15 surface soils at levels within the lower range of background concentrations. Alpha-BHC was detected in one Site 15 surface soil sample at a concentration of 0.13 ug/kg but was not detected in background samples.

The two surface soil samples collected at Site 15 were also analyzed for moisture, pH, and TPH. TPH was detected at concentrations ranging from 120 to 200 mg/kg. TPH background surface soil results were 9.0 to 110 mg/kg.

TABLE 1-15
OCCURRENCE AND DISTRIBUTION OF INORGANICS IN SURFACE SOIL AT SITE 15
OU-9 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY
(mg/kg)

	BACKGROUND			SITE-RELATED				
SUBSTANCE	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	2 X AVERAGE BKGD CONCENTRATION	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	AVERAGE CONCENTRATION	MEAN > 2 X BKGD	REPRESENTATIVE CONCENTRATION
ALUMINUM*	4 / 4	1710 - 5310	6152.50	2 / 2	897 - 9250	5073.5	NO	9250
ANTIMONY	NOT DETECTED	-	-	1 / 2	1.8	1.11	YES	1.8
ARSENIC	4 / 4	1.35 - 14.4	13.43	2 / 2	10.1 - 19.2	14.65	YES	19.2
BARIUM	4 / 4	1.85 - 31	22.53	2 / 2	7.8 - 18	12.9	NO	18
BERYLLIUM	1 / 4	0.28	0.39	1 / 2	0.97	0.49375	YES	0.97
CADMIUM	1 / 4	0.57	0.67	2 / 2	0.85 - 3.4	2.125	YES	3.4
CALCIUM	4 / 4	40.1 - 519	551.80	2 / 2	407 - 828	617.5	YES	828
CHROMIUM*	4 / 4	7.8 - 59.5	69.05	2 / 2	3.7 - 37.7	20.7	NO	37.7
COBALT	2 / 4	0.75 - 5	3.15	2 / 2	1.1 - 2.8	1.95	NO	2.8
COPPER	4 / 4	0.97 - 8.4	10.06	2 / 2	14.3 - 33.2	23.75	YES	33.2
IRON	4 / 4	3745 - 62500	52402.50	2 / 2	10900 - 52300	31600	NO	52300
LEAD	4 / 4	1.8 - 39.4	37.30	2 / 2	56.8 - 110	83.4	YES	110
MAGNESIUM	4 / 4	71.7 - 619	578.85	2 / 2	118 - 2260	1189	YES	2260
MANGANESE	4 / 4	3.45 - 214	128.33	2 / 2	60.7 - 92.9	76.8	NO	92.9
MERCURY	4 / 4	0.035 - 0.17	0.18	2 / 2	0.051 - 0.16	0.1055	NO	0.16
NICKEL*	2 / 4	1.8 - 7.2	5.18	2 / 2	3 - 7.5	5.25	YES	7.5
POTASSIUM	4 / 4	95 - 792	912.50	2 / 2	122 - 6790	3456	YES	6790
SODIUM	4 / 4	17.5 - 86.2	78.30	2 / 2	47.4 - 195	121.2	YES	195
THALLIUM	2 / 4	0.7 - 1.9	1.64	1 / 2	1.5	1.025	NO	1.5
VANADIUM	4 / 4	11.05 - 64	70.13	2 / 2	14.9 - 36	25.45	NO	36
ZINC	3 / 4	1.1 - 27.6	22.80	2 / 2	7.2 - 52.4	29.8	YES	52.4

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

TABLE 1-16
OCCURRENCE AND DISTRIBUTION OF ORGANICS IN SURFACE SOIL AT SITE 15
OU-9 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY
(ug/kg)

SUBSTANCE	BACKGROUND			SITE-RELATED		
	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	REPRESENTATIVE CONCENTRATION	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	REPRESENTATIVE CONCENTRATION
4,4'-DDE	2 / 4	16 - 330	277.86	2 / 2	13 - 43	43
4,4'-DDT	2 / 4	43 - 420	355.71	1 / 1	12	12
ALPHA-BHC	NOT DETECTED	-	-	1 / 2	0.13	0.13
BENZO(A)ANTHRACENE	NOT DETECTED	-	-	1 / 2	71	71
BENZO(A)PYRENE	NOT DETECTED	-	-	2 / 2	58 - 69	69
BENZO(B)FLUORANTHENE	NOT DETECTED	-	-	2 / 2	120 - 160	160
BIS(2-ETHYLHEXYL)PHTHALATE	NOT DETECTED	-	-	2 / 2	100 - 110	110
CHRYSENE	NOT DETECTED	-	-	2 / 2	68 - 90	90
FLUORANTHENE	2 / 4	40 - 84	84	2 / 2	130 - 180	180
PHENANTHRENE	NOT DETECTED	-	-	2 / 2	69 - 100	100
PYRENE	1 / 4	46	46	2 / 2	140 - 210	210

TABLE 1-17
OCCURRENCE AND DISTRIBUTION OF INORGANICS IN SUBSURFACE SOIL AT SITE 15
OU-9 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY
(mg/kg)

	BACKGROUND			SITE-RELATED				
SUBSTANCE	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	2 X AVERAGE BKGD CONCENTRATION	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	AVERAGE CONCENTRATION	MEAN > 2 X BKGD	REPRESENTATIVE CONCENTRATION
ALUMINUM*	8 / 8	675 - 5310	5370.00	4 / 4	890 - 7185	3288.75	NO	7185
ARSENIC	8 / 8	1.35 - 14.4	13.29	3 / 4	8.8 - 20.5	12.40	NO	20.5
BARIUM	8 / 8	0.92 - 31	17.92	4 / 4	3.9 - 11.25	6.96	NO	11.25
BERYLLIUM*	2 / 8	0.12 - 0.28	0.28	4 / 4	0.12 - 0.275	0.17	NO	0.275
CADMIUM	1 / 8	0.57	0.58	3 / 4	1.2 - 2.8	1.49	YES	2.8
CALCIUM	8 / 8	28.6 - 799	577.55	4 / 4	70.8 - 584	228.55	NO	584
CHROMIUM*	8 / 8	4.7 - 59.5	54.73	4 / 4	2.4 - 16.8	8.10	NO	16.8
COBALT	4 / 8	0.75 - 5	2.77	3 / 4	0.16 - 0.69	0.33	NO	0.69
COPPER	8 / 8	0.97 - 8.6	8.66	4 / 4	0.35 - 3.3	1.81	NO	3.3
IRON	8 / 8	3745 - 62500	40871.25	4 / 4	1600 - 43400	22525.00	NO	43400
LEAD*	8 / 8	1.4 - 39.4	24.33	4 / 4	1.9 - 6.65	4.49	NO	6.65
MAGNESIUM	8 / 8	18.5 - 619	504.05	4 / 4	68.8 - 464.5	210.53	NO	464.5
MANGANESE	8 / 8	2.6 - 214	92.51	4 / 4	1.9 - 7.35	4.19	NO	7.35
MERCURY	8 / 8	0.03 - 0.17	0.13	1 / 4	0.0054	0.00	NO	0.00
NICKEL	4 / 8	1.8 - 7.2	4.75	4 / 4	0.48 - 1.7	1.14	NO	1.7
POTASSIUM	7 / 8	95 - 792	793.35	4 / 4	55 - 553	297.00	NO	553
SELENIUM	2 / 8	0.57 - 0.93	0.79	2 / 4	1.3 - 1.6	1.01	YES	1.6
SODIUM	8 / 8	17.5 - 94.8	79.35	4 / 4	29.3 - 116.3	56.28	NO	116.3
THALLIUM	4 / 8	0.7 - 1.9	1.38	2 / 4	1.3 - 1.5	0.93	NO	1.5
VANADIUM	8 / 8	11.05 - 64	64.71	4 / 4	4.5 - 39.4	20.95	NO	39.4
ZINC	6 / 8	1.1 - 50.7	31.35	4 / 4	0.75 - 11.4	4.76	NO	11.4

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

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TABLE 1-18
OCCURRENCE AND DISTRIBUTION OF ORGANICS IN SUBSURFACE SOIL AT SITE 15
OU-9 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY
(ug/kg)

SUBSTANCE	BACKGROUND			SITE-RELATED		
	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	REPRESENTATIVE CONCENTRATION	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	REPRESENTATIVE CONCENTRATION
BIS(2-ETHYLHEXYL)PHTHALATE	NOT DETECTED	-	-	4 / 4	59 - 260	260

TABLE 1-19
OCCURRENCE AND DISTRIBUTION OF INORGANICS IN SEDIMENT AT SITE 15
OU-9 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY
(mg/kg)

	BACKGROUND			SITE-RELATED				
SUBSTANCE	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	2 X AVERAGE BKGD CONCENTRATION	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	AVERAGE CONCENTRATION	MEAN > 2 X BKGD	REPRESENTATIVE CONCENTRATION
ALUMINUM	3 / 3	839 - 3940	5492.67	3 / 3	2550 - 10600	6086.67	YES	10600
ARSENIC	2 / 3	2.4 - 6.2	5.95	3 / 3	10.5 - 25.5	17.73	YES	25.5
BARIUM	3 / 3	3.9 - 10.6	14.07	3 / 3	28.9 - 45.4	39.17	YES	45.4
BERYLLIUM	1 / 3	0.57	0.67	2 / 3	0.32 - 1.7	0.69	YES	1.7
CADMIUM	NOT DETECTED	-	-	1 / 3	1.9	0.92	YES	1.9
CALCIUM	3 / 3	179 - 518	685.33	3 / 3	282 - 5100	2144.00	YES	5100
CHROMIUM	3 / 3	4.3 - 56	43.13	3 / 3	8.6 - 58.7	33.27	NO	58.7
COBALT	1 / 3	2.1	3.30	2 / 3	5.6 - 7.1	4.47	YES	7.1
COPPER	3 / 3	1.5 - 13	12.47	3 / 3	11.3 - 269	122.03	YES	269
IRON	3 / 3	228 - 7650	6578.67	3 / 3	20800 - 84000	49833.33	YES	84000
LEAD	3 / 3	4.6 - 34.3	30.60	3 / 3	42.5 - 187	97.33	YES	187
MAGNESIUM	3 / 3	60.7 - 256	306.47	3 / 3	251 - 1530	970.33	YES	1530
MANGANESE	3 / 3	4.6 - 9.2	13.80	3 / 3	12 - 72.8	45.90	YES	72.8
MERCURY	1 / 3	0.068	0.05	3 / 3	0.11 - 0.67	0.31	YES	0.67
NICKEL	2 / 3	2.1 - 6	7.93	2 / 3	11.1 - 15.5	9.42	YES	15.5
POTASSIUM	2 / 3	86.1 - 681	589.40	3 / 3	395 - 576	476.33	NO	576
SELENIUM	NOT DETECTED	-	-	2 / 3	1.5 - 2.2	1.35	YES	2.2
SILVER	NOT DETECTED	-	-	2 / 3	0.52 - 3.1	1.34	YES	3.1
SODIUM	3 / 3	26.6 - 116	115.27	3 / 3	222 - 317	276.67	YES	317
THALLIUM	NOT DETECTED	-	-	3 / 3	1 - 2.8	2.07	YES	2.8
VANADIUM	3 / 3	5.9 - 42.7	36.93	3 / 3	20.1 - 48.7	34.67	NO	48.7
ZINC	3 / 3	14.2 - 26.9	37.33	3 / 3	136 - 464	258.67	YES	464

Note: Selected COPCs are indicated in boldface type.

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TABLE 1-20
OCCURRENCE AND DISTRIBUTION OF ORGANICS IN SEDIMENT AT SITE 15
OU-9 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY
(ug/kg)

SUBSTANCE	BACKGROUND			SITE-RELATED		
	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	REPRESENTATIVE CONCENTRATION	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	REPRESENTATIVE CONCENTRATION
2-BUTANONE	NOT DETECTED	-	-	1 / 3	86	86
2-METHYLNAPHTHALENE	NOT DETECTED	-	-	1 / 3	300	300
4,4'-DDD	2 / 3	4.9 - 21	21	3 / 3	13 - 45	45
4,4'-DDE	1 / 3	1.7	1.7	3 / 3	2.1 - 59	59
4,4'-DDT	1 / 3	19	19	2 / 3	7.2 - 46	46
ACENAPHTHENE	NOT DETECTED	-	-	1 / 3	140	140
ALPHA-CHLORDANE	NOT DETECTED	-	-	2 / 3	3.8 - 31	31
ANTHRACENE	NOT DETECTED	-	-	2 / 3	52 - 240	240
AROCLOR-1260	NOT DETECTED	-	-	2 / 3	16 - 100	100
BENZO(A)ANTHRACENE	2 / 3	140 - 560	560	2 / 3	270 - 1400	1400
BENZO(A)PYRENE	2 / 3	160 - 590	590	2 / 3	260 - 1500	1500
BENZO(B)FLUORANTHENE	2 / 3	150 - 490	490	3 / 3	130 - 2700	2700
BENZO(G,H,I)PERYLENE	2 / 3	130 - 380	380	2 / 3	170 - 1200	1200
BENZO(K)FLUORANTHENE	2 / 3	150 - 470	470	2 / 3	140 - 930	930
BUTYLBENZYLPHTHALATE	NOT DETECTED	-	-	1 / 3	910	910
CARBAZOLE	NOT DETECTED	-	-	1 / 3	250	250
CHRYSENE	2 / 3	250 - 940	940	3 / 3	120 - 2200	2200
DI-N-BUTYLPHTHALATE	NOT DETECTED	-	-	1 / 3	160	160
DIBENZ(A,H)ANTHRACENE	NOT DETECTED	-	-	1 / 3	340	340
DIBENZOFURAN	NOT DETECTED	-	-	1 / 3	130	130
ENDRIN	NOT DETECTED	-	-	1 / 3	10	10
FLUORANTHENE	2 / 3	300 - 1800	1800	3 / 3	200 - 3600	3600
FLUORENE	1 / 3	190	190	1 / 3	180	180
GAMMA-CHLORDANE	1 / 3	0.095	0.095	2 / 3	5.1 - 29	29
HEPTACHLOR EPOXIDE	NOT DETECTED	-	-	2 / 3	0.47 - 3.2	3.2
INDENO(1,2,3-CD)PYRENE	2 / 3	110 - 310	310	2 / 3	150 - 1100	1100
NAPHTHALENE	NOT DETECTED	-	-	1 / 3	140	140
PHENANTHRENE	2 / 3	200 - 1900	1900	3 / 3	120 - 1800	1800
PYRENE	2 / 3	350 - 1900	1900	3 / 3	180 - 3400	3400
STYRENE	NOT DETECTED	-	-	1 / 3	11	11

TABLE 1-21

OCCURRENCE AND DISTRIBUTION OF INORGANICS IN SURFACE WATER AT SITE 15
OU-9 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY
(ug/L)

	BACKGROUND			SITE-RELATED				
SUBSTANCE	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	2 X AVERAGE BKGD CONCENTRATION	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	AVERAGE CONCENTRATION	MEAN > 2 X BKGD	REPRESENTATIVE CONCENTRATION
ALUMINUM	3 / 3	265 - 409	705.33	2 / 2	104 - 338	221	NO	338
BARIUM	3 / 3	16.3 - 34	53.73	2 / 2	34.6 - 49.5	42.05	NO	49.5
BERYLLIUM	2 / 3	0.22 - 0.33	0.41	2 / 2	0.22 - 0.88	0.55	YES	0.88
CADMIUM	1 / 3	0.18	0.23	2 / 2	0.31 - 0.37	0.34	YES	0.37
CALCIUM	3 / 3	462 - 10100	9128.00	2 / 2	22200 - 26900	24550	YES	26900
COBALT	3 / 3	0.81 - 1.9	2.54	2 / 2	5 - 10.9	7.95	YES	10.9
COPPER	2 / 3	1.1 - 9.8	7.40	2 / 2	3.3 - 6.8	5.05	NO	6.8
IRON	3 / 3	160 - 702	1040.00	2 / 2	7460 - 7940	7700	YES	7940
LEAD	1 / 3	4.4	3.43	1 / 2	2	1.185	NO	2
MAGNESIUM	3 / 3	369 - 2770	2525.33	2 / 2	7300 - 9020	8160	YES	9020
MANGANESE	3 / 3	14 - 55.5	59.93	2 / 2	885 - 1120	1002.5	YES	1120
MERCURY	2 / 3	0.023 - 0.028	0.04	2 / 2	0.11 - 0.13	0.12	YES	0.13
NICKEL	3 / 3	2.1 - 7.1	8.60	2 / 2	5.6 - 12.5	9.05	YES	12.5
POTASSIUM	2 / 3	251 - 1850	1482.33	2 / 2	4180 - 4870	4525	YES	4870
SODIUM	NOT DETECTED	-	-	2 / 2	61400 - 80800	71100	YES	80800
ZINC	3 / 3	7.6 - 29.4	32.67	2 / 2	14.7 - 68.1	41.4	YES	68.1

Note: Selected COPCs are indicated in boldface type.

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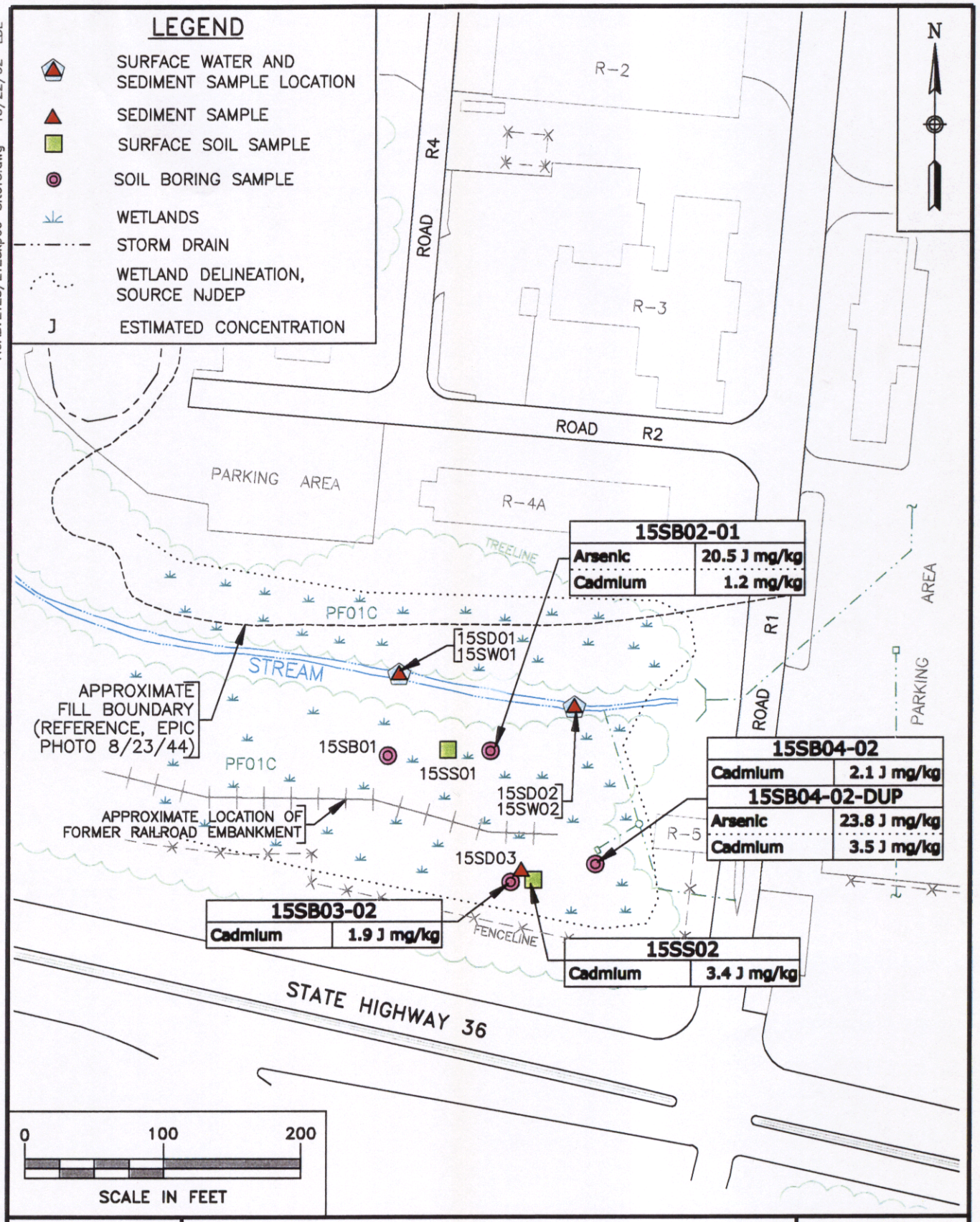
TABLE 1-22
OCCURRENCE AND DISTRIBUTION OF ORGANICS IN SURFACE WATER AT SITE 15
OU-9 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY
(ug/L)

SUBSTANCE	BACKGROUND			SITE-RELATED		
	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	REPRESENTATIVE CONCENTRATION	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	REPRESENTATIVE CONCENTRATION
4,4'-DDD	NOT DETECTED	-	-	1 / 1	0.0018	0.0018

ACAD: 2128/2128kp06-Site15.dwg 10/22/02 LDL



TETRA TECH NUS, INC.

CONCENTRATIONS ABOVE SUBSURFACE AND SURFACE SOILS SCREENING LEVELS
SITE 15 – SLUDGE DISPOSAL SITE
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

SCALE AS NOTED
FILE: 2128kp06.dwg
3/18/03 LDL PHL
REV 1 DATE 10/25/02
FIGURE 1-12

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ACAD:2128/2128kp08-Site15.dwg 11/20/02 LDL

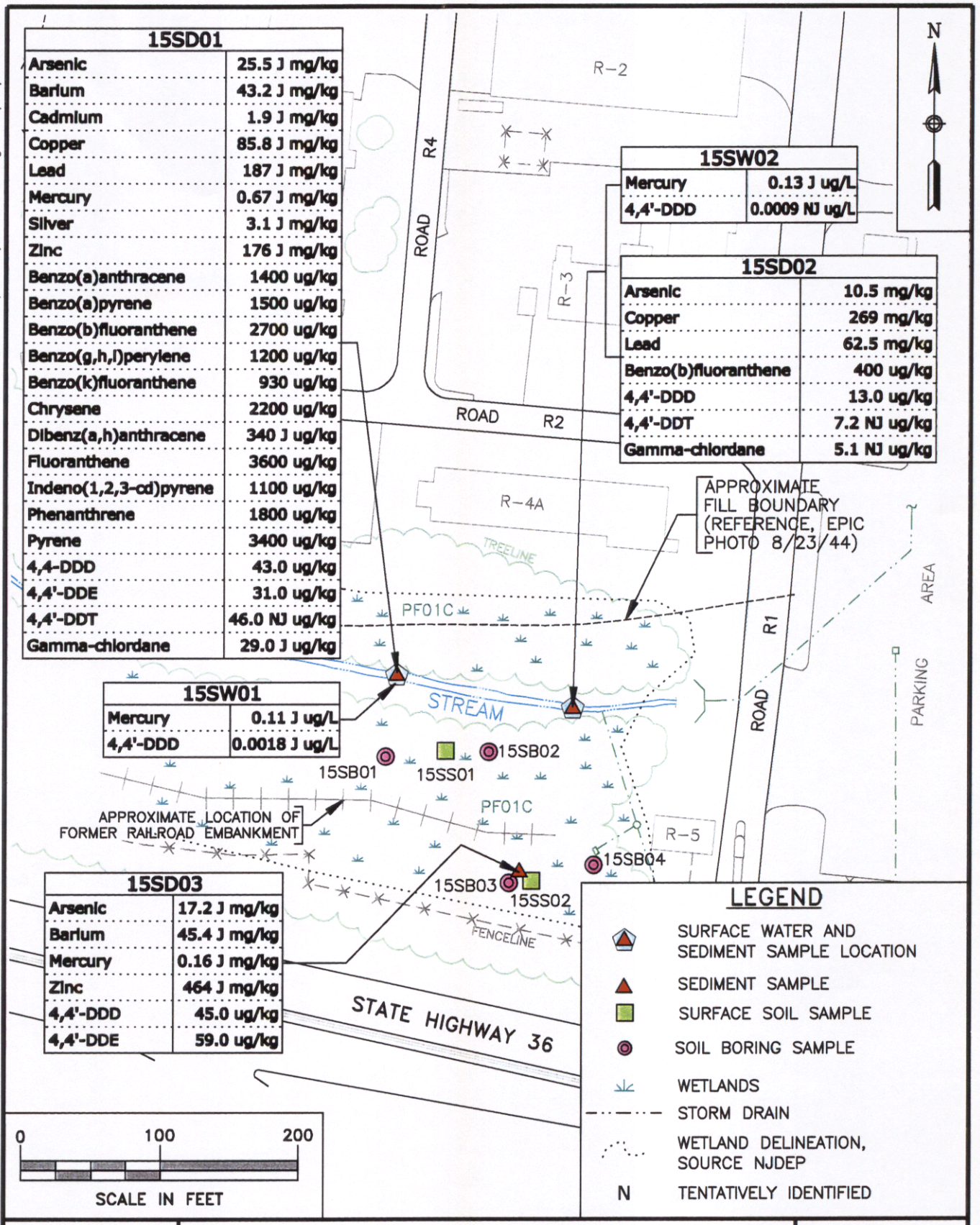
15SD01	
Arsenic	25.5 J mg/kg
Barium	43.2 J mg/kg
Cadmium	1.9 J mg/kg
Copper	85.8 J mg/kg
Lead	187 J mg/kg
Mercury	0.67 J mg/kg
Silver	3.1 J mg/kg
Zinc	176 J mg/kg
Benzo(a)anthracene	1400 ug/kg
Benzo(a)pyrene	1500 ug/kg
Benzo(b)fluoranthene	2700 ug/kg
Benzo(g,h,i)perylene	1200 ug/kg
Benzo(k)fluoranthene	930 ug/kg
Chrysene	2200 ug/kg
Dibenz(a,h)anthracene	340 J ug/kg
Fluoranthene	3600 ug/kg
Indeno(1,2,3-cd)pyrene	1100 ug/kg
Phenanthrene	1800 ug/kg
Pyrene	3400 ug/kg
4,4-DDD	43.0 ug/kg
4,4'-DDE	31.0 ug/kg
4,4'-DDT	46.0 NJ ug/kg
Gamma-chlordane	29.0 J ug/kg

15SW02	
Mercury	0.13 J ug/L
4,4'-DDD	0.0009 NJ ug/L

15SD02	
Arsenic	10.5 mg/kg
Copper	269 mg/kg
Lead	62.5 mg/kg
Benzo(b)fluoranthene	400 ug/kg
4,4'-DDD	13.0 ug/kg
4,4'-DDT	7.2 NJ ug/kg
Gamma-chlordane	5.1 NJ ug/kg

15SW01	
Mercury	0.11 J ug/L
4,4'-DDD	0.0018 J ug/L

15SD03	
Arsenic	17.2 J mg/kg
Barium	45.4 J mg/kg
Mercury	0.16 J mg/kg
Zinc	464 J mg/kg
4,4'-DDD	45.0 ug/kg
4,4'-DDE	59.0 ug/kg



TETRA TECH NUS, INC.

CONCENTRATIONS ABOVE SURFACE WATER AND SEDIMENT SCREENING LEVELS
SITE 15 – SLUDGE DISPOSAL SITE
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

SCALE AS NOTED
FILE: 2128kp08.dwg
3/18/03 LDL PHL
REV 1 DATE 11/20/02
FIGURE 1-13

Subsurface Soils

Four subsurface soil samples 15SB01 through 15SB04 were collected in Site 15. Tables 1-17 and 1-18 present the occurrence and distribution of inorganic and organic chemicals in Site 15 samples and compare them to background. Concentrations of most metals in Site 15 samples were similar to background. Cadmium was present at levels slightly greater than background in one sample (15SB04-02).

Bits(2-Ethylhexyl) phthalate (59 to 260 ug/kg) was detected in all four subsurface soil samples collected at Site 15. This compound was not detected in background subsurface soil samples.

The four subsurface soil samples collected at Site 15 were also analyzed for moisture, pH, and TPH. TPH was detected at concentrations ranging from 20 to 110 mg/kg. TPH in background subsurface soil samples ranged from 12.0 to 220 mg/kg.

Sediment

Three sediment samples 15SD01 through 15SD03 were collected at Site 15. Tables 1-19 and 1-20 present the occurrence and distribution of inorganic and organic chemicals in Site 15 sediment samples and compare them to background. Arsenic, barium, copper, iron, lead, mercury, nickel, selenium, silver, and zinc were detected at levels greater than background samples. The highest concentrations of arsenic (25.5 mg/kg), iron (84,000 mg/kg), and lead (187 mg/kg) were seen in sample 15SD01. The highest concentration of copper (269 mg/kg) was in sample 15SD02, and zinc exhibited a maximum concentration (464 mg/kg) in sample 15SD03.

PAHs including benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, indeno(1,2,3-cd)pyrene, fluoranthene, fluorene, phenanthrene, and pyrene were detected in background sediment samples from 110 to 1,900 ug/kg. Similar PAHs were detected in sediment samples collected at Site 15. PAH levels in sample 15SD01 were generally two to five times higher than background ranges. Samples 15SD02 and 15SD03 exhibited concentrations within a range similar to background samples. Butylbenzyl phthalate (910 ug/kg) and di-n-butyl phthalate (160 ug/kg) were detected in one Site 15 sediment sample but were not detected in background sediment samples.

Background sediment samples exhibited the presence of 4,4'-DDD (4.9 to 21 ug/kg), 4,4'-DDE (1.7 ug/kg), and 4,4'-DDT (19 ug/kg). Pesticides detected at similar levels in Site 15 sediment samples included 4,4'-DDT (7.2 to 46 ug/kg), 4,4'-DDD (13 to 45 ug/kg), and 4,4'-DDE (2.1 to 59 ug/kg). Gamma-Chlordane (5.1 to 29 ug/kg) was detected at levels greater than background ranges. Alpha-Chlordane (3.8 to 31 ug/kg), endrin (10 ug/kg), and heptachlor epoxide (0.47 to 3.2 ug/kg) were also detected in sediment samples collected at Site 15 but were not observed in background samples. Site 15 sediment samples also contained Aroclor

1260 (16 ug/kg in 15SD02 and 100 ug/kg in 15SD01), and styrene (11 ug/kg) and 2-butanone (86 ug/kg) were each detected in one sediment sample (15SD03).

The three sediment samples collected at Site 15 were also analyzed for moisture, pH, and TPH. TPH was detected I sediments at concentrations ranging from 370 to 3100 mg/kg. TPH levels in background soil/sediment samples ranged from 50.0 to 660 mg/kg.

Surface Water

Two surface water samples 15SW01 and 15SW02 were collected at Site 15. Tables 1-26 and 1-27 present the occurrence and distribution of inorganic and organic chemicals detected in Site 15 surface water samples and compare them to background. TPH was analyzed for but not detected in surface water samples. Concentrations of most metals in the two Site 15 samples were similar or lower than background. Slightly higher levels of cobalt and manganese were detected in both Site 15 samples.

4,4'-DDD was detected in one surface water sample from Site 15 at a concentration of 0.0018 ug/L (15SW01). This compound was not detected in background surface water samples.

1.3.4.3.3 Contaminant Fate and Transport

The behavior of contaminants in the environment at Site 15 is described in this subsection. Analytical results for the media sampled at Site 15 indicated relatively low levels of TPH, metals, VOCs, PCBs, SVOCs, and pesticides in sediment, PAHs, and pesticides in surface soil, and limited metals in surface water.

TPH was detected at levels up to 3,100 mg/kg in Site 15 sediments. Benzene, toluene, ethylbenzene, and xylenes were not detected in site-related sediments. The highest levels of PAHs were noted in the same sample (stream sediment 15SD01) that contained the highest level of TPH. This suggests that the form of TPH present may have included heavier range hydrocarbons such as oils or diesel range fuels, rather than light fuels.

The PCB Aroclor 1260 was present at a maximum concentration of 100 ug/kg in 15SD01, at a level approximately six times greater than the other stream sediment sample 15SD02 (16.0 mg/kg). Both stream sediments were within a region that could potentially have been impacted by the site, although 15SD02 was somewhat farther upstream. Subsurface and surface soil samples from the sludge disposal site did not contain PCBs. Based on these data, additional upstream sources of PCBs could not be ruled out.

Slightly elevated levels of certain metals in sediment may have been related to sludge disposal activities. Surface water samples at Site 15 did not indicate chemical migration impacts from this area. The detected sediment contamination was likely the result of runoff and erosional dispersion.

Heavy molecular weight organic contaminants detected in the sediments at Site 15 had low potential for impacts to groundwater. Runoff and erosional dispersion may have allowed limited migration of contaminated sediments. PAHs were detected at low levels, from two to five times background, in sediment samples. PAHs in surface and subsurface soils exhibited even lower concentrations. PAHs were generally detected in association with TPH, which is consistent with site history.

Very low concentrations of two VOCs were detected in a sediment sample within the former sludge disposal area. However, these VOCs were not detected in stream sediments and were not detected in a hydropunch groundwater sample collected during a 1992 investigation. Therefore, there does not appear to be a potential for significant or widespread VOC impact at this site.

PCBs were detected in stream sediments but were not detected elsewhere in the disposal area. Because surface and subsurface soils did not reveal the presence of PCBs, the source of the detected PCB contamination could be erosional dispersion from unknown off-site locations farther upstream of Site 15.

The occurrence and frequency of low-level metals contamination were different in each of the sampled media (surface water, sediment, surface soil, and subsurface soil); therefore, no obvious pattern of contaminant migration of metals was suggested at Site 15. However, the low pH of several subsurface and surface soils may have facilitated migration of metals in the environment. Historical data collected during a 1992 investigation cannot be used to determine the presence of metals contamination in groundwater because hydropunch sampling techniques were used to collect unfiltered groundwater samples that may not be representative of dissolved-phase metals concentrations.

1.3.4.3.4 Baseline Human Health Risk Assessment

Surface soil, subsurface soil, sediment, and surface water were sampled at Site 15. The potential receptors considered for this site were current industrial and future industrial, residential, and recreational receptors. Appendix B-3 contains summary tables of the estimated human health risks for Site 15. The cancer risks associated with surface (8.6E-05) and subsurface (8.3E-05) soil exposure for the future residential exposure scenario were within the 1E-04 to 1E-06 target risk range. Arsenic (via ingestion and dermal contact with surface and subsurface soil) was the major COPC that contributed to the cancer risks for these exposure scenarios.

The future residential (surface soil (1.3) and subsurface soil (1.4)) exposure scenario yielded total RME HIs (sum of HIs for ingestion, dermal, and inhalation of dusts) greater than 1.0, the cutoff point below which adverse effects are not expected to occur. These RME estimates are probably overly conservative because a central tendency calculation shows that non-cancer HIs are more likely to be below 1.0. Central tendency generates a lower risk estimate than RME because it assumes typical rather than upper range receptor

behavior patterns related to the ingested dose. CTE risk estimates provide additional information but decisions are based on the RME.

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

1.3.4.3.5 Ecological Risk Assessment

Site 15 is located in the Waterfront complex and occupies an estimated one acre area. Excellent habitat exists at and near Site 15, mainly for terrestrial receptors that use the site proper and terrestrial and wetland receptors that use the marsh to the northwest. For the most part, runoff and erosion are the main contaminant migration pathways. It is unclear exactly where activities at the site took place, and runoff from an adjacent parking lot drains into a manhole that empties into the drainage swale. As a result, runoff from and to the site is not confined to discrete sources. Limited groundwater to surface water contaminant migration may be possible, but the small area of the site and of the potentially contaminated area at the site minimizes the impact of this pathway.

Subsurface soil, sediment, and groundwater samples were taken as part of 1993 SI activities at the site. Phthalates were the only contaminants detected in subsurface soil, all at low concentrations. Four sediment samples were taken from the drainage ditch. A few phthalates and some PAHs including phenanthrene, anthracene, flouranthene, and pyrene were detected, all at relatively low concentrations. In groundwater, no organics were detected, although elevated levels of some metals were present.

Surface water, sediment, and surface soil samples were taken as part of 1995 RI activities at Site 15 to more fully characterize the nature and extent of contamination in those media and to investigate potential off-site migration. Data from these samples were used for quantitative assessment. HQs for constituents in surface water were indicative of relatively low potential risk. HQs for inorganics in sediment were indicative of relatively low risk, with the exception of zinc. This metal slightly exceeded a less conservative ET value. Some inorganics were retained as final COPCs in sediments because no suitable ET values were available. Of these, only aluminum was detected significantly above background. Most HQ values for inorganics were indicative of low potential risk, although the pesticides 4,4'-DDE and 4,4'-DDT and the PAHs benzo(b)fluoranthene, phenanthrene, and pyrene slightly exceeded less conservative ET values. The pesticides detected may have been the result of intense past seashore vector control programs not due to Site 15 activities and were not detected at relatively high concentrations. Styrene and 2-butanone were conservatively retained as final COPCs because no suitable ETs were available, but these compounds were only detected in one sample and at low concentrations.

HQ values for inorganics in surface soils were indicative of low potential risk, with the exception of chromium. Chromium had an HQ value indicative of moderately high risk, but the associated surface soil concentration was less than background. The elevated HQ value for this inorganic was probably due to the very conservative ET used. HQs for organics were also indicative of low potential risk. A phthalate compound was conservatively retained as a final COPC because no ET value was available, but it was detected at a low concentration. Phthalates are ubiquitous in the environment and are common laboratory contaminants. For terrestrial plants, HQs were reflective of low potential risk, with the exception of aluminum, chromium, and vanadium, but these metals were detected at concentrations below or only slightly above background. No suitable terrestrial plant ET values were available for organics detected in surface soils, but terrestrial plants generally do not significantly translocate organics into root tissue, and no evidence of stressed vegetation is apparent at the site.

In summary, HQ values for most concentrations in most media at Site 15 were indicative of low potential risk. Most elevated HQs were mitigated by various factors including concentrations below background. Previous studies indicated relatively low concentrations of contaminants in sediments. Only a few inorganics exceeded ET values in surface water, and the HQ values were mostly indicative of low risk. Some constituents had HQ values greater than one but did not exceed background; this was mainly a function of extremely conservative ET values rather than excessively high background values. Potential risks from inorganics in sediments were also low. A suite of organic contaminants in sediments exceeded ET values, but most of these exceedances were low. However, a few HQ values were indicative of moderate risk. Some contaminants were present in sediments for which no suitable ETs were available, but concentrations of these contaminants were fairly low. As a result, they are not likely to pose significant potential risk. In addition, organic contaminants in sediments have a low tendency to migrate because they bind to organic fractions in sediments.

In Site 15 surface soils, no inorganics exceeded ETs or were retained as final COPCs. Aluminum was retained because no ET was available, but concentrations were only slightly above background. Potential risks from organics in surface soils were also minimal. In addition, potential risk to terrestrial plants from inorganic contaminants in surface soils was low. No suitable terrestrial plant ETs were available for organics. Most terrestrial plants do not absorb organic contaminants to the same degree as inorganics. Several organics were detected in site sediments, mainly PAHs, and a few of these slightly exceeded less conservative ET values, indicating moderate potential risk. However, these compounds could as likely have resulted from runoff from a nearby road and parking lot because surface drainage from those areas empties into the drainageway next to the site.

Site 15 is small and the contaminant source is not discrete. Moreover, the concentrations of contaminants are relatively low. The PAHs detected have strong affinities for organic fractions in sediments; as a result, they do not tend to migrate significantly. For these reasons, additional investigation does not appear to be necessary, nor does remediation at the site based on ecological concerns.

1.3.5 Site 17

1.3.5.1 Initial Assessment and Confirmation Study

The 1983 IAS consisting of interviews and visual inspection concluded minimal impact. Site 17 was not recommended for a confirmation study because of the presence of largely inert and immobile materials.

During the 1993 SI, soil samples were collected from three soil borings and two of the four monitoring well borings. Soil borings were completed to the water table, and subsurface soil samples were collected from between 5 and 11 feet bgs. Four monitoring wells were installed and screened in the upper water-bearing zone. In addition, four sediment samples were collected from the marsh area downgradient of the site. Soil samples were analyzed for metals and cyanide. Analytical results indicated that no significant concentrations of metals or cyanide were present. Elevated levels of VOCs, SVOCs, and pesticides were detected in sediment samples. Groundwater samples were analyzed for TAL metals, TCL VOCs, SVOCs pesticides PCBs, and landfill parameters. Elevated levels of metals and landfill indicator parameters were present in groundwater.

1.3.5.2 Remedial Investigation

Between June and October 1995, B&R Environmental conducted the following field investigation activities at Site 17:

- Sampling and analysis of surface water
- Sampling and analysis of sediment
- Drilling and installation of one shallow permanent monitoring well
- Sampling and analysis of groundwater from the newly installed well and existing wells
- Measurement of staticwater levels in the wells
- Sampling and analysis of surface soil

B&R Environmental conducted a survey to establish the horizontal locations and vertical elevations of the surface water and sediment samples, the surface soil sample, the newly installed and selected existing wells.

On October 28 and 30, 1996 B&R Environmental conducted additional surface water and sediment sampling at Site 17.

1.3.5.3 Summary of Results

The landfill surface is paved and is currently utilized as a parking area for Waterfront personnel. The face of the landfill is 10 to 15 feet higher in elevation than the marsh area and is heavily vegetated. Infiltration is limited to some degree by the nature of the surface cover, and overland flow drains toward the salt marsh north and west of the site. The groundwater flow direction is north-northwest toward the marsh, based on measured groundwater elevations. Geo-rectified digital imagery was utilized to interpret the probable extent of disposal areas with respect to the placement of fill material during the early 1940's, on which the Waterfront facilities were originally constructed. Results of the RI revealed slightly elevated levels of PAHs and pesticides in drainage pathway sediments and elevated levels of metals, possibly due to suspended sediment, in drainage pathway surface water samples.

No slope stabilization work was performed at Site 17 as was performed at Site 6. However, Foster Wheeler Environmental Corporation conducted work on the flat portion of Site 17 including grading, topsoil cover and seeding, and installation of a wooden barricade to prevent any future deposition of soils or debris on the sloped area of Site 17.

1.3.5.3.1 Site Geology and Hydrology

Geology

Regional mapping places Site 17 within the outcrop area of the Englishtown Formation. The Englishtown Formation ranges between 35 and 150 feet in thickness, and the soil borings installed as part of RI activities are no more than 20 feet deep. The lithology of the sediments encountered in the on-site borings generally agrees with the published description of the Englishtown Formation. In general, the borings encountered fill material and yellowish-brown, olive brown, and gray silty sand, clayey sand and sand, olive brown silt, and gray clay. Based on the boring log descriptions, the wells and borings at Site 17 penetrated fill material and the Englishtown Formation.

Hydrogeology

Groundwater in the fill material and the Englishtown aquifer beneath the site occurs under unconfined conditions, and the fill material and formation are interpreted to be hydraulically interconnected. Static water level measurements and water table elevations are summarized in Table 1-23. Groundwater elevations for August 1995 and October 1995 are contoured on Figures 1-14 and 1-15, respectively. The direction of shallow groundwater flow in the aquifer, as indicated by both the August and October groundwater contour maps, is northwest. There does not appear to be a significant seasonal variation in groundwater flow

TABLE 1-23
SITE 17 STATIC-WATER-LEVEL MEASUREMENT SUMMARY
OU 9 FEASIBILITY STUDY
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

Monitoring Well Number	August 7, 1995			October 17, 1995		
	Depth to Water Table(1) (feet)	Top of PVC Riser(2)	Elevation of Water Table(2)	Depth to Water Table(1) (feet)	Top of PVC Riser(2)	Elevation of Water Table(2)
MW17-01	11.41	18.58	7.17	11.75	18.58	6.83
MW17-02	Not found	11.55	---	4.89*	11.55	6.66
MW17-03	7.29	14.09	6.80	7.68	14.09	6.41
MW17-04	8.63	14.95	6.32	7.40	14.95	7.55
MW17-05	7.50	14.56	7.06	7.79	14.56	6.77

(1) In feet below top of riser.

(2) In feet above mean sea level.

* Water-level measurement taken on October 18, 1995.

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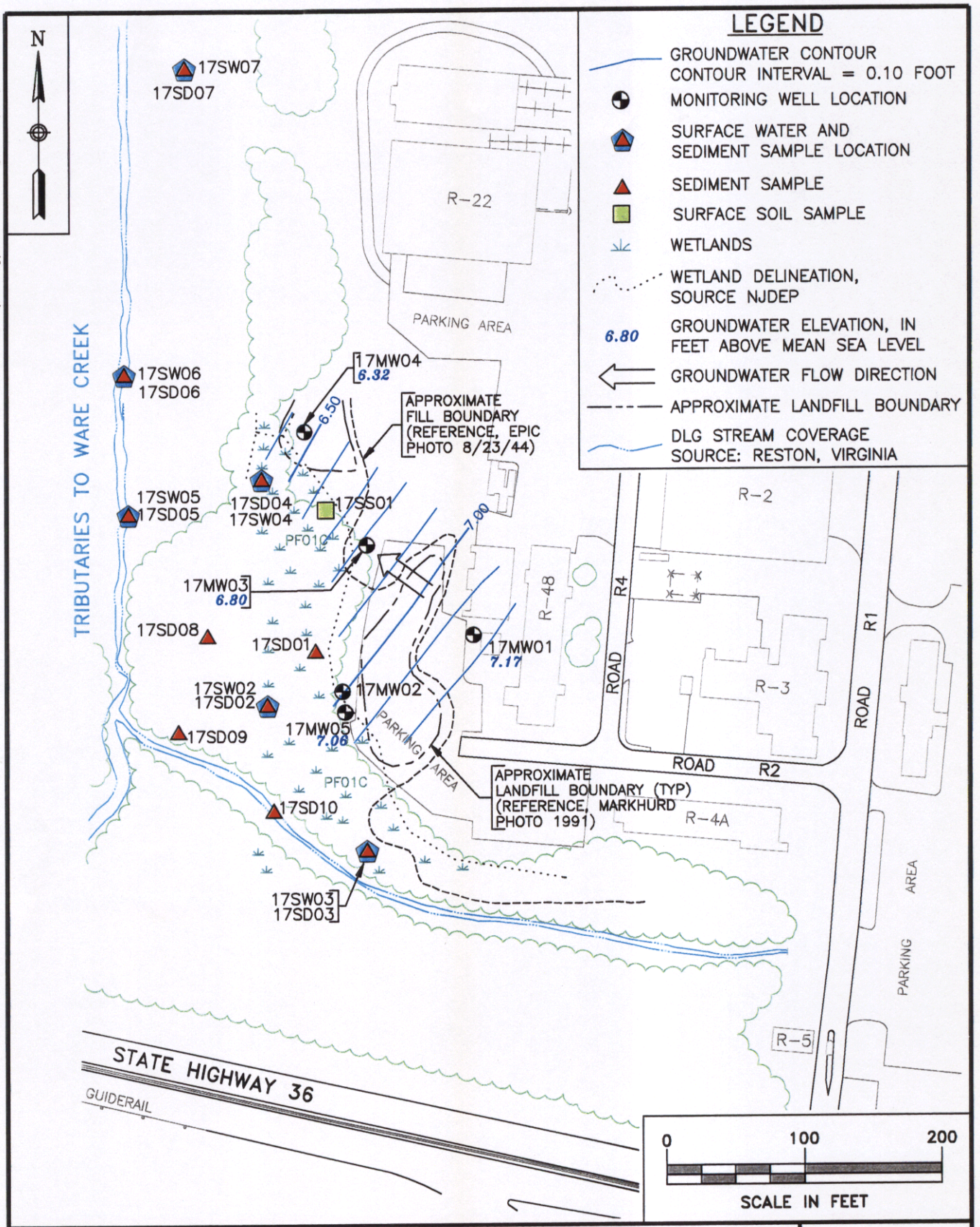

TETRA TECH NUS, INC.

GROUNDWATER CONTOUR MAP
AUGUST 7, 1995
SITE 17 – LANDFILL
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

SCALE	AS NOTED
FILE:	2128gp07.dwg
3/18/03	LDL PHL
REV 1	DATE 10/25/02
FIGURE NUMBER	FIGURE 1-14

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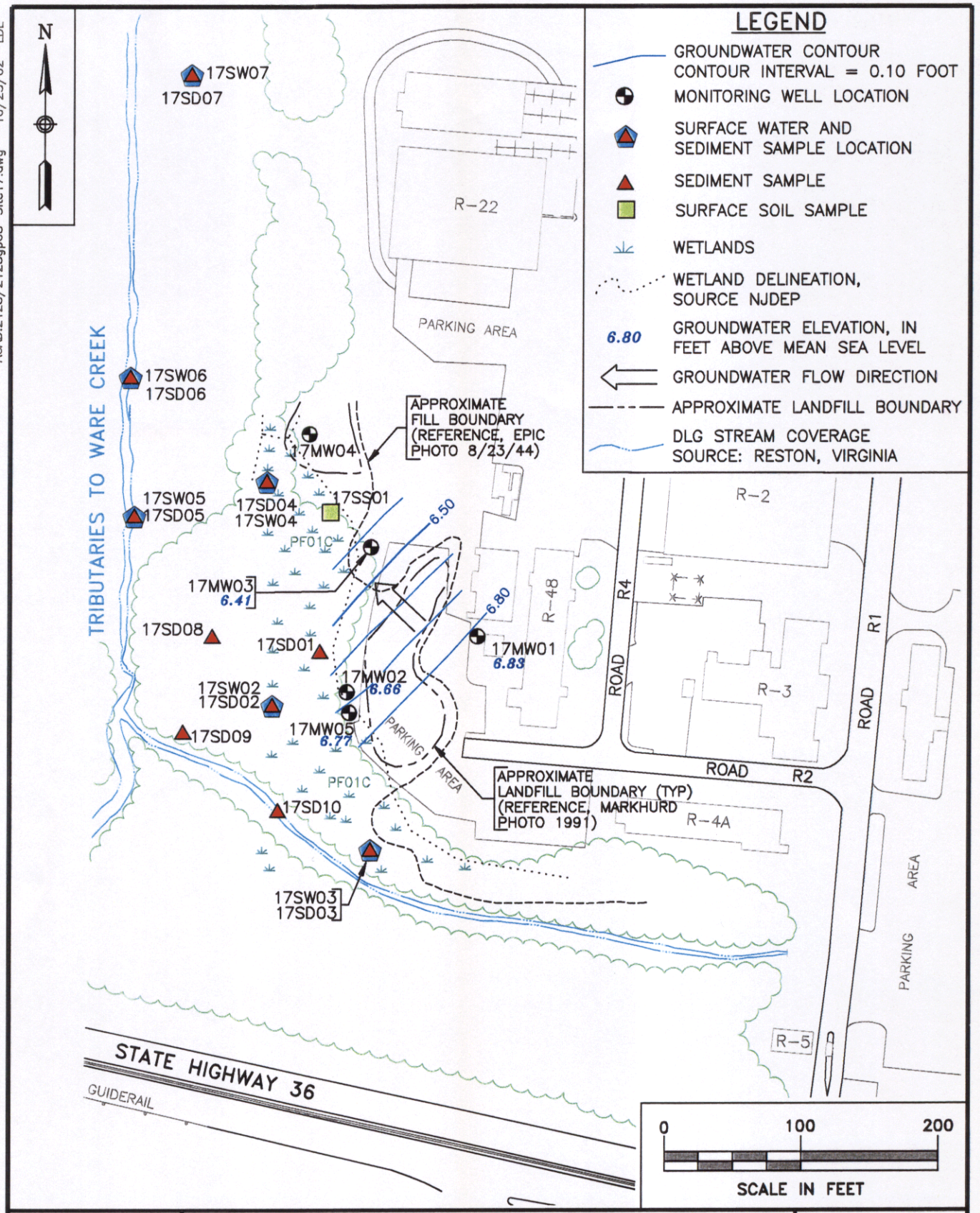

TETRA TECH NUS, INC.

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

SCALE	AS NOTED
FILE:	2128gp08.dwg
3/18/03	LDL PHL
REV	DATE
1	10/25/02
FIGURE NUMBER	FIGURE 1-15

1.3.5.3.2 Nature and Extent of Contamination

This section evaluates the occurrence and distribution of samples from the 1995 RI and 1996 RI Addendum field activities. Tables 1-24 through 1-30 compare the results of background samples to samples collected at Site 6. Figure 1-16 shows sample locations and concentrations of compounds that exceed screening levels.

Surface Soils

One site-related surface soil sample (17SS01) was collected at Site 17. Tables 1-24 and 1-25 present the occurrence and distribution of inorganic chemicals detected in site-related surface soil samples and compares them to background. Concentrations of metals in 17SS01 were within the ranges found in background samples. 4,4'-DDT was detected in background surface soil samples in the concentration range of 43 ug/kg to 420 ug/kg. The pesticide compound was detected in the surface soil sample at Site 17 at a much lower concentration of 1.2 ug/kg.

Sediment

Four site-related sediment samples (17SD01 through 17SD04) were collected during the 1995 RI, and an additional six sediment samples (17SD05 through 17SD10) were collected during the 1996 RI Addendum field work. Tables 1-26 and 1-27 present the occurrence and distribution of inorganic and organic chemicals in Site 17 samples and compare them to facility-wide background. Facility-wide background samples (BGSD01, BGSD02, and BGSD04 through BGSD07) were used for COPC selection for the human health risk assessment. Only those background samples obtained form this watershed (BGSD05 through BGSD07), however, were used for the ecological risk assessment.

Elevated levels of metals were detected in several site samples, notably sample locations 17SD02 and 17SD07. Metals detected at levels at least two times background included aluminum (up to 19,300 mg/kg), arsenic (up to 41.9 mg/kg), barium (up to 71.9 mg/kg), beryllium (up to 1.9 mg/kg), cadmium (up to 3.1 mg/kg), cobalt (up to 21.1 mg/kg), copper (up to 99.1 mg/kg), iron (up to 66,400 mg/kg), lead (up to 236 mg/kg), magnesium (up to 4,800 mg/kg), manganese (up to 218 mg/kg), mercury (up to 0.32 mg/kg), nickel (up to 29.3 mg/kg), vanadium (up to 101 mg/kg), and zinc (up to 242 mg/kg). Sample 17SD03 also contained elevated levels of arsenic, cobalt, iron, lead, and mercury but at levels below 17SD01 and 17SD07. Analytes detected in Site 17 samples, but not present in background samples, included antimony (17SD07), selenium (17SD01 through 17SD04), and thallium (17SD02 and 17SD07).

TABLE 1-24

OCCURRENCE AND DISTRIBUTION OF INORGANICS IN SURFACE SOIL AT SITE 17
OU-9 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY
(mg/kg)

	BACKGROUND***					SITE-RELATED					
SUBSTANCE	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	UTL**	2 X AVERAGE CONCENTRATION	EPRESENTATIV ONCENTRATIO	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	AVERAGE CONCENTRATION	MEAN > X BKGD	MEAN > ACK UTL	REPRESENTATIVE CONCENTRATION
ALUMINUM	4 / 4	1710 - 5310	7.5E+03	6153	5310	1 / 1	525 - 525	525	NO	NO	525
ARSENIC *	4 / 4	1.35 - 14.4	2.3E+01	13.43	14.4	1 / 1	2.3 - 2.3	2.30	NO	NO	2.3
BARIUM	4 / 4	1.85 - 31	4.7E+01	22.53	31	1 / 1	3.2 - 3.2	3.20	NO	NO	3.2
BERYLLIUM	1 / 4	0.28 - 0.28	5.6E+00	0.39	0.28	1 / 1	0.049 - 0.049	0.05	NO	NO	0.049
CADMIUM	1 / 4	0.57 - 0.57	7.5E-01	0.67	0.52	1 / 1	0.098 - 0.098	0.10	NO	NO	0.098
CALCIUM	4 / 4	40.1 - 519	6.8E+03	551.80	519	1 / 1	129 - 129	129	NO	NO	129
CHROMIUM	4 / 4	7.8 - 59.5	1.1E+02	69.05	59.5	1 / 1	5.4 - 5.4	5.40	NO	NO	5.4
COBALT	2 / 4	0.75 - 5	7.6E+00	3.15	4.27	1 / 1	0.27 - 0.27	0.27	NO	NO	0.27
COPPER	4 / 4	0.97 - 8.4	1.5E+01	10.06	8.4	1 / 1	2.2 - 2.2	2.20	NO	NO	2.2
IRON	4 / 4	3745 - 62500	9.6E+04	52403	62500	1 / 1	3060 - 3060	3060	NO	NO	3060
LEAD	4 / 4	1.8 - 39.4	4.0E+02	37.30	39.4	1 / 1	7.5 - 7.5	7.50	NO	NO	7.5
MAGNESIUM	4 / 4	71.7 - 619	9.0E+02	578.85	619	1 / 1	95.5 - 95.5	95.50	NO	NO	95.5
MANGANESE	4 / 4	3.45 - 214	3.3E+02	128.33	182.62	1 / 1	9.9 - 9.9	9.90	NO	NO	9.9
MERCURY	4 / 4	0.035 - 0.17	5.9E-01	0.18	0.17	1 / 1	0.019 - 0.019	0.02	NO	NO	0.019
NICKEL	2 / 4	1.8 - 7.2	1.1E+01	5.18	7.2	1 / 1	1.3 - 1.3	1.30	NO	NO	1.3
POTASSIUM	4 / 4	95 - 792	4.1E+03	912.50	792	1 / 1	104 - 104	104	NO	NO	104
SODIUM	4 / 4	17.5 - 86.2	1.2E+02	78.30	86.2	1 / 1	444 - 444	444	YES	YES	444
VANADIUM	4 / 4	11.05 - 64	2.0E+02	70.13	64	1 / 1	6 - 6	6.00	NO	NO	6
ZINC	3 / 4	1.1 - 27.6	4.6E+02	22.80	27.6	1 / 1	10.4 - 10.4	10.40	NO	NO	10.4

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

TABLE 1-25
OCCURRENCE AND DISTRIBUTION OF ORGANICS IN SURFACE SOIL AT SITE 17
OU-9 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY
(ug/kg)

	BACKGROUND			SITE-RELATED		
SUBSTANCE	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	REPRESENTATIVE CONCENTRATION	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	REPRESENTATIVE CONCENTRATION
4,4'-DDT*	2 / 4	43 - 420	355.71	1 / 1	1.2	1.2

* - Selected as a COPC

TABLE 1-26
OCCURRENCE AND DISTRIBUTION OF INORGANICS IN SEDIMENT AT SITE 17
OU-9 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY
(mg/kg)

	BACKGROUND***				SITE-RELATED					
SUBSTANCE	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	UTL**	2 X AVERAGE CONCENTRATION	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	AVERAGE CONCENTRATION	MEAN > 2 X BKGD?	MEAN > BACK UTL?	REPRESENTATIVE CONCENTRATION
ALUMINUM	6 / 6	839 - 3940	8.1E+07	5460	10 / 10	745 - 19300	7190	YES	NO	19300
ANTIMONY *	NOT DETECTED	-	-	-	1 / 10	2.3 - 2.3	2.19	YES	-	2.30
ARSENIC *	5 / 6	2.40 - 9.90	2.9E+02	11.23	10 / 10	4 - 41.9	15.10	YES	NO	21.77
BARIUM	6 / 6	3.20 - 15.80	2.9E+02	16.80	10 / 10	2.4 - 71.8	26.40	YES	NO	38.20
BERYLLIUM	4 / 6	0.34 - 0.57	3.3E-01	0.72	10 / 10	0.11 - 1.9	0.67	NO	YES	0.94
CADMIUM	2 / 6	0.44 - 0.46	1.1E+00	0.93	6 / 10	0.23 - 3.1	0.57	NO	NO	1.04
CALCIUM	6 / 6	179 - 518	6.7E+05	690.83	10 / 10	109 - 4660	1038	YES	NO	1870
CHROMIUM	6 / 6	4.30 - 56	2.6E+03	40.42	10 / 10	6.8 - 69	34.17	NO	NO	69
COBALT	4 / 6	0.51 - 2.10	6.4E+00	2.85	10 / 10	0.58 - 21.1	3.55	YES	NO	6.86
COPPER *	6 / 6	1 - 13	1.9E+01	9.08	10 / 10	2 - 99.1	24.07	YES	YES	42.63
IRON	6 / 6	228 - 21400	7.2E+09	23589	10 / 10	5640 - 66400	25035	YES	NO	49496
LEAD *	6 / 6	4.00 - 34.30	4.8E+01	21.07	10 / 10	5.2 - 236	50.69	YES	YES	89.83
MAGNESIUM	6 / 6	60.70 - 880	2.0E+06	809.90	10 / 10	117 - 4800	1171.18	YES	NO	1968
MANGANESE	6 / 6	3.90 - 63.10	8.9E+01	36.22	10 / 10	4 - 218	44.32	YES	NO	77.55
MERCURY *	1 / 6	0.07 - 0.07	8.5E-03	0.09	4 / 10	0.02 - 0.32	0.13	YES	YES	0.19
NICKEL	5 / 6	1.60 - 6	3.4E+01	6.90	9 / 10	2.7 - 29.3	8.30	YES	NO	13.82
POTASSIUM	5 / 6	86.10 - 2900	1.4E+07	1892	10 / 10	235 - 4000	1642	NO	NO	3536
SELENIUM *	NOT DETECTED	-	1.9E+00	-	5 / 10	0.93 - 7.4	1.78	YES	-	4.47
SILVER	2 / 6	0.11 - 0.15	2.8E+00	1.13	3 / 10	0.13 - 0.17	0.45	NO	NO	0.17
SODIUM	4 / 6	26.60 - 2280	2.9E+03	876.80	7 / 10	50.2 - 10800	1223	YES	NO	2965
THALLIUM*	NOT DETECTED	-	2.2E+00	-	1 / 10	1.5 - 1.5	0.78	YES	-	1.10
VANADIUM	6 / 6	5.90 - 42.70	2.1E+03	39.42	10 / 10	9.4 - 101	46.73	YES	NO	95.83
ZINC	6 / 6	12.50 - 34.70	1.5E+03	41.23	10 / 10	7.3 - 242	66.15	YES	NO	107.97

* - Selected as a COPC

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

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

TABLE 1-27

OCCURRENCE AND DISTRIBUTION OF ORGANICS IN SEDIMENTAT SITE 17
OU-9 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY
(ug/kg)

SUBSTANCE	BACKGROUND**			SITE-RELATED		
	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	REPRESENTATIVE CONCENTRATION	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	REPRESENTATIVE CONCENTRATION
4,4'-DDD *	2 / 6	4.9 -	11.98	4 / 9	23 - 58	58
4,4'-DDE *	1 / 6	1.7 - 1.7	1.70	6 / 9	4.8 - 110	110
4,4'-DDT *	1 / 6	19 - 19	10.64	4 / 10	13 - 59	59
ALPHA-CHLORDANE *	NOT DETECTED	-	-	3 / 9	4.5 - 14	13.90
AROCLOR-1248 *	1 / 6	5.8 - 5.8	5.80	1 / 9	57 - 57	57
AROCLOR-1254 *	NOT DETECTED	-	-	1 / 9	120 - 120	107.08
AROCLOR-1260 *	NOT DETECTED	-	-	2 / 9	31 - 80	60.54
ENDOSULFAN II *	NOT DETECTED	-	-	1 / 10	0.21 - 0.21	0.21
ENDRIN *	NOT DETECTED	-	-	1 / 10	10 - 10	8.58
GAMMA-CHLORDANE *	1 / 6	0.095 - 0.095	0.10	3 / 9	5 - 10	10
METHOXYCHLOR *	NOT DETECTED	-	-	2 / 10	1.6 - 3.9	3.90
2-METHYLNAPHTHALENE *	NOT DETECTED	-	-	1 / 8	170 - 170	170
4-METHYLPHENOL *	NOT DETECTED	-	-	2 / 8	420 - 820	766.58
ACENAPHTHENE *	NOT DETECTED	-	-	1 / 8	340 - 340	340
ACENAPHTHYLENE *	NOT DETECTED	-	-	1 / 8	89 - 89	89
ANTHRACENE *	NOT DETECTED	-	-	1 / 8	1000 - 1000	1000
BENZ(A)ANTHRACENE *	3 / 6	85 - 560	560	3 / 8	120 - 2600	2317
BENZO(A)PYRENE *	3 / 6	110 - 590	393.60	5 / 8	41 - 2600	2600
BENZO(B)FLUORANTHENE *	3 / 6	150 - 490	346.54	7 / 8	62 - 5000	5000
BENZO(G,H,I)PERYLENE *	3 / 6	51 - 380	380	3 / 8	66 - 3100	3100
BENZO(K)FLUORANTHENE *	3 / 6	63 - 470	470	3 / 8	92 - 1300	1197
BIS(2-ETHYLHEXYL)PHTHALATE *	NOT DETECTED	-	-	3 / 8	54 - 9400	9400
BUTYLBENZYLPHTHALATE *	NOT DETECTED	-	-	1 / 8	610 - 610	610
CARBAZOLE *	NOT DETECTED	-	-	1 / 8	630 - 630	630
CHRYSENE *	3 / 6	130 - 940	577.87	8 / 8	50 - 3100	3100
DI-N-BUTYLPHTHALATE *	1 / 6	97 - 97	97	1 / 8	140 - 140	140
DIBENZ(A,H)ANTHRACENE *	NOT DETECTED	-	-	1 / 8	820 - 820	820
DIBENZOFURAN *	NOT DETECTED	-	-	1 / 8	220 - 220	220
DIETHYLPHTHALATE *	1 / 6	44 - 44	44	2 / 8	43 - 100	100
FLUORANTHENE *	3 / 6	240 - 1800	1024.31	8 / 8	93 - 4700	4700
FLUORENE *	1 / 6	190 - 190	190	1 / 8	590 - 590	590
INDENO(1,2,3-CD)PYRENE *	3 / 6	55 - 310	310	3 / 8	68 - 2200	2200
ISOPHORONE *	NOT DETECTED	-	-	1 / 8	75 - 75	75
NAPHTHALENE *	NOT DETECTED	-	-	1 / 8	160 - 160	160
PHENANTHRENE *	3 / 6	110 - 1900	1052	5 / 8	63 - 4200	4131
PYRENE *	3 / 6	200 - 1900	1077	8 / 8	75 - 7000	7000
TOLUENE *	1 / 3	480 - 480	480	1 / 4	4 - 4	4

* - Selected as a COPC

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

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TABLE 1-28
OCCURRENCE AND DISTRIBUTION OF INORGANICS IN GROUNDWATER AT SITE 17
OU-9 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY
(ug/L)

	BACKGROUND***				SITE-RELATED					
SUBSTANCE	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	UTL**	2 X AVERAGE CONCENTRATION	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	AVERAGE CONCENTRATION	MEAN > 2 X BKGD?	MEAN > BACK UTL?	REPRESENTATIVE CONCENTRATION
ALUMINUM	3 / 3	1320 - 2090	1.6E+11	3387	4 / 4	96.8 - 2090	1262	NO	NO	2090
ARSENIC *	1 / 3	5.1 - 5.1	1.7E+02	5.60	3 / 4	4.2 - 19.7	8.14	YES	NO	19.70
BARIUM	3 / 3	30.4 - 78.1	2.5E+06	105.47	4 / 4	16 - 590	193.43	YES	NO	590
BERYLLIUM	2 / 3	0.23 - 4.5	7.7E+01	3.19	2 / 4	1.4 - 4.5	1.50	NO	NO	4.50
CADMIUM	3 / 3	0.43 - 7	2.2E+01	5.29	3 / 4	0.43 - 8.3	2.45	NO	NO	7.05
CALCIUM	3 / 3	11000 - 24100	9.4E+14	38067	4 / 4	1700 - 517000	134248	YES	NO	434535
CHROMIUM *	NOT DETECTED	-	1.1E+00	-	2 / 4	1.1 - 4.6	1.67	YES	YES	3.99
COBALT	3 / 3	3.2 - 24.7	4.2E+04	23.67	4 / 4	0.72 - 24.7	10.41	NO	NO	24.70
COPPER *	NOT DETECTED	-	4.0E-02	-	3 / 4	0.83 - 2.5	1.18	YES	YES	2.50
IRON	3 / 3	1400 - 95200	2.4E+16	66847	4 / 4	1400 - 54300	19450	NO	NO	54300
LEAD *	NOT DETECTED	-	3.8E-01	-	2 / 4	3.8 - 5.7	2.75	YES	YES	5.70
MAGNESIUM	3 / 3	8610 - 17300	2.5E+14	26940	4 / 4	1440 - 89900	28208	YES	NO	77011
MANGANESE	3 / 3	720 - 3040	7.3E+11	3720	4 / 4	79.9 - 3040	1179	NO	NO	3040
MERCURY	1 / 3	0.044 - 0.044	1.1E-05	0.03	1 / 4	0.054	0.02	NO	YES	0.05
NICKEL	3 / 3	3.7 - 43.2	2.7E+05	38.33	3 / 4	3.2 - 43.2	15.64	NO	NO	43.20
POTASSIUM	3 / 3	3000 - 3620	1.1E+12	6780	4 / 4	2460 - 92700	25300	YES	NO	78174
SODIUM	3 / 3	15800 - 92500	1.9E+17	127600	4 / 4	4780 - 15700000	3937370	YES	NO	13164690
VANADIUM *	1 / 3	1.1 - 1.1	9.4E-01	1.14	3 / 4	1.1 - 18.1	7.43	YES	YES	18.10
ZINC	2 / 2	18.9 - 30.9	7.3E+11	49.80	2 / 4	3.8 - 10.5	43.81	NO	NO	10.50

* - Selected as a COPC

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

*** - Background samples are as follows: MW4-04, BGMW-02, BGMW-01, MW26-03, MW3-06, MW5-02, MW5-03, MW19-01, MW1-03, MW5-08, MW11-03

TABLE 1-29

OCCURRENCE AND DISTRIBUTION OF INORGANICS IN SURFACE WATER AT SITE 17
OU-9 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY
(ug/L)

	BACKGROUND***				SITE-RELATED					
SUBSTANCE	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	UTL**	2 X AVERAGE CONCENTRATION	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	AVERAGE CONCENTRATION	MEAN > 2 X BKGD?	MEAN > BACK UTL?	REPRESENTATIVE CONCENTRATION
ALUMINUM *	5 / 6	102 - 1540	2.2E+03	904.20	6 / 6	124 - 9680	3027	YES	YES	6348
ARSENIC *	1 / 6	9 - 9	1.3E+01	5.32	3 / 6	6.8 - 88.6	20.03	YES	YES	48.28
BARIUM	6 / 6	16.3 - 36.4	2.4E+03	55.05	6 / 6	17.2 - 331	165.65	YES	NO	290.13
CADMIUM	3 / 6	0.22 - 1.2	1.7E+00	0.70	1 / 6	1.3 - 1.3	0.31	NO	NO	0.71
CALCIUM	1 / 6	0.18 - 0.18	3.2E-01	0.23	1 / 6	3.2 - 3.2	0.96	YES	YES	1.94
CHROMIUM	6 / 6	462 - 177000	2.3E+05	71114	6 / 6	10200 - 52600	27000	NO	NO	52600
COBALT *	3 / 5	0.72 - 2.6	4.4E+00	1.78	2 / 4	13.9 - 20.4	9.69	YES	YES	20.40
COPPER	6 / 6	0.81 - 2	5.2E+00	3.10	5 / 6	0.67 - 6.2	2.79	NO	NO	6.20
IRON	5 / 6	1.1 - 17.8	3.0E+02	11.92	6 / 6	3.5 - 65.1	20.72	YES	NO	39.70
LEAD *	6 / 6	160 - 23100	3.0E+04	9577	6 / 6	2480 - 170000	42570	YES	YES	95730
MAGNESIUM	2 / 6	4.4 - 16	2.2E+01	7.31	5 / 6	1.6 - 77.1	24.18	YES	YES	50.98
MANGANESE	6 / 6	369 - 559000	7.0E+05	190703	6 / 6	4930 - 118000	26908	NO	NO	63886
MERCURY	6 / 6	14 - 203	3.8E+02	172.43	6 / 6	81.2 - 646	299.53	YES	NO	646
NICKEL	2 / 6	0.023 - 0.028	2.3E-01	0.12	3 / 6	0.05 - 0.2	0.13	YES	NO	0.20
POTASSIUM	6 / 6	2.1 - 7.9	8.2E+01	10.23	6 / 6	3.3 - 11	8.02	NO	NO	11
SODIUM	5 / 6	251 - 259000	3.2E+05	88923	6 / 6	3190 - 54700	13788	NO	NO	30456
THALLIUM	2 / 6	3.5 - 9.2	1.4E+01	6.27	3 / 6	4.6 - 15.7	5.21	NO	NO	9.72
VANADIUM	3 / 3	11150 - 4340000	1.3E+07	2912233	6 / 6	26500 - 3000000	701617	NO	NO	1685764
ZINC	3 / 6	3.5 - 5.5	2.8E+01	5.90	4 / 6	3.3 - 12.5	4.62	NO	NO	7.98

* - Selected as a COPC

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

*** - Background samples are as follows: BGSW01, BGSW02, BGSW04 through BGSW07

TABLE 1-30
OCCURRENCE AND DISTRIBUTION OF ORGANICS IN SURFACE WATER AT SITE 17
OU-9 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY
(ug/L)

SUBSTANCE	BACKGROUND**			SITE-RELATED		
	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	REPRESENTATIVE CONCENTRATION	FREQUENCY OF DETECTION	RANGE OF POSITIVE DETECTION	REPRESENTATIVE CONCENTRATION
PYRENE*	0 / 6	-	-	2 / 6	1 - 1	1

* - Selected as a COPC
** - Background samples are as follows: BGSW01, BGSW02, BGSW04 through BGSW07

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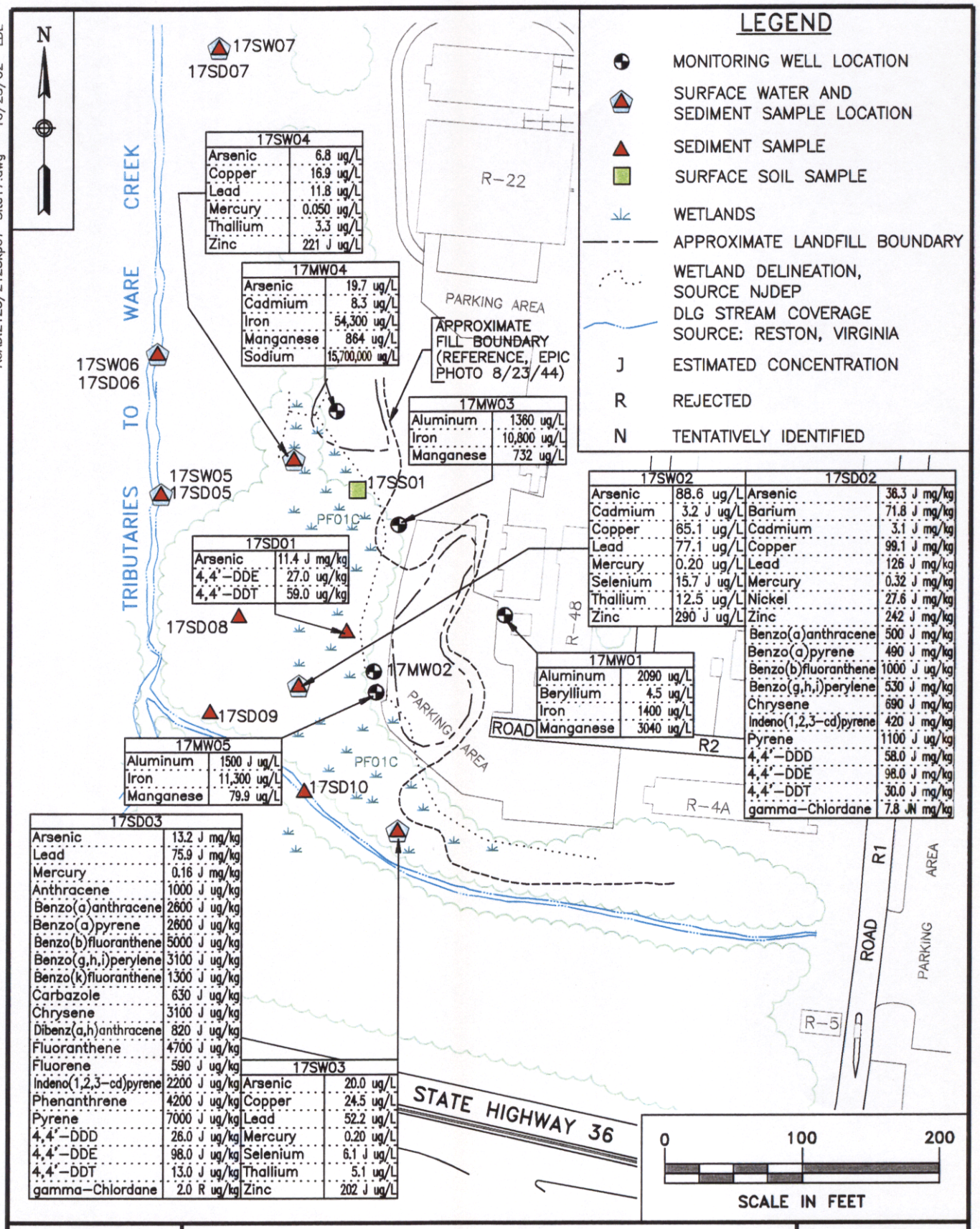

17SW04	
Arsenic	6.8 ug/L
Copper	16.9 ug/L
Lead	11.8 ug/L
Mercury	0.050 ug/L
Thallium	3.3 ug/L
Zinc	221 J ug/L

17MW04	
Arsenic	19.7 ug/L
Cadmium	8.3 ug/L
Iron	54,300 ug/L
Manganese	864 ug/L
Sodium	15,700,000 ug/L

17MW03	
Aluminum	1360 ug/L
Iron	10,800 ug/L
Manganese	732 ug/L

17SW02	
Arsenic	88.6 ug/L
Cadmium	3.2 J ug/L
Copper	65.1 ug/L
Lead	77.1 ug/L
Mercury	0.20 ug/L
Selenium	15.7 J ug/L
Thallium	12.5 ug/L
Zinc	290 J ug/L

17SD02	
Arsenic	36.3 J mg/kg
Barium	71.8 J mg/kg
Cadmium	3.1 J mg/kg
Copper	99.1 J mg/kg
Lead	126 J mg/kg
Mercury	0.32 J mg/kg
Nickel	27.6 J mg/kg
Zinc	242 J mg/kg
Benzo(a)anthracene	500 J mg/kg
Benzo(a)pyrene	490 J mg/kg
Benzo(b)fluoranthene	1000 J ug/kg
Benzo(g,h,i)perylene	530 J mg/kg
Chrysene	690 J mg/kg
Indeno(1,2,3-cd)pyrene	420 J mg/kg
Pyrene	1100 J ug/kg
4,4'-DDD	58.0 J mg/kg
4,4'-DDE	98.0 J mg/kg
4,4'-DDT	30.0 J mg/kg
gamma-Chlordane	7.8 JN mg/kg

17SD01	
Arsenic	11.4 J mg/kg
4,4'-DDE	27.0 ug/kg
4,4'-DDT	59.0 ug/kg

17MW01	
Aluminum	2090 ug/L
Beryllium	4.5 ug/L
Iron	1400 ug/L
Manganese	3040 ug/L

17MW05	
Aluminum	1500 J ug/L
Iron	11,300 ug/L
Manganese	79.9 ug/L

17SD03	
Arsenic	13.2 J mg/kg
Lead	75.9 J mg/kg
Mercury	0.16 J mg/kg
Anthracene	1000 J ug/kg
Benzo(a)anthracene	2600 J ug/kg
Benzo(a)pyrene	2600 J ug/kg
Benzo(b)fluoranthene	5000 J ug/kg
Benzo(g,h,i)perylene	3100 J ug/kg
Benzo(k)fluoranthene	1300 J ug/kg
Carbazole	630 J ug/kg
Chrysene	3100 J ug/kg
Dibenz(a,h)anthracene	820 J ug/kg
Fluoranthene	4700 J ug/kg
Fluorene	590 J ug/kg
Indeno(1,2,3-cd)pyrene	2200 J ug/kg
Phenanthrene	4200 J ug/kg
Pyrene	7000 J ug/kg
4,4'-DDD	26.0 J ug/kg
4,4'-DDE	98.0 J ug/kg
4,4'-DDT	13.0 J ug/kg
gamma-Chlordane	2.0 R ug/kg

17SW03	
Arsenic	20.0 ug/L
Copper	24.5 ug/L
Lead	52.2 ug/L
Mercury	0.20 ug/L
Selenium	6.1 J ug/L
Thallium	5.1 ug/L
Zinc	202 J ug/L

TETRA TECH NUS, INC.

CONCENTRATIONS ABOVE SCREENING LEVELS
SITE 17 – LANDFILL
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

SCALE: AS NOTED
FILE: 2128kp07.dwg
3/18/03 LDL PHL
REV 1 DATE 10/25/02
FIGURE NUMBER
FIGURE 1-16

The PAH compounds dibenz(a,h)anthracene, acenaphthene, acenaphthylene, naphthalene, and anthracene (concentration range 4 to 1,000 ug/kg) were found in at least one Site 17 sediment sample. The maximum concentrations of PAHs were observed in sample 17SD03 with levels greater than the range of background samples.

Bis (2-Ethylhexyl) phthalate, di-n-butyl phthalate, diethyl phthalate, and butylbenzyl phthalate were detected in Site 17 sediment samples. Bis (2-Ethylhexyl) phthalate was present at the highest concentrations (9,400 ug/kg in sample 17 SD 03 and 4,400 ug/kg in 17 SD 02). Aroclor 1260 was detected in 17 SD 02 at 80 ug/kg and in 17 SD 03 at 31 ug/kg. Aroclor 1248 was detected at 17 SD 10 at 57 ug/kg. Aroclor 1254 was also detected at 17 SD 10 at a concentration of 120 ug/kg. The Aroclor 1260 result for 17SD03 was qualified rejected (R) based on data validation and cannot be used for risk assessment. 4-Methylphenol (420 to 820 ug/kg), isophorone (75 ug/kg), endosulfan II (range) alpha-chlordane (4.5 ug/kg to 14 ug/kg), and methoxychlor (1.6 to 3.9 ug/kg) were detected in at least one Site 17 sediment sample. The following pesticide compounds were detected in one or more Site 17 sediment samples: 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, and gamma-chlordane. The highest levels of pesticides were found primarily at sample locations 17SD01 through 17SD03 and 17SD07.

The 1995 RI sediment samples collected at Site 17 were also analyzed for moisture, pH, and TOC. Two sediment samples (17SD01 and 17SD04) contained pH levels exceeding maximum sediment background levels. The 1996 RI Addendum samples were also analyzed for TOC and percent solids. Sample 17SD07 showed TOC (149,000 mg/kg).

Groundwater

Four groundwater samples (17GW01, 17GW03, 17GW04, and 17GW05) were collected at Site 17. Table 1-28 presents the occurrence and distribution of inorganic chemicals detected in Site 17 groundwater samples and compares them to background. No organic compounds were detected, and most metals were present in Site 17 samples at concentrations similar to background. Arsenic, barium, cadmium, and iron were detected in sample 17GW04 at levels greater than the ranges of background samples. This sample had a very high sodium level (1.6 percent).

Miscellaneous parameter analyses of four groundwater samples at Site 17 consisted of ammonia, BOD, COD, chlorides, sulfates, TOC, phosphates, and turbidity. 17MW03 and 17MW01 (downgradient) along with 17MW05 (crossgradient and adjacent to the landfill) revealed greater concentrations of indicator parameters than 17MW01 (upgradient). COD, TOC, and phosphates were detected in 17MW04 and 17MW05 in concentrations greater than maximum background levels. 17MW04 also contained ammonia, chloride, and sulfate concentrations above background. Chloride concentrations in 17MW04 were very high (31,000 mg/L). Sulfate was detected at levels exceeding maximum background levels in 17MW01, 17MW03, and 17MW04. With the exception of very high chloride concentrations in 17MW04, none of the other indicator

parameters were high enough to be within a range typically associated with concentrated landfill leachate (Chian and DeWalle, 1976; ASCE, 1976; Brunner and Keller, 1972).

Surface Water

Three surface water samples (17SW02 through 17SW04) were collected at Site 17 in 1995, and three surface water samples (17SW05 through 17SW07) were collected in 1996. Tables 1-29 and 1-30 present the occurrence and distribution of inorganic and organic chemicals detected in Site 17 surface water samples and compares them to background. Facility-wide background samples (BGSW01, BGSW02, and BGSW04 through BGSW07) were used for COPC selection for the human health risk assessment. Only those background samples obtained from this watershed (BGSW05 through BGSW07) however were used for the ecological risk assessment.

Higher concentrations of most metals were seen in sample 17SW02. Metals present in this sample at levels greater than two times background included aluminum, arsenic, barium, cadmium, chromium, cobalt, copper, iron, lead, mercury, thallium, vanadium, and zinc. Elevated levels were also observed for aluminum, arsenic, barium, iron, chromium, lead, manganese, mercury, vanadium, and zinc in 17SW03 and barium and zinc in 17SW03. The presence of elevated levels of aluminum in 17SW02 and 17SW03 suggested that a significant portion of the metals in these samples may have been present in a suspended rather than dissolved form. No elevated levels of metals were detected in the 1996 RI Addendum surface water samples.

The only organic compound detected in surface water samples was bis(2-ethylhexyl) phthalate at a concentration of 1 ug/L at sample location 17SW06. This compound was not detected in background samples.

Miscellaneous parameter analyses for three surface water samples collected at Site 17 in 1995 consisted of ammonia, BOD, COD, chlorides, nitrates, hardness, TOC, phosphates, and turbidity. All the indicator parameters except for nitrates were detected above maximum surface water background concentrations in all samples. Nitrate concentrations in sample 17SW04 exceeded background levels. None of the indicator parameters detected in the surface water samples were high enough to be within range typically associated with concentrated landfill leachate (Chian and DeWalle, 1976; ASCE, 1976; Brunner and Keller, 1972).

1996 samples were analyzed for alkalinity, BOD, COD, total dissolved solids, hardness, and total suspended solids. Results indicated elevated levels of alkalinity, total dissolved solids, and hardness in sample 17SW07 when compared to the other Site 17 samples; however, no background samples were analyzed for these parameters.

1.3.5.3.3 Contaminant Fate and Transport

The behavior of contaminants in the environment at Site 17 is described in this subsection. Analytical results at Site 17 indicated detectable amounts of PAHs, pesticides, and PCB compounds in sediment and several inorganics present in groundwater, sediment, and surface water.

Low levels of PCBs, PAHs, phthalates, and certain pesticides were detected in sediment. The detected PAHs and PCBs are typically strongly bound to organic matter and are not expected to migrate significantly except in conjunction with surface water erosional patterns. Pesticides are also considered of low mobility when absorbed onto high-carbon content substrates such as natural organic material in soil or sediments.

Bis (2-Ethylhexyl) phthalate was detected at a maximum concentration in 17SD03 and was also detected in the surface water from the same location. This compound possesses a high soil-water distribution coefficient (K_d) and fairly low solubility. Adsorption onto suspended solids and particulate matter and complexation with natural organic substances are probably the most important environmental transport processes for bis (2-ethylhexyl) phthalate. Phthalate esters are commonly found in freshwater and saltwater sediment samples and readily interact with the fulvic acid present in humic substances in water and soil, forming a complex that is readily soluble in water (Clement Associates, 1985).

Levels of metals were slightly greater than background in one Site 17 sediment sample and in a corresponding surface water sample. These metals may or may not have been present in soluble form because the surface water sample exhibited several minerals that are normally insoluble, which suggests that transport as suspended solids was possible. Organic compounds have a strong tendency to adsorb onto soil/sediment particles, a factor that greatly reduces their mobility. Surface water erosional transport may have been the principal mechanism for migration of the detected organic compounds and metals in sediment.

One groundwater sample, 17GW04, exhibited slightly elevated levels of several metals. In this well and others at Site 17, low turbidity readings were achieved by sampling using dedicated low-flow bladder pumps, so that results should have represented the presence of dissolved metals. Very high levels of sodium chloride (approximately 5 percent by weight) were present in this groundwater sample, which was collected from monitoring well 17MW04.

For the classes of detected chemicals, environmental persistence varies considerably. PCBs and pesticides found at the site are considered highly persistent and undergo biodegradation at slow rates that vary according to the chlorinated isomer substitution pattern for each type or PCB congener in Aroclor mixtures. PAHs can be biodegraded, but the rate of degradation is slower for the higher molecular weight compounds.

The rate of degradation depends on a number of factors including oxygen, carbon sources, nutrients, pH, moisture, and appropriate acclimatized organisms.

No VOCs were detected in the groundwater, surface soil, surface water, or sediment. Organic contaminant species of low solubility and mobility (PAHs, pesticides, and PCBs) were detected at low levels in sediment but were not found in surface water or surface soil. Phthalates were detected at elevated levels in two sediment samples, with a corresponding phthalate present at a trace level in one of the surface water samples from the same location.

Elevated levels of certain metals were noted in sediment and surface water samples locations within the marsh area that is downslope and west of the edge of the landfill. Overland flow from the site drains toward the salt marsh north of the site.

Most inorganic constituents detected in Site 17 groundwater samples were within concentration ranges of background groundwater samples. One monitoring well (17MW04) showed slightly elevated levels of arsenic, barium, cadmium, and iron, which, given the low turbidity readings observed, may have indicated the potential for groundwater transport of one or more of these metals. The same well also exhibited sodium chloride at levels of approximately 5 percent (a concentration comparable to that of seawater, which is approximately 2.8 percent). One monitoring well (17MW04) at the northwestern end of the landfill contained several metals at slightly elevated levels. This well was also found to contain concentrations of sodium chloride in the same general range as seawater. Arsenic, barium, and iron were detected at elevated levels in this well (and were also found at elevated levels in two sediment and three surface water samples). Monitoring wells near the western edge of the landfill did not reveal elevated levels of metals.

Several classes of organic compounds detected in sediment are considered to be species of low mobility (PAHs, pesticides, and PCBs) that are not expected to transport quickly from source areas. The occurrence of these compounds in sediment may have been the result of gradual migration from the landfill through seeps and erosional dispersion; however, surface water did not reveal the presence of these contaminants. Phthalate esters detected in two sediments and one surface water exhibit a tendency to bind to organic matter in soil. These compounds can be rendered mobile in surface water when complexed with soluble forms of humic substances. Phthalate esters are commonly detected in sediments and might have been related to migration from the landfill through seeps or overland flow.

Elevated levels of metals were detected at three surface water locations. Several of the same metals were present at elevated levels in sediment samples from the same locations. Elevated levels of aluminum in these surface water locations suggested that metals may have been present in association with suspended solids. The presence of these metals might have been related to migration from the landfill through seeps or overland flow.

1.3.5.3.4 Baseline Human Health Risk Assessment

Surface soil, groundwater, sediment, and surface water were sampled at Site 17. The potential receptors considered for this site were current industrial and future industrial, residential, and recreational receptors. Appendix B-4 contains summary tables of the estimated human health risks for Site 17.

The RME cancer risks associated with a future residential (groundwater) exposure scenario were at the upper end of the target risk range of 1E-04 to 1E-06. The CTE cancer risks for the future residential receptor were also at the upper end of the target acceptable risk range of 1E-04 to 1E-06. Arsenic (via ingestion) is the principal COPC that contributed to the cancer risks for this exposure scenario. The RME cancer risks associated with future industrial (groundwater) exposure were at the upper end of the target acceptable risk range of 1E-04 to 1E-06. Arsenic (via ingestion) is the principal COPC that contributed to the cancer risks for this exposure scenario.

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

The estimated RME cancer risk for the future industrial employee is at the upper end of the target acceptable risk range, based mainly on ingestion of groundwater. The estimated RME cancer risk for the future residential receptor is at the upper end of the target risk range, based mainly on ingestion of groundwater. The estimated CTE cancer risk for the future residential receptor is also at the upper end of the target risk range, based mainly on ingestion of groundwater. The estimated RME non-cancer HI for the future residential receptor exceeds 1.0, based mainly on ingestion of groundwater. The estimated CTE cancer risk for the future residential receptor exceeds 1.0, based mainly on ingestion of groundwater.

Lead concentrations detected at the site during the RI were below the EPA guidelines and are not expected to be associated with a significant increase in blood-lead levels based on the results of the IEUBK Lead Model (v. 0.99). IEUBK lead model results indicate that less than five percent of the modeled population (resident child) would be expected to develop a blood lead concentration greater than 10 ug/dl.

Arsenic was detected in three of four Site 17 groundwater samples at concentrations of 4.2 ug/l, 7.0 ug/l, and 19.7 ug/l. Arsenic was detected in one of three background groundwater samples at a concentration of 5.1 ug/l. One of the Site 17 concentrations, 19.7 ug/l, is clearly elevated above background. The other two concentrations are similar to the background concentration. The Site 17 average groundwater concentration for arsenic is greater than the average background concentration (5.6 ug/l versus 8.14 ug/l).

1.3.5.3.5 Ecological Risk Assessment

Site 17 is a former landfill located a few hundred feet from Site 6, at the edge of the marsh. The results of the RI ecological risk assessment showed that several inorganics and organics, primarily PAH compounds were present in surface water and sediment near the site in excess of screening values. Concentrations of several metals in surface water and several PAHs in sediments collected near the Site 17 landfill toe were significantly elevated. Because data from the 1993 SI and 1996 RI indicated minimal impacts to groundwater, erosion and overland runoff from the landfill toe contaminant migration pathways were considered possible. However, surface water and sediment samples had not been collected farther away from the site in the marsh. As a result, additional surface water and sediment samples were collected to determine the extent of the impacts of landfill-related contaminants on the marsh.

In Site 17 surface water, only barium significantly exceeded its threshold value, but the background concentration of this inorganic was higher than the average Site 17 concentration. HQ values for inorganics in marsh sediments near Site 17 were all low. Sediment concentrations of aluminum, cobalt, and vanadium, which had no suitable ETs, were significantly elevated in sample 17SD07, but surface water concentrations of these metals at the same location were not elevated and surface water and sediment concentrations of these contaminants in samples collected in the same general area as 17SD07 but closer to the landfill were all much lower. Only one organic bis (2ethylhexyl) phthalate found in Site 17 sediments exceeded its corresponding background concentration, and the HQ value was low.

In summary, significantly elevated contaminant concentrations and exceedances of threshold values from the 1995 RI report ecological risk assessment were not prevalent in surface water and sediment samples collected farther into marsh from Site 17. Therefore, impacts of contaminants from Site 17 on the marsh are minimal. Elevated concentrations of some inorganics were present but were confined primarily to ubiquitous metals in only a few samples collected relatively far from the landfill. This indicates that these elevated concentrations are most likely only indicative of contaminant "hot spots" that do not stem from landfill-related releases. Additive impacts on the watershed and cumulative effects from contaminants from other sites on marsh receptors are also unlikely. Concentrations of contaminants that bioaccumulate and biomagnify were relatively low. Thus, potential risks to organisms from exposure via the food chain (e.g., wading birds) appear to be highly unlikely. Concentrations of contaminants in surface water and sediments in the two samples collected upstream from the marsh were low and, as a result, impacts to the marsh from upstream sources appear to be negligible.

The data indicate that the assessment endpoint chosen, the maintenance of receptor populations in the marsh, does not appear to be compromised from Site 17 or upstream contaminants; therefore, ecological risks to the marsh from Navy-related areas appear to be insignificant. Remedial action based on ecological risk concerns or additional, more focused ecological studies are therefore unwarranted.

Site-Specific Uncertainties

Significantly, elevated concentrations of some inorganics (aluminum, cobalt, and vanadium) were detected in sediment sample 17SD07. Yet, this sample was collected farthest from Site 17, and samples (surface water and sediment) collected in the same general area of the marsh but closer to the site did not have elevated concentrations of those metals. Therefore, this area appears to be a "hot spot" that is unrelated to the site. Although other RI sites are located in the Waterfront (Sites 15, 12 and 6), they were determined to have minimal ecological impacts on the surrounding areas in the RI report. Therefore, although these constituents do not appear to be due to Site 17, their presence introduces uncertainty into the assessment. Additionally, the lack of adequate sediment toxicity data for aluminum and vanadium introduces uncertainty into the results for Site 17.

Despite heavier than average rainfall, sampling conditions precluded the collection of surface water samples at the RI Addendum sampling locations closest to the landfills. Although the definitive nature of the remainder of the data set heavily mitigates the lack of surface water data at those sampling locations, uncertainty is introduced into the ecological risk assessment because of this data gap.

Potential risks were often considered to be low in the assessment if HQ values were low although, theoretically, the potential for risk exists if a threshold is exceeded at all. These conclusions were made because thresholds are based on data from laboratory studies that do not take into account ameliorating physico-chemical factors in the environment. Although the HQ cannot be interpreted as a probabilistic indicator of risk (i.e., an HQ of 10 cannot be assumed to correlate to 10 times more risk than an HQ of 1), a slight exceedance of a threshold generally indicates less potential risk than a major exceedance of a threshold. It should be noted, however, that contaminants with low HQ values were assessed on an individual basis for their potential for risk. For these reasons, it is unlikely that significant potential risks exist from the contaminants that only slightly exceeded surface water or sediment thresholds. Nonetheless, the conclusions that minor exceedances result in low potential risks introduces uncertainty into the results of the ecological risk assessment.

1.4 QUALITATIVE EVALUATION OF HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT RESULTS

This section considers potential impacts of new or changed (since 1998) ARARs on potential risk posed to human health. The chemical-specific ARARs used in the RI and RI Addendum identified for each of the sites (6, 12, 15, and 17) 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 1999 RI and 1998 RI Addendum risk assessment estimations) is not necessary for any of these sites.

The procedures used for this evaluation follow the guidance from EPA for performing a CERCLA Five-Year review and are provided in Appendix E, along with a tabular listing of the "old" and "new" criteria. The conclusions form this review follow, listed by Site.

Site 6

There are no changes to the sediment HHRA conclusions based on the updated documents that would be used as benchmarks to select COPCs. However, a comparison of the maximum concentration of the parameters in the sediment with the NJDEP Guidance for Sediment Quality Evaluations criteria would eliminate antimony and thallium from the list of COPCs and would add cadmium, chromium, nickel, and zinc to the list of COPCs for the ERA conclusions.

There are no changes to the groundwater HHRA conclusions based on the change in the arsenic criteria that would be used as the benchmark to select COPCs.

There are minor changes to the surface water HHRA conclusions based on the updated documents that would be used as benchmarks to select COPCs. A comparison of the maximum concentration of the parameters in the surface water with the USEPA AWQCs and New Jersey State Surface Water Quality Standards would eliminate cadmium from the list of COPCs and would add barium, copper, manganese, and zinc to the list of COPCs.

Site 12

The remediation work (excavation and disposal) at Site 12 was completed in accordance with the work plan and Federal, state, and local regulations. Based on the USEPA and NJDEP approval, Site 12 has met the applicable requirements for closure and the remediation at the site is complete (Foster Wheeler Environmental Corporation, 1999).

Site 15

There are several changes to the surface soil HHRA conclusions based on the updated documents that would be used as benchmarks to select COPCs. A comparison of the maximum concentration of the parameters in the surface soil with the criteria would eliminate antimony, beryllium, cadmium, copper,

lead, and zinc from the list of COPCs and would add vanadium to the list of COPCs. There are no changes to the COPC list for the organics in the surface soil.

There are two changes to the subsurface soil HHRA conclusions based on the updated documents that would be used as benchmarks to select COPCs. A comparison of the maximum concentration of the parameters in the subsurface soil with the criteria would eliminate cadmium from the list of COPCs and would add vanadium to the list of COPCs. There are no changes to the COPC list for the organics in the subsurface soil.

There are a several changes to the sediment HHRA conclusions based on the updated documents that would be used as benchmarks to select COPCs. Arsenic, thallium, vanadium, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene would be added to the list of COPCs for the HHRA conclusions. No substances would be eliminated from the list of COPCs. Comparison of the maximum concentration of the parameters in the sediment with the NJDEP Guidance for Sediment Quality Evaluations criteria would add arsenic, cadmium, chromium, copper, lead, mercury, silver, thallium, zinc, 4,4-DDD, 4,4-DDE, 4,4-DDT, alpha-chlordane, gamma-chlordane, endrin, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, fluoranthene, indeno(1,2,3-cd)pyrene, phenanthrene, and pyrene to the list of COPCs for the ERA conclusions.

There is one change to the surface water HHRA conclusions based on the updated documents that would be used as benchmarks to select COPCs. A comparison of the maximum concentration of the parameters in the surface water with the USEPA AWQCs and New Jersey State Surface Water Quality Standards would eliminate mercury from the list of COPCs.

Site 17

There are two changes to the surface soil HHRA conclusions based on the updated documents that would be used as benchmarks to select COPCs. A comparison of the maximum concentration of the parameters in the surface soil with the criteria would eliminate 4,4-DDT from the list of COPCs and would add vanadium to the list of COPCs. There are no changes to the COPC list for the organics in the surface soil.

There are a several changes to the sediment HHRA conclusions based on the updated documents that would be used as benchmarks to select COPCs. Vanadium would be added to the list of COPCs for the HHRA conclusions. Antimony, selenium, thallium, 4,4-DDD, 4,4-DDE, 4,4-DDT, alpha-chlordane, the aroclors, endosulfan II, endrin, gamma-chlordane, methoxychlor, 2-methylnaphthalene, 4-methylphenol, acenaphthene, acenaphthylene, anthracene, bis(2-ethylhexyl)phthalate, butylbenzylphthalate, carbazole,

chrysene, di-n-butylphthalate, dibenzofuran, diethylphthalate, fluoranthene, fluorene, isophorone, naphthalene, phenathrene, pyrene, and toluene would be eliminated from the list of COPCs. In addition, a comparison of the maximum concentration of the parameters in the sediment with the NJDEP Guidance for Sediment Quality Evaluations criteria would add cadmium, chromium, nickel, and zinc to the list of COPCs for the ERA conclusions.

There are minor changes to the groundwater HHRA conclusions based on the updated documents that would be used as benchmarks to select COPCs. A comparison of the maximum concentration of the parameters in the surface water with the NJDEP Ground Water Quality Standards would eliminate chromium, copper, lead, and vanadium from the list of COPCs and would add aluminum, cadmium, iron, and manganese to the list of COPCs.

There are two changes to the surface water HHRA conclusions based on the updated documents that would be used as benchmarks to select COPCs. A comparison of the maximum concentration of the parameters in the surface water with the USEPA AWQCs and New Jersey State Surface Water Quality Standards would eliminate pyrene from the list of COPCs and would add thallium to the list of COPCs.

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 9 sites. 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 Sites 6, 12, 15, and 17 are presented in Section 2.6.

2.1 POTENTIAL ARARs AND TBCs

ARARs are promulgated, enforceable federal and state environmental or public health requirements that are determined to be legally applicable or relevant and appropriate to the hazardous substances, remedial actions, or other circumstances at a CERCLA site. The National Contingency Plan (NCP), Section 300.430, states that on-site remedial actions at CERCLA sites must meet ARARs unless there are grounds for invoking a waiver. A waiver is required if ARARs cannot be achieved. The two classes of 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 (standards and guidance to be considered) are non-promulgated advisories or guidance issued by federal or state governments that are not legally binding but may be considered during development of remedial alternatives. For example, EPA Health Advisories and Reference Doses are non-promulgated criteria 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

TABLE 2-1
POTENTIAL FEDERAL CHEMICAL-SPECIFIC ARARs AND TBCs
OPERABLE UNIT 9 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 9 sites. MCLs can be used to derive potential soil clean-up levels.
Resource Conservation and Recovery Act (RCRA) - Groundwater Protection Standard (40 CFR 264.94)	Potentially Relevant and Appropriate	The RCRA Groundwater Protection Standard is established for groundwater monitoring of RCRA-permitted treatment, storage, or disposal facilities. The standard is set at either an existing or proposed RCRA MCL, background concentration, or an alternate concentration limit (ACL) protective of human health and the environment.	RCRA MCLs may be used or ACLs may be developed to identify levels of contamination in the aquifer above which human health and the environment are at risk and to provide an indicator when corrective action is necessary.
RCRA Land Disposal Restrictions (40 CFR 268)	Potentially Applicable	These regulations identify hazardous wastes that are restricted from land disposal and establish waste analysis and recordkeeping requirements and "treatment standards" (concentration levels or methods of treatment) that wastes must meet in order to be eligible for land disposal.	Contaminated soil must be analyzed and disposed in accordance with the requirements of these regulations. If necessary, soils will be treated to attain applicable "treatment standards" prior to placement in a landfill or other land disposal facility. This requirement would be considered for alternatives involving land disposal.
Clean Water Act - Ambient Water Quality Criteria (AWQCs)	To Be Considered	AWQCs are non-promulgated health-based surface water quality criteria that have been developed for carcinogenic and non-carcinogenic compounds for the protection of human health. AWQCs have also been developed for the protection of aquatic organisms.	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
OU 9 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.	If any of the OU 9 sites are to be considered for eventual residential use, then the screening value may be used to assess whether site-specific lead levels require further evaluation and possible remediation.
EPA Groundwater Protection Strategy	To Be Considered	Provides classification and restoration goals for groundwater based on its vulnerability, use, and value.	This strategy is considered in conjunction with the federal SDWA and state Groundwater Protection Rules to determine groundwater clean-up levels.
EPA Risk Reference Doses (RfDs)	To Be Considered	RfDs are dose levels developed by EPA for use in estimating the non-carcinogenic risk resulting from exposure to toxic substances.	RfDs 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 Health Advisories and Acceptable Intake Health Assessment Documents	To Be Considered	Intended for use in qualitative human health evaluation of remedial alternatives.	These advisories and health assessment documents 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 6 and 17 landfills are estimated to be much less than 2 million cubic feet in capacity. However, soil gas studies and measurement of methane concentrations at the landfill surfaces need to be conducted during the pre-design phase to determine whether landfill gas controls need to be included as part of the control systems.

TABLE 2-2
POTENTIAL STATE CHEMICAL-SPECIFIC ARARs AND TBCs
OPERABLE UNIT 9 FEASIBILITY STUDY
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION IN THE FS
New Jersey Ground Water Quality Standards (GWQs) (N.J.A.C. 7:9-6)	Applicable	This regulation establishes the rules to protect ambient groundwater quality through establishing groundwater protection and clean-up standards and setting numerical criteria limits for discharges to groundwater. The Groundwater Quality Criteria (GWQCs) [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 Surface Water Quality Standards (SWQSs).	Because contaminated groundwater is present underneath OU 9 sites in excess of GWQSs, these regulations will be considered in determining groundwater action levels. Application for Classification Exception Area (CEA) may be required if GWQSs will not be met during the term of proposed remediation. The CEA procedure ensures that designated groundwater uses at remediation sites are suspended for the term of the CEA.
New Jersey SWQS (N.J.A.C. 7:9B)	Applicable	These standards establish rules to protect and enhance surface water resources, define surface water classifications and uses, and establish water-quality-based criteria, and effluent discharge limitations. The Surface Water Quality Criteria (SWQCs) (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 Act (N.J.A.C. 7:10)	Potentially Relevant and Appropriate	These regulations were promulgated to assure the provision of safe drinking water to consumers in public community water systems. MCLs [N.J.A.C. 7:10-16] 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 9 sites. MCLs can be used to derive potential soil clean-up levels.
New Jersey Soil Cleanup Criteria	To Be Considered	These are non-promulgated soils clean-up criteria for residential direct contact, non-residential direct contact, and impact to groundwater (through leaching).	These criteria will be considered in the development of soil clean-up goals.

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 9 sites is not currently used for drinking water, and potable water is provided by a public water supply. Federal chemical-specific ARARs such as the Safe Drinking Water Act (SDWA) Maximum Containment Levels (MCLs) [40 Code of Federal Regulations (CFR) 141] and the Resource Conservation and Recovery Act (RCRA) MCLs and alternate concentration limits (ACLs) (40 CFR 264.94) may be relevant and appropriate requirements in establishing groundwater 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 Sites include the New Jersey Ground Water Quality Standards (GWQSs) (N.J.A.C. 7:9-6) that regulate groundwater quality and the Surface Water Quality Standards (SWQSs) (N.J.A.C. 7:9B) that provide guidelines for surface water quality. These state ARARs may potentially be relevant and appropriate and may be used to establish clean-up levels that are protective of human health and the environment.

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

2.1.2 Potential Location-Specific ARARs and TBCs

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

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).

TABLE 2-3
POTENTIAL FEDERAL LOCATION-SPECIFIC ARARs AND TBCs
OPERABLE UNIT 9 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.	Remedial alternatives that involve excavation or deposition of materials will include all practicable means of minimizing harm to the wetlands adjacent to the OU 9 sites. Wetlands protection consideration will be incorporated into the planning, decision making, and implementation of remedial alternatives.
Floodplains Executive Order (E.O. 11988) & 40 CFR 6, App. A (Policy on Implementing E.O. 11988)	Potentially Applicable	Federal agencies are required to reduce the risk of flood loss, minimize impact of floods, and restore and preserve the natural and beneficial value of floodplains.	The potential effects on floodplains will be considered during the development and evaluation of remedial alternatives. All practicable measures will be taken to minimize adverse effects on floodplains.
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 9 sites.
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 9.
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 9.

TABLE 2-4
POTENTIAL STATE LOCATION-SPECIFIC ARARs AND TBCs
OPERABLE UNIT 9 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.	Remedial alternatives will be developed to avoid activities that would be detrimental to the wetlands located adjacent to OU 9 sites.
New Jersey Freshwater Wetlands Protection Act Rules, Mitigation (N.J.A.C. 7:7A-14)	Potentially Applicable	This regulation requires mitigation of the disturbed wetlands or filled open water. Generally requires the restoration, creation, or enhancement of the area or donations to the Mitigation Bank of equal ecological value.	If a remedial alternative results in the loss of wetlands through dredging, filling, or construction activities, mitigation measures will need to be incorporated into the alternative's design.
New Jersey Flood Hazard Area Control (N.J.A.C. 7:14)	Potentially Applicable	These regulations control development in floodplains and water courses that may adversely affect the flood-carrying capacity of these features, subject new facilities to flooding, increase storm water runoff, degrade water quality, or result in increased sedimentation, erosion, or environmental damage.	This requirement is applicable to remedial alternatives that may adversely affect floodplains adjacent to OU 9 sites.
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 9. However, if remedial alternatives employs an on-site or on-base treatment scheme, remediation activities will need to be consistent with these requirements.

The Federal Fish and Wildlife Coordination Act and the Endangered Species Act are potential ARARs that are promulgated protect to 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 Sites 6 and 17 are military landfills, two OSWER directives are TBC guidance documents that may be considered in developing remedial alternatives that employ presumptive remedies. These guidance documents are OSWER Directive 9355.0-62FS, Application of the CERCLA Municipal Landfill Presumptive Remedy to Military Landfills (Interim Guidance) (USEPA, 1996); and OSWER Directive 93550.0-49FS, Presumptive Remedy for CERCLA Municipal Landfill Sites (USEPA, 1993).

TABLE 2-5
POTENTIAL FEDERAL ACTION-SPECIFIC ARARs AND TBCs
OPERABLE UNIT 9 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 9 FEASIBILITY STUDY
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY
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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 Sites 6 and 17.
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 Sites 6 and 17.

TABLE 2-6
POTENTIAL STATE ACTION-SPECIFIC ARARs AND TBCs
OPERABLE UNIT 9 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.

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 Sites 6, 12, 15, and 17 is presented in Sections 2.6 through 2.9, respectively.

2.3 METHOD USED FOR DEVELOPMENT OF PRELIMINARY REMEDIATION GOALS

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

A range of PRGs for each site was developed for soil and groundwater COCs based on the results of the RI and human health risk assessment and chemical-specific ARARs. Additionally, background concentrations of COCs and analytical detection limits were identified as potential PRGs to ensure selection of clean-up goals that are reasonably attainable and measurable. Each type of PRG is briefly discussed below. 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 developed for each site are presented in Sections 2.6 through 2.9.

2.3.1 ARAR/TBCs Basis

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

There are chemical-specific federal and state groundwater ARARs. The State 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 New Jersey Surface Water Quality Criteria (SWQCs) are promulgated under N.J.A.C. 7:9B and establish allowable contaminant concentrations in surface water.

2.3.2 Human Health Risk Basis

Human health risk-based PRGs were developed for the future industrial worker and resident exposure scenarios based on carcinogenic risks of 1E-06 and an HI of 0.1. Risk-based concentrations (RBCs) will be considered in the PRGs development. It should be noted that there are no plans to use the site for residential purposes.

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 Creek Watershed.

2.3.4 Protection of Groundwater Basis

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

2.3.5 Background Concentrations Basis

Some inorganic compounds of concern (COCs) (natural components of soil) are present in site soils and in the background locations (areas deemed not to be affected by the sites) at concentrations higher than

the risk-based or groundwater protection-based PRGs calculated for the sites. Section 31 of the RI report presents background results. Because it is not reasonable and may not be possible to remediate site soils to concentrations lower than are present naturally in area soils, background concentrations may be considered as reasonable PRGs for inorganics. As part of the RI, eight representative background soil samples were collected, and the mean and 95 percent UTL values were calculated and are presented in Tables 1-7 and 1-8 of this FS report. Representative background groundwater concentration values for formations underlying NWS Earle are presented in Tables 1-4, 1-5, and 1-6. These values are also presented in the site-specific PRG tables of this FS.

2.4 METHOD USED FOR DEVELOPMENT OF GENERAL RESPONSE ACTIONS

The RAOs were used to develop general response actions that describe medium-specific measures that will satisfy the RAOs. General response actions presented in OSWER Directive No. 9355.3-01, Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA, were evaluated for their applicability to 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 (Institutional Controls)
- Containment
- Excavation and Treatment Actions
- Excavation, Treatment, and Disposal Actions

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

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

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

General response actions specific to the OU 9 sites are presented in Sections 2.6 through 2.9 of this FS.

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

During this phase of alternatives formulation, preliminary screening is performed to reduce the universe of potentially applicable technology types and process options. The purpose of screening is to investigate all available technologies and process options and to eliminate those obviously not applicable to specific conditions at each site, based on the established 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 contaminants of concern (metals, VOCs), 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.

- Implementability - The implementability evaluation encompasses both the technical and institutional feasibility of implementing a process. Technical implementability was used in developing general response actions as an initial screen of technology types and process options to eliminate those that are

clearly ineffective or unworkable at a site. Therefore, this subsequent, more detailed evaluation of process options places greater emphasis on the institutional aspects of implementability such as the ability to obtain permits, availability of treatment, storage, and disposal services, and availability of necessary equipment and resources.

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

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

2.6 SITE 6 TECHNOLOGY SCREENING

The selection of viable remedial technologies and process options for assemblage into remedial alternatives for Site 6 is presented in this section.

2.6.1 Site 6 Remedial Action Objectives

The results of the RI, other previous investigations, and the human health and ecological risk assessments for Site 6 were evaluated to determine the RAOs that may be needed to protect human health and the environment.

Human Health Protection Considerations

Sediment, groundwater, and surface water were sampled at Site 6, and potential receptors considered for this site were future industrial, residential, and recreational receptors.

The RME cancer risks associated with future residential groundwater exposure exceeded the upper end of EPA's target acceptable risk range. The RME cancer risks associated with future industrial groundwater exposure were at the upper bound of EPA's target acceptable risk range. In addition, CTE cancer risks for the future residential receptor groundwater exposure were within the upper bound of EPA's target risk range. Arsenic (via ingestion of and dermal contact with groundwater) is the principal COPC that contributed to the cancer risks for these exposure scenarios.

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

The estimated RME cancer risk for the future industrial employee and the future residential receptor exceeds 1E-04, based mainly on ingestion of groundwater. The estimated CTE cancer risk for the future residential receptor exceeds 1E-04, based mainly on ingestion of groundwater. The estimated RME non-cancer HI for the future residential receptor exceeds 1.0, based mainly on ingestion of groundwater. The estimated CTE cancer risk for the future residential receptor exceeds 1.0, based mainly on ingestion of groundwater.

Only the maximum concentration of arsenic found in one groundwater sample, 26.8 ug/l, would result in calculated human health risk above the EPA acceptable risk range under the RME or CTE future residential exposure scenarios. Detected arsenic concentrations in the other Site 6 groundwater wells were 5.1 and 8.8 ug/l. These relatively lower site-related concentrations, as well as the average concentration in the four background groundwater samples, 10.6 ug/l, would also result in calculated risk levels within (at the upper end of) EPA's acceptable risk range.

Lead concentrations detected at the site during this RI were below the EPA guidelines and are not expected to be associated with a significant increase in blood-lead levels based on the results of the IEUBK Lead Model (v. 0.99).

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 6 being considered for future residential land use.

Ecological Receptors Risk Considerations

Site 6 is a former landfill located in the Waterfront area of NWS Earle. The site is located a few hundred feet northeast from Site 17, at the edge of a large marsh that connects to Sandy Hook Bay. The former landfill received a variety of waste materials. The results of the RI ecological risk assessment showed that several inorganics and organics, primarily PAH compounds, were present in surface water and sediment near the site in excess of screening values. Concentrations of lead, zinc, and several PAHs in sediment collected near the Site 6 landfill toe were significantly elevated. Because data from the 1993 SI and 1996 RI indicated minimal impacts to groundwater, erosion and overland runoff from the landfill toe were considered possible migration pathways. However, surface water and sediment samples had not been collected farther away from the site in the marsh. As a result, additional surface water and sediment

samples were collected farther into the marsh at the site to determine the extent of the impacts of landfill-related contaminants on the marsh.

In Site 6 surface water and sediments, only a few contaminants that had high frequencies of detection exceeded screening levels. Of these, the most significant exceedances in surface water were for aluminum, iron, lead, and vanadium. The high concentrations were confined to sample 06SW06, which was one of the samples collected farthest from the former landfill. Sediment concentrations at this location were not significantly elevated and sediment contaminant concentrations in sample 06SD09, which was collected in the same area as 06SW06 but closer to the landfill, were also relatively low. In Site 6 sediments, the average concentrations of all metals were below threshold values. Concentrations of some inorganics for which no screening values were available were significantly elevated in sediment sample 06SD07. However, surface water concentrations at that location were not elevated, and sediment concentrations in sample 06SD10, which was taken in the same general area as sample 06SD07 but closer to the landfill, were not significantly elevated. Frequencies of detection and HQ values for organics in Site 6 sediments were all low.

In summary, significantly elevated contaminant concentrations and exceedances of threshold values based on data from the 1995 RI samples and 1996 RI report were not prevalent in surface water and sediment samples collected farther into the marsh from Site 6. Therefore, impacts of contaminants from Site 6 on the marsh are considered minimal. Elevated concentrations of some inorganics were present but were confined primarily to ubiquitous metals in only a few samples collected relatively far from the landfill. This indicates that these elevated concentrations are most likely only indicative of contaminant "hot spots" and are not the result of landfill-related releases. Additive impacts on the watershed and cumulative effects from contaminants from the site on marsh receptors are also unlikely. Concentrations of contaminants that bioaccumulate and biomagnify were also relatively low. Thus, potential risks to organisms from exposure via the food chain (e.g., wading birds) appear to be highly unlikely. Concentrations of contaminants in surface water and sediments in the two samples collected upstream from the marsh were low and, as a result, impacts to the marsh from upstream sources appear to be negligible.

The data indicate that the assessment endpoint chosen, the maintenance of receptor populations in the marsh, does not appear to be compromised from Site 6 or upstream contaminants; therefore, ecological risks to the marsh from Navy-related areas appear to be insignificant. Remedial action based on ecological risk concerns or additional, more focused ecological studies are therefore unwarranted.

Environmental Media Protection Considerations

Based on the 1995 RI results, metals concentrations in groundwater exceeded regulatory and human health risk assessment guideline cancer and non-cancer risk criteria (almost exclusively due to arsenic in groundwater). Metals in groundwater at levels greater than regulatory guidelines included arsenic, aluminum, cadmium, iron, magnesium, and sodium. The concentration of sodium chloride in the groundwater approaches the concentration found in seawater; therefore, shallow groundwater in this area (of tidal influence) is not consumed or consumable by humans. Considering the uncertainty stemming from the calculation of arsenic background risk levels from only four groundwater samples installation-wide and the generally (naturally) low quality of the shallow groundwater in this area at the edge of the salt marsh, the calculated human health risk (at approximately the upper end of the EPA guideline) does not appear to be significant at Site 6. No organic compounds were found in groundwater at concentrations greater than regulatory guidelines.

The ecological risk assessment concluded that significantly elevated contaminant concentrations and exceedances of threshold values observed in RI surface water and sediment samples obtained near the toe of the landfill were not present in RI Addendum surface water and sediment samples collected farther into the marsh. Therefore, impacts of contaminants from Site 6, Site 17, and upstream areas on the marsh are low.

Remedial Action Objective Selection

Based on the information developed to date, no remedial actions appear to be warranted for the further protection of human health. However, there are two inorganic contaminants found in site groundwater at concentrations greater than background concentrations and New Jersey GWQSs. Considering the presence of metals in groundwater, the establishment of a classification exception area (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 6:

Protection of Human Health RAO

- Prevent potential human exposure to metals in groundwater.

Protection of the Environment RAO

- None.

2.6.2 Site 6 Preliminary Remediation Goals

Data from the RI human health risk assessment and ARARs were reviewed to identify COCs for Site 6. A summary and the basis for selecting the COCs are provided in Table 2-7.

Because Site 6 is an inactive landfill used for the disposal of material such as lumber, glass, paper, packing material, and small amounts of paint and solvent, the presumptive remedy for CERCLA municipal landfill will be considered. The metal contaminants in groundwater that would contribute to excess human health carcinogenic risk (greater than 1E-04 total) or an HI greater than 1.0, or were detected at greater than twice the background concentration, were selected as human health risk-based COCs, PRGs associated with these COCs are and are presented in Table 2-8.

Metal contaminants in groundwater underlying and adjacent to the site that exceeded the State GWQSs or were greater than background concentrations, were selected as COCs. Potential PRGs based on ARARs/TBCs and the maximum detected background concentrations are presented in Table 2-8.

A set of proposed groundwater PRGs for Site 6 is presented on Table 2-9, along with the basis for selection. These proposed PRGs may be used to establish a CEA as defined under the N.J.A.C. 7:9-6.

2.6.3 Site 6 General Response Actions

General response actions were selected based on the RAO for Site 6 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 6 that address potential human exposures to landfill contents include:

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

TABLE 2-7
SITE 6 GROUNDWATER CONTAMINANTS OF CONCERN
OPERABLE UNIT 9 FEASIBILITY STUDY
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

Contaminant of Concern	Exceeds NJ GWQS	Exceeds SDWA MCL	Exceeds Twice the Background Level	Poses Human Health Risk
Aluminum	X	---(1)	---	---
Arsenic	X	X	X	X(2,3)
Cadmium	X	X	---	---
Chromium	---	---(1)	X	---
Iron	X	---(1)	---	---
Manganese	X	---(1)	---	---

Notes:

X indicates the basis for selection of the compound or element as a COC.
New Jersey groundwater quality standards (GWQSs) (N.J.A.C. 7:9-6) are ARARs.
Safe Drinking Water Act (SDWA) Maximum Contaminant Levels (MCLs) regulate organic and inorganic constituents in public drinking Water supplies and are included for comparison purposes.

1. No SDWA MCL for this analyte.
2. COC contributes to HI greater than 1.0 for future residential receptor under RME and CT exposures.
3. COC contributes to excess carcinogenic risks for the future residential receptor through RME ingestion and dermal exposures.

TABLE 2-8
SITE 6 GROUNDWATER PRELIMINARY REMEDIATION GOALS (µg/L)
OPERABLE UNIT 9 FEASIBILITY STUDY
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

Contaminant of Concern	ARARs NJ GWQS	SDWA MCL	Maximum Background Concentration	Maximum Detected Site Concentration
Aluminum	200	---(1)	2,090	1,320
Arsenic	8.0	50	5.1	26.8
Cadmium	4.0	5.0	7	7
Chromium	100	100	Not Detected	1.2
Iron	300	---(1)	95,200	95,200
Manganese	100	100	3,040	1,820

Notes: New Jersey groundwater quality standards (GWQSs) (N.J.A.C. 7:9-6) are ARARs.
Safe Drinking Water Act (SDWA) Maximum Contaminant Levels (MCLs) regulate organic and inorganic constituents in public drinking Water supplies and are included for comparison purposes.
--not a COC under this parameter.
1 No MCL established for this constituent.

TABLE 2-9
SITE 6 PROPOSED GROUNDWATER PRGs
OPERABLE UNIT 9 FEASIBILITY STUDY
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

Contaminant of Concern	Proposed PRG	Basis of Selection
Aluminum	2,090	Background
Arsenic	8.0	NJ GWQS
Cadmium	7	Background
Chromium	100	NJ GWQS
Iron	95,200	Background
Manganese	3,040	Background

Notes:

All units in ug/L
New Jersey groundwater quality standards (GWQSs) (N.J.A.C. 7:9-6) are ARARs.

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

- No action
- Institutional controls (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 6

Table 2-10 presents a summary of potential remedial technologies and process options that apply to the Site 6 RAO 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 after remedial construction activities in 1999. During the screening step, process options and entire technology types were eliminated from further consideration on the basis of technical implementability or as a result of remedial activities performed by the Navy in 1999.

Site conditions considered included fill materials consisting of heterogeneous municipal-type waste possibly mixed with minor quantities of military waste materials, the location of the landfill adjacent to a wetlands area, relatively sparse top cover of the landfilled materials, and erosion and runoff from landfill soils and materials into the adjacent wetlands.

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

2.6.5 Summary of Site 6 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 institutional controls. 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

TABLE 2-10
SITE 6 REMEDIAL ACTION OBJECTIVES, GENERAL RESPONSE ACTIONS, TECHNOLOGY TYPES, AND PROCESS OPTIONS
OPERABLE UNIT 9 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 - Institutional Controls - Long-Term Monitoring	- Groundwater monitoring - Implement classification exception area

TABLE 2-11
PRELIMINARY SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS FOR SITE 6 LANDFILL MATERIALS
OPERABLE UNIT 9 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.	Grading and slope stabilization of current cover material was already conducted in 1999. Eliminated.
		Revegetation	Seeding and maintaining site surface to establish vegetation to minimize erosion and to promote evapotranspiration of precipitation, thus reducing infiltration.	Revegetation was conducted as part of slope stabilization work conducted in 1999. Eliminated.

TABLE 2-11
PRELIMINARY SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS FOR SITE 6 LANDFILL MATERIALS
OU 9 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. Work in 1999 included removal of debris, backfilling, regrading, and seeding.	Potentially viable if direct contact and erosion are the prime threats. Offers little additional protection. Eliminated.
		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. Offers little additional protection. Eliminated.
		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. Eliminated
Removal and Disposal	Excavation	Mechanical Excavation	Mechanical removal of solid materials using common construction equipment such as bulldozers, excavators, and front-end loaders.	Potentially viable for hot spot areas if encountered during remediation. Performed in 1999. Eliminated.
		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 6 has not been indicated. Eliminated.

TABLE 2-11
PRELIMINARY SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS FOR SITE 6 LANDFILL MATERIALS
OU 9 FEASIBILITY STUDY
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY
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GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	DESCRIPTION	SCREENING COMMENTS
Removal and Disposal (continued)	Disposal Off Base	RCRA Landfill	Transport and disposal of excavated materials in a RCRA-permitted landfill.	Technically impracticable to excavate and dispose of entire landfill. Eliminated.
	Disposal On Site	New RCRA-Type Landfill	Disposal of untreated bulk landfill materials in a specially constructed on-base landfill.	Technically impracticable to excavate and dispose of entire landfill. Eliminated.
		Consolidation (into existing landfill)	Relocation of landfill materials into another on-base landfill. Or relocation of small, isolated quantities of contaminated materials into an existing on-base landfill so that one closure action can accommodate both.	Technically impracticable to excavate and relocate landfill. Eliminated. Offers little additional protection. Eliminated.

TABLE 2-12
PRELIMINARY SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS
FOR SITE 6 CONTAMINATED GROUNDWATER
OPERABLE UNIT 9 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 2-13
DETAILED EVALUATION OF TECHNOLOGIES AND PROCESS OPTIONS FOR SITE 6 LANDFILL MATERIALS
OPERABLE UNIT 9 FEASIBILITY STUDY
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	EFFECTIVENESS	IMPLEMENTABILITY	COST	CONCLUSION
No Action	No Action	No Action	Would not achieve remedial action objectives.	Implementable.	Capital: None O & M: 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	Grading was completed as part of slope stabilization work conducted in 1999.	Implementable, numerous companies with personnel and heavy equipment to perform earth moving and grading.	Capital: Low O & M: None	Eliminated.

TABLE 2-13
DETAILED EVALUATION OF TECHNOLOGIES AND PROCESS OPTIONS FOR SITE 6 LANDFILL MATERIALS
OU 9 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE
COLTS NECK, NEW JERSEY
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GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	EFFECTIVENESS	IMPLEMENTABILITY	COST	CONCLUSION
Containment (continued)	Surface Controls	Revegetation	Revegetation was completed as part of slope stabilization work performed in 1999.	Implementable; numerous companies with personnel and equipment available to perform revegetation.	Capital: Low O & M: Low	Eliminated.
	Cap	Soil (Permeable) Cover	Would prevent direct exposure to site soils. Would reduce precipitation infiltration, leaching, and erosion to adjacent wetlands. Work performed in 1999 included debris removal, backfilling, regrading, and seeding.	Implementable using standard methods and readily available equipment.	Capital: Low O & M: Low	Eliminated.
		Single Barrier	Would limit infiltration and significantly reduce contaminant leaching to groundwater. Would prevent exposure to contaminated soils and surface migration of contaminated soils. No contaminant reduction.	Implementable by standard construction techniques; would require specialized but readily available equipment and materials to install synthetic cap.	Capital: Moderate O & M: Low	Eliminated.
		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 6 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 2-13
DETAILED EVALUATION OF TECHNOLOGIES AND PROCESS OPTIONS FOR SITE 6 LANDFILL MATERIALS
OU 9 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE
COLTS NECK, NEW JERSEY
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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.	Implementable with standard construction equipment. Equipment and resources are readily available from various contractors.	Capital: Low O & M: None	Eliminated.
		Drum Removal	Effective for drum removal, if encountered during remediation. There has been no indication of drums or containers at Site 6.	Equipment and resources are readily available from various contractors.	Capital: Low O & M: None	Eliminated.
	Disposal Off-Base	RCRA Landfill (for hot spot removals only)	Effectively controls release of hot spot contaminants to environment, if encountered during remedial actions. Would probably handle volume of hot spot materials encountered. Landfill materials may require treatment prior to disposal to meet land disposal requirements.	Implementable. Commercial landfill facilities are available. Implementation becomes more difficult if excavated materials require segregation or treatment prior to disposal.	Capital: Moderate O & M: None	Eliminated.
	Disposal On-Base	Consolidation	Allows small volumes of material from other isolated locations to be consolidated and addressed with the majority of landfill materials.	Readily implementable for small or moderate soil volumes. No implementability concerns.	Capital: Low O & M: Low	Eliminated.

TABLE 2-14
DETAILED EVALUATION OF TECHNOLOGIES AND PROCESS OPTIONS FOR SITE 6 CONTAMINATED GROUNDWATER
OPERABLE UNIT 9 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.

appear to constitute a significant problem. Surface controls for site soils and soil cover options were eliminated due to previous work conducted in 1999 to stabilize the site slope, which included removal of debris, backfilling, and regrading and revegetation.

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

2.7 SITE 12 TECHNOLOGY SCREENING

Selection of remedial technologies and process options for assemblage into remedial alternatives for Site 12 is presented in this section for the record. The Navy performed cleanup and verification sampling at this site for the compounds of concern subsequent to the RI, thereby removing the need for any further action.

2.7.1 Site 12 Remedial Action Objectives

The results of the RI, other previous investigations, and the human health and ecological risk assessments for Site 12 were evaluated to determine the RAOs that may be needed to protect human health and the environment.

Human Health Protection Considerations

Surface soil, subsurface soil, and sediment were sampled at Site 12. The potential receptors considered for this site were current industrial and future industrial, residential, and recreational receptors.

The RME cancer risk associated with the future residential (surface and subsurface soil) exposure scenario was at the upper end of the target acceptable risk range. Arsenic (via ingestion of and dermal contact with surface and subsurface soil), benzo(a)pyrene (via ingestion of surface soil), and benzo(b)fluoranthene (via ingestion of surface soil) were the major COPCs that contributed to the cancer risk for this exposure scenario. The RME non-carcinogenic HIs associated with the future residential (surface and subsurface soil) exposure scenario exceeded 1.0, the cutoff point below which adverse effects are not expected to occur. Antimony (via ingestion of surface soil) and arsenic (via ingestion of subsurface soil) were the principal COPCs that contributed to the HI exceeding 1.0 for this scenario.

The CTE cancer risk associated with the future residential (surface and subsurface soil) exposure scenario was calculated to be at the upper bound of the 1E-04 to 1E-06 target acceptable risk range. Arsenic (via ingestion of and dermal contact with surface and subsurface soil), benzo(a)pyrene (via ingestion of surface

soil), and benzo(b)fluoranthene (via ingestion of surface soil) were the major COPCs that contributed to the cancer risk for these exposure scenarios. The CTE non-carcinogenic HIs associated with the future residential (surface and subsurface soil) exposure scenario exceeded 1.0. Antimony (via ingestion of surface soil) was the principal COPC that contributed to the HI exceeding 1.0 for this exposure scenario.

The estimated RME cancer risk for the future residential receptor was calculated to be at the upper end of the target risk range, based mainly on ingestion of surface and subsurface soil. The estimated CTE cancer risk for the future residential receptor was also at the upper end of the target acceptable risk range, based mainly on ingestion of surface and subsurface soil. The estimated RME non-cancer HI for the future residential receptor exceeded 1.0, based mainly on ingestion of surface and subsurface soil. The estimated CTE cancer risk for the future residential receptor exceeded 1.0, based mainly on ingestion of surface soil.

Arsenic ranged from 5.1 to 16.5 mg/kg in surface soil samples; these levels result in risks within the target risk range of 1E-04 to 1E-06. Benzo(a)pyrene ranged from 250 to 2,250 ug/kg; these levels result in risks within the target risk range. Benzo(b)fluoranthene levels ranged from 610 to 10,350 ug/kg; these levels, except the minimum of 610 ug/kg, would result in a risk range within the target risk range of 1E-04 to 1E-06. Antimony and arsenic were detected in one of four samples each at a concentration of 71.5 mg/kg and 16.5 mg/kg, respectively. These two values were the drivers for the non-carcinogenic risks found above EPA's risk assessment acceptable risk range. However, considering the uncertainties inherent to the calculations, arsenic levels may have been within background concentrations for surface soil.

Lead was detected in surface soil at the site at levels greater than the EPA screening guideline. Based on the results of the IEUBK Lead Model (v. 0.99), the maximum detected soil concentration was estimated to be associated with significant increases in blood-lead levels (i.e., above 10 ug/dL) in 58 percent of children from a population exposed under similar conditions. However, due to biased sampling for hot spots (avoiding paved areas) in which a limited number of samples was collected over a small portion of the site, the lead risk assessment was probably overly conservative because most areas at the site were not expected to yield lead concentrations as high as the calculated RME representative concentration.

Ecological Receptors Risk Considerations

Site 12 is located in a highly developed area in the Waterfront complex. No habitat exists on the site, but an extensive salt marsh is located approximately 200 feet to the northwest. The salt marsh contains excellent wetland habitat and is most likely utilized by a wide variety of ecological receptors. Runoff from the site drains to a storm sewer that outfalls via a culvert into the edge of the marsh. A small drainage depression is located north of the site and some runoff may enter it, but water tends to accumulate in the depression rather than flow toward the marsh. Infiltration of contaminants and subsequent groundwater to surface water migration is considered insignificant because most of the site is paved or developed.

A surface water and sediment sample were taken at the storm water outfall as part of 1993 SI activities. Low levels of some VOCs, PAHs, and pesticides were detected in the sediment sample. Slightly elevated levels of some metals, mainly lead, were detected in the sediment sample and surface water sample. Surface soil samples were taken in the developed area as part of 1995 RI activities. Elevated levels of metals and PAHs were detected in those samples. The adjacent railroad bed (since removed) may have been the source of the PAHs.

Sediment samples were taken in the drainageway north of the railroad tracks as part of 1995 RI activities and were used for quantitative assessment. HQs for inorganic contaminants were indicative of low potential risk. Aluminum and vanadium were conservatively retained as final COPCs since no suitable ETs were available, but these inorganics were only detected at concentrations below or slightly above background. HQs for organics were also indicative of low potential risk, with the exception of a moderately high value for 4,4'-DDT. However, the concentrations detected were not relatively high, and there is no evidence that this compound and its analogs were stored or disposed at the site. These pesticides were probably used base-wide for pest control in the past. HQs for all PAHs were relatively low, and these contaminants may be associated with the adjacent railroad bed rather than site releases. For these reasons, despite the elevated concentrations of some contaminants in site surface soils, overland migration of contaminants does not appear to be significant.

The presence of low levels of contaminants in the drainage ditch and storm water outfall at the marsh edge indicates that some impact from base-related activities has occurred. However, there is no evidence that contaminants detected are related to Site 12 activities. The concentrations of contaminants detected in surface water and sediment at the site are not indicative of significant potential risk to ecological receptors in the marsh. It is possible that small contaminant inputs from Site 12 could have had an additive effect with contaminant inputs from other RI sites, mainly Site 6, but inputs from Site 12 alone do not appear to be significant.

Environmental Media Protection Considerations

Review of the RI data for Site 12 surface soils revealed that concentrations of several inorganic contaminants exceeded both the New Jersey Residential and Non-Residential Cleanup Criteria including antimony, lead, thallium, and zinc. Several metals were detected at concentrations greater than two times background including aluminum, antimony, barium, beryllium, cadmium, calcium, cobalt, copper, lead, magnesium, mercury, nickel, potassium, silver, sodium, vanadium, and zinc. Although arsenic did not exceed State cleanup criteria and was found to be less than two times background, it was determined to contribute to cancer risk.

Four organic contaminants detected in surface soils exceeded the State residential cleanup standards including benzo(a)pyrene, benzo(b)fluoranthene, chrysene, and indeno(1,2,3-cd)pyrene.

Review of the RI data for subsurface soils revealed that beryllium concentrations exceeded the New Jersey Residential and Non-Residential Cleanup Criteria and also were greater than two times background. Antimony was also detected at Site 12 but was not detected in background samples. Although arsenic was not found to exceed State cleanup criteria, it was not eliminated as a COPC based on contribution to cancer and non-cancer risk. Despite relatively high concentrations of lead in surface soils at Site 12, lead was not chosen as a COPC because the 95 percent UTL calculated from the station-wide background sample set was higher than the concentrations at the site. The consequence of this unrealistically high UTL was that lead was not used to calculate human health risks. Alternative benchmark criteria for lead in soil such as 400 ppm (OSWER directive 9355.4-12) or 600 ppm (NJDEP Non-Residential Direct Contact Soil Cleanup Criteria) were available and were used to determine the appropriate clean-up standard and the approximate limits of soil removal.

Based on the information developed from the RI, remedial actions may have been warranted to minimize or mitigate the continued migration of contaminants to groundwater, surface water, and sediments. Considering the presence of metals and organics in site soils, the establishment of a CEA according to State regulations would have been considered. However, the excavation and removal of surface soils and "sediments" in the vicinity of Site 12 to NJDEP residential cleanup standards conducted in 1999, followed by cleanup verification sampling and analysis, removed the compounds of concern and any need for further action at Site 12.

RAOs Selection

For the reasons provided above, the following RAO's have been selected for Site 12.

2.7.2 Site 12 Preliminary Remediation Goals

Data from the RI human health risk assessment and ARARs were reviewed to identify COCs for Site 12. A summary and the basis for selecting the surface soil COCs and subsurface soil COCs are provided in Tables 2-15 and 2-16, respectively. No PRGs or remedial alternatives were developed for Site 12.

Based on soil excavation work performed at Site 12 in 1999 by Foster Wheeler Environmental Corporation on behalf of the Navy, it is recommended that no further action be taken at Site 12. The work included the excavation, removal, and disposal of contaminated soils, sample collection to demonstrate that NJDEP residential cleanup standards have been met, and restoration of the site after excavation.

TABLE 2-15
SITE 12 SURFACE SOIL CONTAMINANTS OF CONCERN
OPERABLE UNIT 9 FEASIBILITY STUDY
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

Contaminant of Concern	Exceeds NJ Residential Cleanup Criterion	Exceeds NJ Non-Residential Cleanup Criterion	Exceeds Twice the Background Level	Poses Human Health Risk
Antimony	X	X	X	X(1)
Arsenic	---	---	---	X(2)
Lead	X	X	X	X
Thallium	X	X	---(3)	---
Zinc	X	X	---(3)	---
Benzo(a)pyrene	---	---	X	X(2)
Benzo(b)fluoranthene	---	---	X	X(2)

Notes:

X indicates the basis for selection of the contaminant as a COC.
New Jersey residential and non-residential direct contact cleanup criteria are ARARs.
1. COC contributes to HI greater than 1.0 for future residential receptor under RME and CTE exposures.
2. COC contributes to excess carcinogenic risks for the future residential receptor.
3. No criterion available.

TABLE 2-16
SITE 12 SUBSURFACE SOIL CONTAMINANTS OF CONCERN
OPERABLE UNIT 9 FEASIBILITY STUDY
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

Contaminant of Concern	Exceeds NJ Residential Cleanup Criterion	Exceeds NJ Non-Residential Cleanup Criterion	Exceeds Twice the Background Level	Poses Human Health Risk
Antimony	---	---	X	---
Arsenic	---	---	---	X(1,2)
Beryllium	X	X	X	X(2)

Notes:

X indicates the basis for selection of the contaminant as a COC.
New Jersey residential and non-residential direct contact cleanup criteria are ARARs.
1. COC contributes to HI greater than 1.0 for future residential receptor under RME and CTE exposures.
2. COC contributes to excess carcinogenic risks for the future residential receptor.

The objectives of the remedial action taken in 1999 included minimizing the potential migration and mobilization of the contaminants to surface water, groundwater, and soils at the site. Approximately 262 tons of excavated soil was shipped offsite for disposal and recycling. Three rounds of confirmatory sampling were conducted to demonstrate compliance with State cleanup standards. The excavation of contaminated soils achieved the remedial action objective for protection of human health and the environment, including prevention of human exposure to contaminated surface and subsurface soils, and migration of contaminants to the adjacent marsh.

Based on EPA and NJDEP approval, Site 12 has met all the applicable requirements for closure, and the remediation for which Foster Wheeler Environmental Corporation was contracted by the Navy is complete as documented in the Remedial Action Report for Soil Excavation at Site 12, Foster Wheeler Environmental Corporation, December 1999.

2.8 SITE 15 TECHNOLOGY SCREENING

The selection of viable remedial technologies and process options for assemblage into remedial alternatives for Site 15 is presented in this section.

2.8.1 Site 15 Remedial Action Objectives

The results of the RI, other previous investigations, and the human health and ecological risk assessments for Site 15 were evaluated to determine the RAOs that may be needed to protect human health and the environment.

Human Health Protection Considerations

Surface soil, subsurface soil, sediment, and surface water were sampled at Site 15. The potential receptors considered were current industrial and future industrial, residential, and recreational receptors. The cancer risks associated with surface and subsurface soil exposure for the future residential exposure scenario were within the 1E-04 to 1E-06 target risk range. Arsenic (via ingestion and dermal contact with surface and subsurface soil) was the major COPC that contributed to the cancer risks for these exposure scenarios.

The future residential (surface soil and subsurface soil) exposure scenario yielded total RME HIs (sum of HIs for ingestion, dermal, and inhalation of dusts) greater than 1.0, the cutoff point below which adverse effects are not expected to occur. However, these RME estimates are probably overly conservative because a central tendency calculation shows that non-cancer HIs are more likely to be below 1.0. Central tendency

generates a lower risk estimate than RME because it assumes typical rather than upper range receptor behavior patterns related to the ingested dose.

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

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 15 being considered for future residential land use.

Ecological Receptors Risk Considerations

Site 15 is located in the Waterfront complex and occupies a relatively small area. Excellent habitat exists at and near Site 15, mainly for terrestrial receptors that use the site proper and terrestrial and wetland receptors that use the marsh to the northwest. For the most part, runoff and erosion are the main contaminant migration pathways. It is unclear exactly where activities at the site took place, and runoff from an adjacent parking lot drains into a manhole that empties into the drainage swale. As a result, runoff from and to the site is not confined to discrete sources. Limited groundwater to surface water contaminant migration may be possible, but the small area of the site and of the potentially contaminated area at the site minimizes the impact of this pathway.

Subsurface soil, sediment, and groundwater samples were taken as part of 1993 SI activities at the site. Phthalates were the only contaminants detected in subsurface soil, all at low concentrations. Four sediment samples were taken from the drainage ditch. A few phthalates and some PAHs, including phenanthrene, anthracene, flouranthene, and pyrene were detected, all at relatively low concentrations. In groundwater, no organics were detected, although elevated levels of some metals were present.

Surface water, sediment, and surface soil samples were taken as part of 1995 RI activities at Site 15 to more fully characterize the nature and extent of contamination in those media and to investigate potential off-site migration. Data from these samples were used for quantitative assessment. HQs for constituents in surface water were indicative of relatively low potential risk. HQs for inorganics in sediment were indicative of relatively low risk, with the exception of zinc. This metal slightly exceeded a less conservative ET value. This zinc concentration may be naturally elevated. Some inorganics were retained as final COPCs in sediments because no suitable ET values were available. Of these, only aluminum was detected significantly above background. Most HQ values for inorganics were indicative of low potential risk, although the pesticides 4,4'-DDE and 4,4'-DDT and the PAHs benzo(b)fluoranthene, phenanthrene, and pyrene slightly exceeded less conservative ET values. The pesticides detected may be the result of intense past seashore vector control programs not due to Site 15-related activities and were not detected at relatively high concentrations.

Styrene and 2-butanone were conservatively retained as final COPCs because no suitable ETs were available, but these compounds were only detected in one sample and at low concentrations.

HQ values for inorganics in surface soils were indicative of low potential risk, with the exception of chromium. Chromium had an HQ value indicative of moderately high risk, but the associated surface soil concentration was less than background. The elevated HQ value for this inorganic is probably due to the very conservative ET used. HQs for organics were also indicative of low potential risk. A phthalate compound was conservatively retained as a final COPC because no ET value was available, but it was detected at a low concentration. Phthalates are ubiquitous in the environment and are common laboratory contaminants. For terrestrial plants, HQs were reflective of low potential risk, with the exception of aluminum, chromium, and vanadium, but all of these metals were detected at concentrations below or slightly above background. No suitable terrestrial plant ET values were available for organics detected in surface soils, but terrestrial plants generally do not significantly translocate organics into root tissue, and no evidence of stressed vegetation is apparent at the site.

In summary, HQ values for most concentrations in most media at Site 15 are indicative of low potential risk. Most elevated HQs are mitigated by various factors including concentrations below background. Previous studies indicated relatively low concentrations of contaminants in sediments. Only a few inorganics exceeded ET values in surface water, and the HQ values were mostly indicative of low risk. Some constituents had HQ values greater than one but did not exceed background; this is mainly a function of extremely conservative ET values rather than excessively high background values. Potential risks from inorganics in sediments were also low. A suite of organic contaminants in sediments exceeded ET values, but most of these exceedances were low. However, a few HQ values were indicative of moderate risk. Some contaminants were present in sediments for which no suitable ETs were available, but concentrations of these contaminants were fairly low. As a result, they are not likely to pose significant potential risk. In addition, organic contaminants in sediments have a low tendency to migrate because they bind to organic fractions in sediments.

In Site 15 surface soils, no inorganics exceeded ETs and were retained as final COPCs, except that aluminum was retained because no ET was available, but concentrations were only slightly above background. Potential risks from organics in surface soils were also minimal. In addition, potential risks to terrestrial plants from inorganic contaminants in surface soils were low. No suitable terrestrial plant ETs were available for organics. Most terrestrial plants do not absorb organic contaminants to the same degree as inorganics. Several organics were detected in site sediments, mainly PAHs, and a few of these slightly exceeded less conservative ET values, indicating moderate potential risk. However, these compounds could as likely result from runoff from a nearby road and parking lot because surface drainage from those areas empties into the drainageway next to the site.

Site 15 is small and the contaminant source is not discrete. Moreover, the concentrations of contaminants are relatively low. The PAHs detected have strong affinities for organic fractions in sediments; as a result, they do not tend to migrate significantly. For these reasons, remediation at the site based on ecological concerns reasons does not appear to be necessary.

Environmental Media Protection Considerations

Results of the human health risk assessment concluded that all calculated risks were below guideline limits. However, some metals could not be eliminated as surface soil COPCs based on background upper 95 percent UTLs. Arsenic could not be eliminated as a subsurface soil COPC because it is a Class A carcinogen.

The ecological risk assessment concluded that the site does not appear to be impacting ecological receptors.

Arsenic, antimony, beryllium, cadmium, chromium, copper, lead, selenium, and zinc were found in site soils at concentrations greater than background. Arsenic and cadmium were found in site soils at levels slightly above NJDEP Soil residential and Non-Residential Direct Contact Cleanup Criteria in the area west of Building R-5.

The highest concentration of arsenic in site soil, 23.8mg/kg, was actually found in a duplicate sample pair; the arsenic concentration in the corresponding duplicate of the sample was 15.9 mg/kg (average concentration for the duplicate pair = 19.9 mg/kg). The only soil sample (15 SB 02-01) unambiguously exceeding the NJDEP direct contact residential soil cleanup criterion for arsenic of 20.0 mg/kg, had an arsenic concentration of 20.5 mg/kg.

Cadmium was found in site soils at a maximum concentration of 3.5 mg/kg compared to the NJDEP direct contact residential soil cleanup criterion of 1.00 mg/kg.

Based on the information developed to date, remedial actions may be warranted to restrict residential contact with site soils. Considering the presence of arsenic and cadmium in site soils at concentrations slightly exceeding the NJDEP direct contact residential soil cleanup criteria, remedial actions may be required.

RAOs Selection

For the reasons provided above, the following RAO has been selected for Site 15:

Protection of Human Health RAO

- Prevent potential human exposure to metals in surface and subsurface soils.

Protection of the Environment RAO

- None.

2.8.2 Site 15 Preliminary Remediation Goals

Data from the RI human health risk assessment and ARARs were reviewed to identify surface and subsurface soil COCs for Site 15. A summary and the basis for selecting the COCs are provided in Tables 2-17 and 2-18. Because concentrations of two metals in site soils exceeded the NJDEP soil direct contact cleanup criteria and were greater than two times background, they were selected as COCs. Potential PRGs based on ARARs/TBCs are presented in Tables 2-19 and 2-20. A set of proposed soil PRGs for Site 15 is presented on Table 2-21, along with the basis for selection. These proposed PRGs may be used to assist in the delineation of the volume of contaminated site soils that may need to be evaluated for potential remedial action.

2.8.3 Site 15 General Response Actions

General response actions were selected based on the RAOs for Site 15 and the consideration that the site is a former sludge disposal area. Because the site is not a landfill, the landfill presumptive remedy is not considered applicable. The general response actions for Site 15 that address potential human exposures to metals in site soils include:

- No action
- Institutional controls (limited action)
- Removal and disposal
- In-situ treatment

TABLE 2-17
SITE 15 SURFACE SOIL CONTAMINANTS OF CONCERN
OPERABLE UNIT 9 FEASIBILITY STUDY
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

Contaminant of Concern	Exceeds NJ Residential Cleanup Criterion	Exceeds NJ Non-Residential Cleanup Criterion	Exceeds Twice the Background Level	Poses Human Health Risk
Arsenic	---	---	X	X
Beryllium	---	---	X	---
Cadmium	X	---	X	---
Copper	---	---	X	---
Lead	---	---	X	---
Zinc	---	---	X	---

Notes:

X indicates the basis for selection of the contaminant as a COC.
New Jersey residential and non-residential direct contact cleanup criteria are ARARs.

TABLE 2-18
SITE 15 SUBSURFACE SOIL CONTAMINANTS OF CONCERN
OPERABLE UNIT 9 FEASIBILITY STUDY
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

Contaminant of Concern	Exceeds NJ Residential Cleanup Criterion	Exceeds NJ Non-Residential Cleanup Criterion	Exceeds Twice the Background Level	Poses Human Health Risk
Arsenic	X	X	X	X
Cadmium	X	---	X	---

Notes:

X indicates the basis for selection of the contaminant as a COC.
New Jersey residential and non-residential direct contact cleanup criteria are ARARs.

TABLE 2-19
SITE 15 SURFACE SOIL PRELIMINARY REMEDIATION GOALS (mg/kg)
OPERABLE UNIT 9 FEASIBILITY STUDY
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

Contaminant of Concern	NJ Residential Cleanup Criterion	PRG Based On ARARs	Maximum Background Concentration	Maximum Detected Site Concentration
Arsenic	20.0	20.0	14.4	19.2
Beryllium	1.0	1.0	0.28	0.97
Cadmium	1.0	1.0	0.57	3.4
Copper	600	600	8.4	33.2
Lead	400	400	39.4	110
Zinc	1,500	1,500	27.6	52.4

Note:

New Jersey residential and non-residential direct contact cleanup criteria are ARARs.

TABLE 2-20
SITE 15 SUBSURFACE SOIL PRELIMINARY REMEDIATION GOALS (mg/kg)
OPERABLE UNIT 9 FEASIBILITY STUDY
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

Contaminant of Concern	NJ Residential Cleanup Criterion	PRG Based On ARARs	Maximum Background Concentration	Maximum Detected Site Concentration
Arsenic	20.0	20	14.4	20.5
Cadmium	1.00	1.00	0.57	2.8

Note:

New Jersey residential and non-residential direct contact cleanup criteria are ARARs.

TABLE 2-21
SITE 15 PROPOSED SOIL PRGs
OPERABLE UNIT 9 FEASIBILITY STUDY
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

Contaminant of Concern	Proposed PRG	Basis of Selection
Arsenic	20	NJ Residential Cleanup Criterion
Cadmium	1	NJ Residential Cleanup Criterion

Notes:

All units in mg/kg.
New Jersey residential direct contact cleanup criteria are ARARs.

2.8.4 Identification, Screening, and Evaluation of Technologies and Process Options for Site 15

Table 2-22 presents a summary of potential remedial technologies and process options that apply to the Site 15 RAOs and general response actions. Screening of the remedial technologies considered their overall applicability to the medium of concern (soils), 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 the presence of a small drainage swale, the location of the site adjacent to a wetlands area, and erosion and runoff from disposal area soils and materials into the adjacent wetlands. The exact locations of the sludge disposal activities are not known.

The preliminary screening of soil remedial technologies is presented and summarized in Table 2-23. Detailed evaluations of the remedial technologies and process options for contaminated soils/sludge disposal materials are presented in Table 2-24.

2.8.5 Summary of Site 15 Selected Remedial Technologies and Process Options

Table 2-24 identifies 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 options, local ordinances were eliminated from further consideration because this action may be difficult to implement and would not offer any greater protection than other institutional controls. The containment and removal options were eliminated because the human health risk assessment eliminated all cancer and non-cancer risks above target guideline limits, the current leaching of disposal area contaminants does not appear to constitute a major problem, and the entire site is located within a wetland.

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

2.9 SITE 17 TECHNOLOGY SCREENING

The selection of viable remedial technologies and process options for assemblage into remedial alternatives for Site 17 is presented in this section.

TABLE 2-22
SITE 15 REMEDIAL ACTION OBJECTIVES, GENERAL RESPONSE ACTIONS, TECHNOLOGY TYPES, AND PROCESS OPTIONS
OPERABLE UNIT 9 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
Soils and Disposal Area	**Protection of Human Health** Prevent human exposure to metals contaminants in soils.	No Action	No Action	Not Applicable
		Limited Action	Institutional Controls	- Deed restrictions - Local ordinances
			Access Restrictions	- Fencing
		Removal and Disposal	Excavation	- Mechanical excavation
			Disposal On Site	- Consolidation into existing landfill - New landfill
			Disposal Off Site	- RCRA Landfill
		In Situ Treatment	Chemical Fixation	- Various Mechanical/Chemical

TABLE 2-23
PRELIMINARY SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS FOR SITE 15 SOILS
OPERABLE UNIT 9 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 or residential development could be restricted or prohibited.	Potentially viable. Retained.
		Local Ordinances	Administrative actions such as zoning bylaws 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. Site is currently fenced off from the base and from the surrounding residential (marsh) areas. Retained.
Removal and Disposal	Excavation	Mechanical Excavation	Mechanical removal of solid materials using common construction equipment such as bulldozers, excavators, and front-end loaders.	Potentially viable for hot spots. Retained.

TABLE 2-23
PRELIMINARY SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS FOR SITE 15 SITES
OU 9 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE
COLTS NECK, NEW JERSEY
PAGE 2 OF 2

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	DESCRIPTION	SCREENING COMMENTS
Removal and Disposal (continued)	Disposal Off Base	RCRA Landfill	Transport and disposal of excavated materials in a RCRA-permitted landfill.	Technically impracticable to excavate and dispose of entire site, because the exact location of the sludge disposal areas is not known. Eliminated.
	Disposal On Site	New RCRA-Type Landfill	Disposal of untreated bulk landfill materials in a specially constructed on-base landfill.	Same as above. Eliminated.
		Consolidation (into existing landfill)	Relocation of disposal materials into an on-base landfill.	Technically impracticable to excavate and relocate disposal area. Eliminated.
			Or relocation of small, isolated quantities of contaminated materials into an existing on-base landfill.	Viable for consolidating small quantities of contaminated materials into existing on-base landfill. Retained.
In Situ Treatment	Chemical Fixation	Various Proprietary	Mechanical addition of chemical fixative agents to soils using common construction equipment such as bulldozers, excavators, and front-end loaders or other proprietary means.	Potentially viable for site soils. Retained.

TABLE 2-24
DETAILED EVALUATION OF TECHNOLOGIES AND PROCESS OPTIONS FOR SITE 15 SOILS
OPERABLE UNIT 9 FEASIBILITY STUDY
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	EFFECTIVENESS	IMPLEMENTABILITY	COST	CONCLUSION
No Action	No Action	No Action	Would not achieve remedial action objectives.	Implementable.	Capital: None O & M: None	Retained.
Limited Action	Institutional Controls	Land Use Restrictions	Effectiveness dependent on continued future enforcement to prevent 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 contaminated soils. No contamination reduction.	Readily implementable; numerous companies available to perform construction.	Capital: Low O & M: Low	Retained.

TABLE 2-24
DETAILED EVALUATION OF TECHNOLOGIES AND PROCESS OPTIONS FOR SITE 15 SOILS
OU 9 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE
COLTS NECK, NEW JERSEY
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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. Due to low contamination and designation of site as a wetland, the level of protection offered by this option is not required.	Implementable with standard construction equipment. Equipment and resources are readily available from various contractors.	Capital: Low O & M: None	Eliminated.
	Disposal Off Base	RCRA Landfill (for hot spot removals only)	Effectively controls release of hot spot contaminants to environment, if encountered during remedial actions. However, the level of protection offered by this option is not required at Site 15.	Implementable. Commercial landfill facilities are available. Implementation becomes more difficult if excavated materials require segregation or treatment prior to disposal.	Capital: Moderate O & M: None	Eliminated.
	Disposal On Base	Consolidation	Allows small volumes of material from isolated locations to be consolidated and addressed with the majority of landfill materials. This level of protection is not required at Site 15.	Readily implementable for small or moderate soil volumes. No implementability concerns.	Capital: Low O & M: Low	Eliminated.
In Situ Treatment	Chemical Fixation	Various	Metals in site soils could effectively be immobilized at least temporarily. No overall reduction in contaminants achieved.	Readily implementable for small or moderate soil volumes. No implementability concerns.	Capital: Low O & M: Low	Eliminated.

2.9.1 Site 17 Remedial Action Objectives

The results of the RI, other previous investigations, and the human health and ecological risk assessments for Site 17 were evaluated to determine the RAOs that may be needed to protect human health and the environment.

Human Health Protection Considerations

Surface soil, groundwater, sediment, and surface water were sampled at Site 17. The potential receptors considered were current industrial and future industrial, residential, and recreational receptors.

The RME cancer risks associated with the future residential (groundwater) exposure scenarios were at the upper end of the target acceptable risk range of 1E-06. The CTE cancer risks for the future residential receptor were also at the upper end of the target risk range. Arsenic (via ingestion) is the principal COPC that contributed to the cancer risks for this exposure scenario. The RME cancer risks associated with future industrial (groundwater) exposure were at the upper end of the target risk range. Arsenic (via ingestion) is the principal COPC that contributed to the cancer risks for this exposure scenario.

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

The estimated RME cancer risk for the future industrial employee is at the upper end of the target risk range, based mainly on ingestion of groundwater. The estimated RME cancer risk for the future residential receptor is at the upper end of the target risk range, based mainly on ingestion of groundwater. The estimated CTE cancer risk for the future residential receptor is also at the upper end of the target risk range, based mainly on ingestion of groundwater. The estimated RME non-cancer HI for the future residential receptor exceeds 1.0, based mainly on ingestion of groundwater. The estimated CTE cancer risk for the future residential receptor exceeds 1.0, based mainly on ingestion of groundwater.

Lead concentrations detected at Site 17 during the RI were below the EPA guidelines and are not expected to be associated with a significant increase in blood-lead levels based on the results of the IEUBK Lead Model (v. 0.99).

Arsenic was detected in three of four Site 17 groundwater samples at concentrations of 4.2, 7.0, and 19.7 ug/l. Arsenic was detected in one of three background groundwater samples at a concentration of 5.1 ug/l. One of the site-related concentrations, 19.7 ug/l, is clearly elevated above background. The other two concentrations are similar to the background concentration. The Site 17 average concentration for arsenic is greater than the average background concentration (5.6 ug/l versus 8.14 ug/l).

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 17 being considered for future residential land use.

Ecological Receptors Risk Considerations

Site 17 is a former landfill located in the Waterfront area of NWS Earle a few hundred feet from Site 6, at the edge of a large marsh that connects to Sandy Hook Bay. The former landfill received a variety of waste materials. The results of the RI ecological risk assessment showed that several inorganics and organics, primarily PAH compounds, were present in surface water and sediment near the site in excess of screening values. Concentrations of several metals in surface water and several PAHs in sediments collected near the Site 17 landfill toe were significantly elevated. Because data from the 1993 SI and 1996 RI indicated minimal impacts to groundwater, erosion and overland runoff from the landfill toe were considered possible migration pathways. However, surface water and sediment samples had not been collected farther away from the site in the marsh. As a result, additional surface water and sediment samples were collected to determine the extent of the impacts of landfill-related contaminants on the marsh.

In Site 17 surface water, only barium significantly exceeded its threshold value, but the background concentration of this inorganic was higher than the average Site 17 concentration. HQ values for inorganics in marsh sediments near Site 17 were all low. Sediment concentrations of aluminum, cobalt, and vanadium, which had no suitable ETs, were significantly elevated in sample 17SD07, but surface water concentrations of these metals at the same location were not elevated, and surface water and sediment concentrations of these contaminants in samples collected in the same general area as 17SD07 but closer to the landfill were all much lower. Only one organic in Site 17 sediments exceeded its threshold, and the HQ value was low.

In summary, significantly elevated contaminant concentrations and exceedances of threshold values from the 1995 RI samples and 1996 RI report ecological risk assessment were not prevalent in surface water and sediment samples collected farther into the marsh from Site 17. Therefore, impacts of contaminants from Site 17 on the marsh are minimal. Elevated concentrations of some inorganics were present but were confined primarily to ubiquitous metals in only a few samples collected relatively far from the landfill. This indicates that these elevated concentrations are most likely only indicative of contaminant "hot spots"

unrelated to the former landfill. Additive impacts on the watershed and cumulative effects from contaminants from waterfront former landfill sites (Sites 6 and 17) on marsh receptors are also unlikely. Concentrations of contaminants that bioaccumulate and biomagnify were also relatively low. Thus, potential risks to organisms from exposure via the food chain (e.g., wading birds) appear to be highly unlikely. Concentrations of contaminants in surface water and sediments in the two samples collected upstream from the marsh were low and, as a result, impacts to the marsh from upstream sources appear to be negligible.

The data indicate that the assessment endpoint chosen, the maintenance of receptor populations in the marsh, does not appear to be compromised from Site 17 or upstream contaminants; therefore, ecological risks to the marsh from Navy-related areas appear to be insignificant. Remedial action based on ecological risk concerns or additional, more focused ecological studies are therefore unwarranted.

Environmental Media Protection Considerations

Based on the 1995 RI results, low metals concentrations in groundwater exceeded regulatory and human health risk assessment guideline cancer and non-cancer risk criteria (almost exclusively due to arsenic in groundwater). Metals in groundwater at levels above regulatory guidelines include arsenic, aluminum, cadmium, iron, magnesium, and sodium. The concentration of sodium chloride in the groundwater approached the concentration found in seawater; therefore, shallow groundwater in this area (of tidal influence) is not consumed or consumable by humans. Considering the uncertainty stemming from the calculation of arsenic background risk levels from only four groundwater samples installation-wide and the generally (natural) low quality of the shallow groundwater in this area at the edge of the salt marsh, the calculated human health risk at Site 17 (at approximately the upper end of the EPA guideline) does not appear to be of concern. No organic compounds were found in groundwater at concentrations above regulatory guidelines.

The ecological risk assessment concluded that significantly elevated contaminant concentrations and exceedances of threshold values observed in RI surface water and sediment samples obtained near the toe of the landfill were not present in RI Addendum surface water and sediment samples collected farther into the marsh. Therefore, impacts of contaminants from Site 6, Site 17, and upstream areas on the marsh are low.

RAOs Selection

For the reasons provided above, the following RAO has been selected for Site 17:

Protection of Human Health RAO

- Prevent potential human exposure to metals in groundwater.

Protection of the Environment RAO

- None.

2.9.2 Site 17 Preliminary Remediation Goals

Data from the RI human health risk assessment and ARARs were reviewed to identify COCs for Site 17. A summary and the basis for selecting the COCs are provided in Table 2-25.

Because Site 17 is an inactive landfill used for the disposal of material such as wood, forklifts, empty paint cans, and construction debris, the presumptive remedy for CERCLA municipal landfills will be applied. The metals contaminants in groundwater that contribute to excess human health carcinogenic risk (greater than 1E-04 total) or an HI greater than 1.0 were selected as human health risk-based COC, as presented in Table 2-25.

Because several metals contaminants in groundwater underlying and adjacent to the site exceed the State GWQSs, these COCs were selected and the GWQS were selected as the ARAR-based PRGs. Table 2-25 also lists the metals contaminants with concentrations in excess of maximum detected background groundwater concentrations. Potential PRGs based on ARARs/TBCs and the maximum detected background concentrations are presented in Table 2-26.

A set of proposed groundwater PRGs for Site 17 is presented on Table 2-27, along with the basis for selection. These proposed PRGs may be used to assist in the delineation of the volume of contaminated groundwater that may need to be evaluated for potential remedial action and may also be used in establishing a CEA as defined under the N.J.A.C. 7:9-6.

TABLE 2-25
SITE 17 GROUNDWATER CONTAMINANTS OF CONCERN
OPERABLE UNIT 9 FEASIBILITY STUDY
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

Contaminant of Concern	Exceeds NJ GWQS	Exceeds SDWA MCL	Exceeds Two Times Background	Poses Human Health Risk
Aluminum	X	---(1)	---	---
Arsenic	X	---	X	X(2,3)
Cadmium	X	X	---	---
Chromium	---	---	X	---
Copper	---	---	X	---
Iron	X	---(1)	---	---
Lead	---	---	X	X
Manganese	X	---(1)	---	---

Notes:

X indicates the basis for selection of the contaminant as a COC.
New Jersey groundwater quality standards (GWQS) (N.J.A.C. 7:9-6) are ARARs.
Safe Drinking Water Act (SDWA) Maximum Contaminant Levels (MCLs) regulate organic and inorganic constituents in public drinking water supplies and are included for comparison purposes.
1. No SDWA MCL for this analyte.
2. COC contributes to HI greater than 1.0 for future residential receptor under RME and CTE exposures.
3. COC contributes to excess carcinogenic risks for the future residential receptor.

TABLE 2-26
SITE 17 GROUNDWATER PRELIMINARY REMEDIATION GOALS (μg/L)
OPERABLE UNIT 9 FEASIBILITY STUDY
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

Contaminant of Concern	NJ GWQS	SDWA MCLs	Maximum Background Conc.	Maximum Detected Site Conc.
Arsenic	8.0	50.0	5.1	19.7
Cadmium	4.0	5.0	7	8.3

Notes: New Jersey groundwater quality standards (GWQSs) (N.J.A.C. 7:9-6) are ARARs Safe Drinking Water Act (SDWA) Maximum Contaminant Levels (MCLs) regulate organic and inorganic constituents in public drinking water supplies and are presented for comparison purposes.

TABLE 2-27
SITE 17 PROPOSED GROUNDWATER PRELIMINARY REMEDIATION GOALS
OPERABLE UNIT 9 FEASIBILITY STUDY
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

Contaminant of Concern	Proposed PRG	Basis of Selection
Arsenic	8.0	NJ GWQS
Cadmium	7	Background

Notes:

All units in ug/L
New Jersey groundwater quality standards (GWQSs) (N.J.A.C. 7:9-6) are ARARs

2.9.3 Site 17 General Response Actions

General response actions were selected based on the RAOs for Site 17 and the consideration that the site is an inactive military landfill, therefore incorporating the application of a presumptive remedy. Treatment of landfill soils and materials is considered technically impracticable. The general response actions for Site 17 that address potential human exposures to potential contaminant migration into groundwater include:

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

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

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

2.9.4 Identification, Screening, and Evaluation of Technologies and Process Options for Site 17

Table 2-28 presents a summary of potential remedial technologies and process options that apply to the Site 17 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 that were considered include fill materials consisting of heterogeneous municipal-type waste possibly mixed with minor quantities of military waste materials, the location of the landfill adjacent to a wetlands area, relatively sparse top cover of the landfilled materials, and erosion and runoff from landfill soils and materials into the adjacent wetlands. Also considered is the work previously done by Foster Wheeler Environmental Corporation in 1999 at Site 17 that included grading, topsoil cover, and seeding of the flat portion of the site. A wooden barricade was also installed on the flat upper portion of the site to prevent any future deposition of soils or debris on the sloped area of Site 17.

TABLE 2-28
SITE 17 REMEDIAL ACTION OBJECTIVES, GENERAL RESPONSE ACTIONS, TECHNOLOGY TYPES, AND PROCESS OPTIONS
OPERABLE UNIT 9 FEASIBILITY STUDY
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

Environmental Medium	Remedial Action Objectives (from site characterization)	General Response Actions (for all RAOs)	Remedial Technology Types (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
		Natural Attenuation	Natural Attenuation	- Biological processes - Chemical processes - Physical processes
		Limited Action	Limited Action Technologies - Institutional Controls - Long-Term Monitoring	- Groundwater monitoring - Implement CEA

The preliminary screening of landfill material remedial technologies is presented and summarized in Table 2-29, and the screening of groundwater response remedial technologies is summarized in Table 2-30. Detailed evaluations of the remedial technologies and process options for contaminated soils/landfill materials and groundwater are presented in Tables 2-31 and 2-32, respectively.

2.9.5 Summary of Site 17 Selected Remedial Technologies and Process Options

Tables 2-31 and 2-32 identify the remedial technologies that were retained after the detailed evaluation process. The technologies and process options that are not likely to be implementable and effective or that would result in higher implementation costs were eliminated from further consideration.

For the contaminated soils and landfill materials options, local ordinances were eliminated from further consideration because this action may be difficult to implement and would not offer any greater protection than other institutional controls. The composite cap was eliminated 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 major problem at Site 17. Grading and revegetation options were eliminated due to the previously completed grading and seeding conducted by Foster Wheeler Environmental Corporation in 1999.

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

TABLE 2-29
PRELIMINARY SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS FOR SITE 17 LANDFILL MATERIALS
OPERABLE UNIT 9 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	Deed 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 action such as zoning by-laws and Board of Health regulations used to limit property use and activities such as well installation.	Not viable Local ordinances may not be applicable to military bases. Eliminated.
	Access Restrictions	Fencing	Security fence installed around contaminated areas to restrict access.	Potentially viable. Retained.
	Monitoring	Groundwater Monitoring	Periodic monitoring of groundwater to evaluate contaminant presence and migration from the landfill.	Potentially viable. Retained.
Containment	Surface Controls	Grading	Reshaping of topography to manage precipitation infiltration and surface runoff.	Grading has already been completed as part of the work conducted in 1999. Eliminated.
		Revegetation	Seeding and maintaining site surface to establish vegetation to minimize erosion and to promote evapotranspiration of precipitation, thus reducing infiltration.	Potentially viable. Seeding has already been completed as part of the work conducted in 1999. Eliminated.

TABLE 2-29
PRELIMINARY SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS FOR SITE 17 LANDFILL MATERIALS
OU 9 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE
COLTS NECK, NEW JERSEY

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	DESCRIPTION	SCREENING COMMENTS
Containment (continued)	Cap	Soil (Permeable) Cover	Soil with a vegetative cover to prevent direct contact and minimize erosion and surface migration of contaminated soils.	Potentially viable if direct contact and erosion are the prime threats. Offers little additional protection. Eliminated.
		Single Barrier	Cap constructed with one low-permeability layer (clay or synthetic membrane) over the site to prevent direct contact, to minimize erosion, and to reduce leaching of contaminants from the landfill into groundwater. Additional layers would be required to protect the barrier.	Potentially viable to prevent direct contact and to reduce erosion and infiltration. Offers little additional protection. Eliminated.
		Composite (Double) Barrier	Multi-media cap with two low-permeability layers (clay and/or synthetic membranes) constructed over the site to prevent direct contact and reduce leaching of landfill contaminants into groundwater. Provides greater reduction in infiltration and better protection against failure than a single-barrier cap.	Potentially viable to prevent direct contact and to reduce erosion and infiltration. Offers little additional protection. Eliminated.
Removal and Disposal	Excavation	Mechanical Excavation	Mechanical removal of solid materials using common construction equipment such as bulldozers, excavators, and front-end loaders.	Potentially viable for hot spot areas, if encountered during remediation. However, no hot spots were identified at Site 17. Eliminated.
		Drum Removal	Removal of buried drums or containers using mechanical equipment such as a drum grappler, a drum cradle, a sling attached to a backhoe, or a front-end loader.	Potentially viable if drums or containers are encountered during remediation. Eliminated.

TABLE 2-29
PRELIMINARY SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS FOR SITE 17 LANDFILL MATERIALS
OU 9 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE
COLTS NECK, NEW JERSEY
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GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	DESCRIPTION	SCREENING COMMENTS
Removal and Disposal (continued)	Disposal Off Base	RCRA Landfill	Transport and disposal of excavated materials in a RCRA-permitted landfill.	Technically impracticable to excavate and dispose of entire landfill, the bulk of which is construction debris. Eliminated. Retained for hot spots and drums, if encountered.
	Disposal On Site	New RCRA-Type Landfill	Disposal of untreated bulk landfill materials in a specially constructed on-base landfill.	Technically impracticable to excavate and dispose of entire landfill, the bulk of which is construction debris. Eliminated.
		Consolidation (into existing landfill)	Relocation of landfill materials into another on-base landfill. Or relocation of small, isolated quantities of contaminated materials into an existing on-base landfill so that one closure action can accommodate both.	Technically impracticable to excavate and relocate landfill. Eliminated. This activity was applicable to the remedial construction activities performed in 1999. Eliminated.

TABLE 2-30
PRELIMINARY SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS FOR SITE 17 CONTAMINATED GROUNDWATER
OPERABLE UNIT 9 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 under facility Master Plan.	Potentially applicable.
	Long-Term Monitoring	Groundwater Monitoring	Periodic sampling and analysis of media to assess groundwater contaminant status and potential migration downgradient.	Potentially applicable.

TABLE 2-31
DETAILED EVALUATION OF TECHNOLOGIES AND PROCESS OPTIONS FOR SITE 17 LANDFILL MATERIALS
OPERABLE UNIT 9 FEASIBILITY STUDY
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	EFFECTIVENESS	IMPLEMENTABILITY	COST	CONCLUSION
No Action	No Action	No Action	Would not achieve remedial action objectives.	Implementable.	Capital: None O & M: 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 contaminated soils. No contamination reduction. There currently is fencing separating the site from the base.	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 be effective in promoting precipitation runoff, however grading was completed as part of prior work conducted in 1999.	Implementable, numerous companies with personnel and heavy equipment to perform earth moving and grading.	Capital: Low O & M: None	Eliminated.

TABLE 2-31
DETAILED EVALUATION OF TECHNOLOGIES AND PROCESS OPTIONS FOR SITE 17 LANDFILL MATERIALS
OU 9 FEASIBILITY STUDY
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	EFFECTIVENESS	IMPLEMENTABILITY	COST	CONCLUSION
Containment (continued)	Surface Controls	Revegetation	Would be effective in reducing precipitation infiltration through promotion of evapotranspiration and reduction of surface erosion. Seeding was completed as part of prior work conducted at the site in 1999.	Implementable; numerous companies with personnel and equipment available to perform revegetation.	Capital: Low O & M: Low	Eliminated.
	Cap	Soil (Permeable) Cover	Would prevent direct exposure to contaminated soils. Would reduce precipitation infiltration and contaminant leaching to groundwater and would reduce erosion of landfill materials to adjacent wetlands. No contaminant reduction.	Implementable using standard methods and readily available equipment.	Capital: Low O & M: Low	Eliminated.
		Single Barrier	Would limit infiltration and significantly reduce contaminant leaching to groundwater. Would prevent exposure to contaminated soils and surface migration of contaminated soils. No contaminant reduction.	Implementable by standard construction techniques; would require specialized, but readily available, equipment and materials to install synthetic cap.	Capital: Moderate O & M: Low	Eliminated.

TABLE 2-31
DETAILED EVALUATION OF TECHNOLOGIES AND PROCESS OPTIONS FOR SITE 17 LANDFILL MATERIALS
OU 9 FEASIBILITY STUDY
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY
PAGE 3 OF 4

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	EFFECTIVENESS	IMPLEMENTABILITY	COST	CONCLUSIONS
Containment (continued)	Cap (continued)	Composite (Double) Barrier	Same as single barrier. Second impermeable barrier would provide greater assurance against cover failure. Level of protection offered by composite barrier cap not required at Site 17 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.
Removal and Disposal	Excavation	Mechanical Excavation	Effective method for removing highly contaminated soils and hot spots, if encountered during remediation.	Implementable with standard construction equipment. Equipment and resources are readily available from various contractors.	Capital: Low O & M: None	
		Drum Removal	Effective for drum removal, if encountered during remediation. However, due to the type of wastes disposed of at the site and because previous grading work was conducted in 1999, there is little possibility that drums are present at the site.	Equipment and resources are readily available from various contractors.	Capital: Low O & M: None	Eliminated.

TABLE 2-31
DETAILED EVALUATION OF TECHNOLOGIES AND PROCESS OPTIONS FOR SITE 17 LANDFILL MATERIALS
OU 9 FEASIBILITY STUDY
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	EFFECTIVENESS	IMPLEMENTABILITY	COST	CONCLUSIONS
Removal and Disposal (continued)	Disposal Off-Base	RCRA Landfill (for hot spot removals only)	Effectively controls release of hot spot contaminants to environment, if encountered during remedial actions. Would probably handle volume of hot spot materials encountered. Landfill materials may require treatment prior to disposal to meet land disposal requirements.	Implementable. Commercial landfill facilities are available. Implementation becomes more difficult if excavated materials require segregation or treatment prior to disposal.	Capital: Moderate O & M: None	Eliminated.
	Disposal On Base	Consolidation	Allows small volumes of material from other isolated locations to be consolidated and addressed with the majority of landfill materials.	Readily implementable for small or moderate soil volumes. No implementability concerns.	Capital: Low O & M: Low	Eliminated.

TABLE 2-32
EVALUATION OF TECHNOLOGIES AND PROCESS OPTIONS FOR SITE 17 CONTAMINATED GROUNDWATER
OPERABLE UNIT 9 FEASIBILITY STUDY
NAVAL WEAPONS STATION EARLE, COLTS NECK, NEW JERSEY

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	EFFECTIVENESS	IMPLEMENTABILITY	COST	RETAIN/ ELIMINATE
No Action	No Action	No Action	Does not achieve remedial action objectives.	Implementable	Capital: None O&M: None	Retained.
Limited Action	Institutional Controls	Deed 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.

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 each site. 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 6 - DEVELOPMENT AND SCREENING OF ALTERNATIVES

Section 3.1.1 presents the rationale for development of remedial action alternatives for Site 6, 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 6 - Rationale for Development of Alternatives

Factors considered in formulating the remedial alternatives to address the RAOs for Site 6 are discussed below:

Protection of Human Health Considerations - The RAO for protection of human health specifies preventing human exposure to metals in groundwater. 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 Installation Restoration (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 6 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 municipal landfills based on the expectation that containment would generally be appropriate for municipal landfill waste because the volume and heterogeneity of the waste generally make treatment impracticable (OSWER Directive No. 9355.0-49FS). Further, EPA established that the municipal landfill presumptive remedy should also be applied to all appropriate military sites (OSWER Directive No. 9355.0-62FS). Based on the criteria presented in that directive, the Site 6 landfill is an appropriate site for the application of the presumptive remedy for CERCLA municipal landfills. However, considering site conditions as discussed in this report and the RI report (i.e., the presence of buildings and sports facilities over the landfilled area), prescreening (elimination) of presumptive remedy technologies was performed in accordance with the presumptive remedy directives noted above and the guidance document Conducting Remedial Investigations/ Feasibility Studies for CERCLA Municipal Landfill Sites. The resulting alternatives development process was streamlined to focus on groundwater issues.

3.1.2 Site 6 - Remedial Alternatives Descriptions

This section presents detailed descriptions of the remedial alternatives for Site 6. The key components of Alternatives 1 and 2 are identified on Table 3-1.

3.1.2.1 Site 6 - Alternative 1: No Action

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

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 to mitigate contaminant migration in the environment. Key components of Alternative 1 are identified on Table 3-1 and described below.

Existing Features - Currently, site features including the buildings, tennis courts, and other facilities provide significant protection of human health and the environment. The primary protective feature is that groundwater underlying Site 6 is not used as a potable water supply. There is currently no pathway for human exposure to metals-contaminated groundwater.

TABLE 3-1
SITE 6 - REMEDIAL ALTERNATIVE COMPONENTS
OPERABLE UNIT 9 FEASIBILITY STUDY
NAVY WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

	ALTERNATIVE	KEY COMPONENTS OF ALTERNATIVE
1	No Action	• No actions would be taken
2	Limited Action	• Fencing (fencing is already in place) • Institutional controls (land use restrictions, CEA*) • Long-term periodic groundwater monitoring • Five-year reviews

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

No actions would be conducted under Alternative 1 to monitor the status of or to preclude potential contact with groundwater.

3.1.2.2 Site 6 - Alternative 2: Institutional Controls and Long-Term Monitoring

Alternative 2 relies on institutional controls to limit potential exposure to contaminated groundwater. This alternative does not employ engineered treatment or containment to address groundwater contamination.

Institutional controls would be enacted to prohibit use of impacted groundwater. 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 5 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 6 features offer some limited protection of human health and the environment. Foster Wheeler Environmental Corporation conducted slope stabilization work at the site in 1999 that included removal of debris, backfilling, regrading, and seeding. Groundwater underlying Site 6 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 has been installed to deter human and animal entry into the landfill area to protect the integrity of the existing cover. The fence is an 8-foot-high chain-link fence with galvanized steel posts installed at 8-foot intervals. Current fencing at the site would be evaluated to see if it could be used in lieu of new fencing for this remedial alternative.

Institutional Controls - Under Alternative 2, land use restrictions would be incorporated into the Base Master Plan to restrict the future use of Site 6 groundwater until natural processes have reduced contaminant concentrations to acceptable levels (GWQSs). Use of untreated, contaminated Site 6 groundwater for drinking water would be prohibited.

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

Long-Term Monitoring - Under Alternative 2, one new well would be installed downgradient of Site 6. Groundwater would be sampled periodically to monitor the migration of contaminants from Site 6 and assess the potential impacts to downgradient receptors. The collected data would be evaluated during the five-year review period.

For the purpose of costing, it is assumed that groundwater samples would be collected from three existing monitoring wells and one new downgradient well. A total of six groundwater samples, including Quality Assurance/Quality Control (QA/QC) samples, would be collected annually. 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.

Five-Year Reviews - Because contaminants would remain in Site 6 groundwater, a review of site conditions and risks would be conducted every 5 years, as required by CERCLA. The reviews would consist of evaluating analytical and hydrogeologic data and assessing whether contaminant migration has increased to determine whether human receptors or natural resources are at risk.

3.1.3 Site 6 - 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 6. The screening is presented in Table 3-2.

3.2 SITE 12 - DEVELOPMENT AND SCREENING OF ALTERNATIVES

Section 3.2.1 presents the rationale for development of remedial action alternatives for Site 12, and Section 3.2.2 describes the assembled alternatives. A detailed evaluation of the retained alternatives are presented in Section 4.0.

3.2.1 Site 12 - Rationale for Development of Alternatives

Factors considered in formulating the remedial alternatives to address the RAOs for Site 12 are discussed below:

Protection of Human Health Considerations – No further action deemed necessary.

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

TABLE 3-2
SITE 6 - SCREENING OF REMEDIAL ALTERNATIVES
OPERABLE UNIT 9 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. 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 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.

3.2.2 Site 12 - Remedial Alternatives Descriptions

Because this site has been remediated by the Navy, this section presents a summary of the remedial activities carried out and a discussion of the no-further-action recommendation proposed for Site 12.

3.2.2.1 Site 12 - No Further Action

The no-further-action alternative is developed as a baseline case, as required by the NCP. No activities would be conducted under this alternative. The no-action alternative has been chosen for Site 12 based on soil excavation activities conducted by Foster Wheeler Environmental Corporation on behalf of the Navy at the site in 1999.

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 to mitigate contaminant migration in the environment.

Existing Features - Currently, site features offer limited protection of human health and the environment. The primary protective feature is that groundwater underlying Site 12 is not used as a potable water supply. There is currently no pathway for human exposure to metals-contaminated groundwater.

The excavation and removal of surface soils in the vicinity of Site 12 conducted in 1999 was based on the RI delineation of lead concentrations. Cleanup and verification sampling of site soils was performed to the NJDEP Residential Direct Contact Soil Cleanup Criteria. Therefore, no PRGs or remedial alternatives were developed in this FS for Site 12. Based on soil excavation work performed at Site 12 in 1999 by Foster Wheeler Environmental Corporation, it is recommended that no further action be taken at Site 12.

Remedial Action Summary

The objectives of the remedial action taken in 1999 included minimizing the potential migration and mobilization of contaminants to surface water, groundwater, and soils at the site. Approximately 262 tons of excavated soil was shipped offsite for disposal and recycling. Three rounds of confirmatory sampling were conducted to demonstrate compliance with State direct contact residential cleanup standards. This prior excavation of contaminated soils achieves the remediation objectives developed for Site 12 for protection of human health and the environment, including prevention of human exposure to contaminated surface and subsurface soils, and migration of contaminants to the adjacent marsh.

Based on EPA and NJDEP approval, Site 12 has met all the applicable requirements for closure, and the remediation for which Foster Wheeler Environmental Corporation was contracted by the Navy is complete (Remedial Action Report for Soil Excavation at Site 12, Foster Wheeler, Environmental Corporation, December 1999).

3.3 SITE 15 - DEVELOPMENT AND SCREENING OF ALTERNATIVES

Section 3.3.1 presents the rationale for development of remedial action alternatives for Site 15, Section 3.3.2 describes the assembled alternatives, and Section 3.3.3 presents the screening of alternatives. Detailed evaluations and costing of the retained alternatives are presented in Section 4.0.

3.3.1 Site 15 - Rationale for Development of Alternatives

Factors considered in formulating the remedial alternatives to address the RAOs for Site 15 are discussed below:

Protection of Human Health Considerations - The RAO for protection of human health specifies preventing human exposure to contaminated surface and subsurface soils. This objective has been addressed in the formulation of remedial alternatives.

Protection of the Environment Considerations - None.

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 alternatives, including one or more engineering control alternatives (such as containment), one or more innovative treatment alternatives, and the baseline no-action alternative. Treatment technologies are favored to address principal threats, and engineering controls are favored to address relatively low long-term threats.

3.3.2 Site 15 - Remedial Alternatives Descriptions

This section presents detailed descriptions of the remedial alternatives for Site 15. The key components of Alternatives 1 and 2 are identified on Table 3-3.

TABLE 3-3
SITE 15 - REMEDIAL ALTERNATIVE COMPONENTS
OPERABLE UNIT 9 FEASIBILITY STUDY
NAVY WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

	ALTERNATIVE	KEY COMPONENTS OF ALTERNATIVE
1	No Action	• No actions would be taken
2	Limited Action	• Institutional controls (land use restrictions) • Fencing (fencing is already in place) • Five-year reviews (including sampling and analysis)

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

3.3.2.1 Site 15 - Alternative 1: No Action

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

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 to mitigate contaminant migration in the environment. Key components of Alternative 1 are identified on Table 3-3 and described below.

Existing Features - Currently, site features offer significant protection of human health and the environment. The primary protective feature is that the entire site is located within a red maple/sweetgum wetland and is fenced off from the remainder of the base by a double-fenced security buffer zone.

3.3.2.2 Site 15 - Alternative 2: Limited Action

Alternative 2 relies on institutional controls to limit exposures to contaminated soils. This alternative does not employ engineered treatment or containment to address soil contamination.

Institutional controls would be enacted to prohibit use of impacted soils. Site conditions and risks would be reviewed every 5 years because contaminants would be left in place. Key components of Alternative 2 are identified on Table 3-3 and described below.

Existing Features - Currently, site security fencing at Site 15 offers significant protection of human health and the environment. The site is fenced off from the remaining base property by a double-fenced security buffer zone.

Security Fencing - Security fencing would be installed to deter human and animal entry into the landfill area to protect the integrity of the existing cover. The fence is expected to be 8-foot-high chain-link fence, with galvanized steel posts installed at 8-foot intervals. A locking gate would be installed to allow controlled access to the site. Current fencing at the site would be evaluated to see if it could be used in lieu of new fencing for this remedial alternative.

Institutional Controls - Under Alternative 2, land use restrictions would be incorporated into the Base Master Plan to restrict the future use of Site 15 to its present security buffer use.

Five-Year Reviews - Because contaminants would remain in Site 15 soils, a review of site conditions and risks would be conducted every 5 years, as required by CERCLA. For the purpose of the five-year review, surface and subsurface soil samples would be collected every 5 years for metals concentration analysis. Analytical data from the soil sampling activity will be assessed to determine if human receptors or natural resources are at risk.

3.3.3 Site 15 - 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 15. The screening is presented in Table 3-4.

3.4 SITE 17 - DEVELOPMENT AND SCREENING OF ALTERNATIVES

Section 3.4.1 presents the rationale for development of remedial action alternatives for Site 17, Section 3.4.2 describes the assembled alternatives, and Section 3.4.3 presents the screening of alternatives. Detailed evaluations and costing of the retained alternatives are presented in Section 4.0.

3.4.1 Site 17 - Rationale for Development of Alternatives

Factors considered in formulating the remedial alternatives to address the RAOs for Site 17 are discussed below:

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

Protection of the Environment Considerations - None.

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 alternatives including one or more engineering control alternatives (such as containment), one or more innovative treatment alternatives, and the baseline no-action alternative. Treatment technologies are favored to address principal threats, and engineering controls are favored to address relatively low long-term threats.

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

TABLE 3-4
SITE 15 - SCREENING OF REMEDIAL ALTERNATIVES
OPERABLE UNIT 9 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. 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. Contact with site soils 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.

EPA established containment as the presumptive remedy for municipal landfills based on the expectation that containment would generally be appropriate for municipal landfill waste because the volume and heterogeneity of the waste generally make treatment impracticable (OSWER Directive No. 9355.0-49FS). Further, EPA established that the municipal landfill presumptive remedy should also be applied to all appropriate military sites (OSWER Directive No. 9355.0-62FS). Based on the criteria presented in that directive, the Site 17 landfill is an appropriate site for the application of the presumptive remedy for CERCLA municipal landfills. However, considering site conditions (the presence of buildings, and parking areas and the work performed by the Navy to protect the former landfill area from disturbance and erosion), prescreening (elimination) of presumptive remedy technologies was performed in accordance with the presumptive remedy directives noted above and the guidance Conducting Remedial Investigations/ Feasibility Studies for CERCLA Municipal Landfill Sites. The resulting alternatives development process was streamlined to focus on groundwater issues.

3.4.2 Site 17 - Remedial Alternatives Descriptions

This section presents detailed descriptions of the remedial alternatives for Site 17. The key components of Alternatives 1 and 2 are identified on Table 3-5.

3.4.2.1 Site 17 - Alternative 1: No Action

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

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. Key components of Alternative 1 are identified on Table 3-5 and described below.

Existing Features - Currently, site features offer limited protection of human health and the environment. The primary protective feature is that groundwater underlying Site 17 is not used as a potable water supply. There is currently no pathway for human exposure to metals-contaminated groundwater.

Work performed by Foster Wheeler Environmental Corporation in 1999 included grading of the flat portion of the site, topsoil cover, and seeding. A wooden barricade was also installed on the flat upper portion of the site to prevent any future deposition of soils or debris on the sloped area of Site 17. Currently, the site is fenced off from other base property.

TABLE 3-5
SITE 17 - REMEDIAL ALTERNATIVE COMPONENTS
OPERABLE UNIT 9 FEASIBILITY STUDY
NAVY WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

	ALTERNATIVE	KEY COMPONENTS OF ALTERNATIVE
1	No Action	• No actions would be taken
2	Limited Action	• Institutional controls (land use restrictions) • Fencing (fencing is already in place) • Five-year reviews (including sampling and analysis)

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

No actions would be conducted under Alternative 1 to monitor the status of or to preclude potential contact with groundwater.

3.4.2.2 Site 17 - Alternative 2: Institutional Controls and Long-Term Monitoring

Alternative 2 relies on institutional controls to limit exposures to contaminated groundwater. This alternative does not employ engineered treatment or containment to address groundwater contamination.

Institutional controls would be enacted to prohibit use of groundwater contaminated with metals. 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 5 years because contaminants would be left in place. Key components of Alternative 2 are identified on Table 3-5 and described below.

Existing Features - Currently, Site 17 features offers some limited protection of human health and the environment. Foster Wheeler Environmental Corporation conducted work at the site in 1999 that included regrading, topsoil cover, seeding, and installation of a wooden barricade. Groundwater underlying Site 17 is not used as a potable water supply. As a result, there is currently no pathway for human exposure to contaminated groundwater. However, potable water supply wells are situated elsewhere on the base, and site groundwater could conceivably be used as a potable water supply in the future, posing a potential human health risk. Although active treatment of groundwater would not be conducted, a gradual reduction in concentrations of groundwater contaminants by dispersion, dilution, and degradation should occur.

Security Fencing - Security fencing was installed in 1999 to deter human and animal entry onto parts of the landfill area to protect the integrity of the existing cover. The existing fence is expected to be sufficient for the purposes of this remedial alternative. However, for cost estimating purposes, installation of fencing has been included in the cost estimate for this Alternative.

Institutional Controls - Under Alternative 2, land use restrictions would be incorporated into the Base Master Plan to restrict the future use of Site 17 groundwater until natural processes have reduced contaminant concentrations to acceptable levels (GWQSs). Use of untreated, contaminated Site 17 groundwater for drinking water would be prohibited.

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

Long-Term Monitoring - Under Alternative 2, one new well would be installed downgradient of Site 17. Groundwater would be sampled periodically to monitor the migration of contaminants from Site 17 and assess the potential impacts to downgradient receptors. The collected data would be evaluated during the five-year review period.

For the purpose of costing, it is assumed that groundwater samples would be collected from three existing monitoring wells and one new downgradient well. A total of six groundwater samples, including QA/QC samples, would be collected annually. 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.

Five-Year Reviews - Because contaminants would remain in Site 17 groundwater, a review of site conditions and risks would be conducted every 5 years, as required by CERCLA. The reviews would consist of evaluating analytical and hydrogeologic data and assessing whether contaminant migration has increased to determine whether human receptors or natural resources are at risk.

3.4.3 Site 17 - 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 17. The screening is presented in Table 3-6.

TABLE 3-6
SITE 17 - SCREENING OF REMEDIAL ALTERNATIVES
OPERABLE UNIT 9 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. 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 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.

4.0 DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES

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

4.1 INDIVIDUAL ANALYSIS OF SITE 6 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 A.

4.1.1 Site 6 - 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 measures would be implemented to prevent future use of site groundwater. Contaminated groundwater would continue to pose a potential health risk until contaminant concentrations naturally reduce to guideline levels.

The potential human health risks from ingestion, inhalation, and contact with contaminated groundwater would not be reduced under Alternative 1. Alternative 1 would involve no active treatment of groundwater or implementation of institutional controls to restrict use of contaminated groundwater. The risks to future residential and industrial receptors from site groundwater would continue to exceed EPA's target levels for carcinogens (residential only) and non-carcinogens.

Compliance with ARARs

Because groundwater beneath Site 6 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.

Long-Term Effectiveness and Permanence

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

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 carcinogenic risk of 6 E-04 and a potential non-carcinogenic risk (HI) greater than 1.0, mainly based on ingestion of groundwater. Exposure to contaminated groundwater under a future industrial land use scenario results in a risk in the upper bound of EPA's target risk range but did not exceed EPA's target risk range for non-carcinogenic hazards. Because Alternative 1 would not include any remedial actions or institutional controls 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 6 is not currently used as a potable water supply and there are no existing plans for its use; however, public non-community wells and domestic wells are situated elsewhere on or near NWS Earle. If site land and groundwater usage 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 many 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 is used to address the contaminated media.

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.

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

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

4.1.2 Site 6 - Alternative 2: Institutional Controls and Long-Term Monitoring

Alternative 2 relies on institutional controls to achieve RAOs. A fence would limit access to the landfill area. Access restrictions would be placed to limit future 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.

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 capped 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 6, 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 temporary exemption (CEA) from these requirements until the GWQSs are achieved. The CEA would be established to provide the State official notice that the constituent standards would not be met for a specified duration and to ensure that consumption of the untreated groundwater is prohibited.

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

Brief descriptions of the cited requirements are provided in Section 2.1 of this report.

Long-Term Effectiveness and Permanence

The risk assessment concluded that, under a future residential land use scenario, exposure to contaminated groundwater beneath the site would result in a potential carcinogenic risk of 6 E-04 and an HI of 5.7 for non-carcinogenic exposures. These risk estimates exceed EPA's guideline risk. Implementing institutional controls to prohibit use of untreated contaminated groundwater would reduce these risks 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 and chemical mechanisms.

The groundwater underlying Site 6 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 institutional controls (access restrictions and 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 wetlands and downgradient receptors, and determine whether additional remedial actions are necessary. The monitoring 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 many 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 (if additional fencing is deemed necessary). Workers who implement Alternative 2 would be adequately safeguarded by using appropriate personal protective equipment (PPE) to prevent exposure to groundwater, contaminant-laden dusts, and airborne VOCs. Occupational Safety and Health Administration (OSHA) standards would be followed and, proper PPE would be used during any intrusive remedial activities.

Upon completion of the fencing if required (current fencing will be evaluated to determine if it is sufficient for the proposed access restrictions purpose), Alternative 2 would 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 a year or longer.

Implementability

Alternative 2 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, 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 of $44,360 have been included in the first-year operations and maintenance (O&M) cost. The average annual O&M cost for long-term monitoring is $11,000, and five-year reviews are $15,500 per event. Over a 30-year period, the net present-worth cost is $214,280 (at a 7 percent discount rate).

4.1.3 Comparative Analysis of Site 6 Alternatives

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

Overall Protection of Human Health and the Environment

Alternative 2 would be considerably more protective than Alternative 1. Because no actions are conducted, Alternative 1 would not reduce human health risk.

Alternative 2 includes restricting access and establishing a groundwater CEA that would reduce human health risks posed by contact with groundwater. Institutional controls would provide assurance that untreated contaminated groundwater is not used as a potable water source in the future. This would significantly reduce the human health risks by eliminating potential exposure to contaminated groundwater (the driving concern in the human risk assessment).

TABLE 4-1
SITE 6 - COMPARATIVE ANALYSIS OF REMEDIAL ACTION ALTERNATIVES
OPERABLE UNIT 9 FEASIBILITY STUDY
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

CRITERION:	ALTERNATIVE 1: NO ACTION	ALTERNATIVE 2: INSTITUTIONAL CONTROLS AND LONG-TERM MONITORING
OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT		
Prevent Human Exposure to Metals Contaminants in Groundwater	No action taken to prevent human exposure to contaminated groundwater. Carcinogenic and non-carcinogenic risks exceeding EPA guidelines would remain. No institutional controls implemented to prohibit use of untreated groundwater.	Institutional controls would minimize potential exposure to site groundwater by prohibiting its use. In time, contaminants would gradually decrease until reaching levels that would not pose excess risk.
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.
Location-Specific ARARs	Not applicable.	Would comply with federal and State ARARs for wetlands, floodplains, and other sensitive receptors.
Action-Specific ARARs	Would comply with all action-specific ARARs. Federal or State ARARs for post-closure maintenance of municipal landfills may not be met.	Would comply with all action-specific ARARs. Five-year review process would ensure Federal or State ARARs for post-closure maintenance of municipal landfills will be met.
LONG-TERM EFFECTIVENESS AND PERMANENCE		
Magnitude of Residual Risk	Existing risks would remain: approximately 6E-04 cancer risk and HI > 1 non-carcinogenic risk from exposure to site groundwater assuming future residential land use and consumption of contaminated groundwater.	Existing risks would remain: approximately 6E-04 cancer risk and HI > 1 non-carcinogenic risk from exposure to site groundwater. Implementation and enforcement of institutional controls would block exposure to site groundwater. Fencing would reduce potential contact with shallow groundwater.
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 and use of contaminated groundwater.
Need for Five-Year Review	Not applicable.	Review would be required because groundwater contaminants would be left in place.
REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT		
Reduction of Toxicity, Mobility, or Volume Through Treatment	No reduction, because no treatment would be employed.	No reduction, because no treatment would be employed.

TABLE 4-1
SITE 6 - COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES
OU-9 FEASIBILITY STUDY
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY
PAGE 2 OF 2

CRITERION:	ALTERNATIVE 1: NO ACTION	ALTERNATIVE 2: INSTITUTIONAL CONTROLS AND LONG-TERM MONITORING
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.
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.
Environmental Impacts	No adverse impacts to the environment anticipated.	No adverse impacts to the environment anticipated.
Time Until Action is Complete	Not applicable.	Approximately 1 year to institute CEA.
IMPLEMENTABILITY		
Ability to Construct and Operate	No construction or operation involved.	No difficulties anticipated. Monitoring well and fencing installation are readily implementable technologies.
Ease of Doing More Action if Needed	Additional actions would be easily implemented if required.	Additional actions would be easily implemented if required.
Ability to Monitor Effectiveness	Not applicable.	Monitoring would provide assessment of potential exposures, contaminant presence, and migration, or changes in site conditions.
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.
Availability of Treatment, Storage Capacities, and Disposal Services	None required.	None required.
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.
Availability of Technology	Not required.	Common construction techniques and materials required for construction.
COST		
Capital Cost	$0	$44,360
First-Year Annual O&M Cost	$0	$11,000
Five-Year Reviews	$0	$15,500
Present Worth Cost*	$0	$214,280

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

Compliance with ARARs

Because Alternatives 1 does not include any remedial actions, it may not comply with State and federal ARARs pertaining to post-closure of municipal landfills (40 CFR 258.60 & 258.61 and N.J.A.C. 7:26-2A.9). Periodic monitoring of landfill cover conditions and access restrictions would ensure that alternative 2 complies with these ARARs.

Alternative 1 would not comply with State ARARs for attainment of groundwater quality standards (N.J.A.C. 7:9-6). Alternative 2 would comply by seeking a temporary exemption (CEA) from these requirements until the GWQSs are achieved. Alternative 2 would comply with federal and State monitoring requirements through periodic monitoring and evaluation, and five-year reviews.

Long-Term Effectiveness and Permanence

Alternative 2 offers long-term protection of human health and the environment. Under Alternative 1, risks would remain the same over time. Potential future users of site groundwater may be at risk under Alternative 1 because it lacks institutional controls that would prohibit use of untreated contaminated groundwater.

Alternative 2 would mitigate long-term risks due to ingestion of site groundwater by implementing institutional controls to prohibit use of untreated, contaminated groundwater. Alternative 2 would reduce human risks due to direct exposure to groundwater by eliminating the potential for exposure.

Reduction of Toxicity, Mobility, or Volume through Treatment

Because neither of the alternatives includes treatment, they would not reduce the toxicity, mobility, or volume through treatment.

Short-Term Effectiveness

The short-term effectiveness of the alternatives would be similar because the use of appropriate engineering controls and PPE under Alternative 2 is expected to minimize adverse impacts to base residents and personnel, the local community, and workers during implementation.

Under Alternative 1, no action is proposed so there would be no opportunity for short-term impact. Alternative 2 would present a greater opportunity for short-term impact due to monitoring well installation, maintenance, and monitoring activities.

Impacts to the environment are not anticipated under Alternatives 1 and 2 because minimal activities would be conducted.

Alternative 1 would not achieve any of the RAOs. Alternative 2 would achieve all RAOs within approximately 1 year, which is be the time estimated to implement the CEA.

Implementability

Alternative 1 is easily implemented because no activities are proposed. Alternative 2 is also easily implemented because the only activities would be installation of fencing and one monitoring well, long-term monitoring, and five-year reviews.

If additional actions are warranted, they could be easily implemented under Alternatives 1 and 2.

Cost

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

4.2 INDIVIDUAL ANALYSIS OF SITE 12 ALTERNATIVES

It is recommended that no further action be performed at Site 12. No activities would be conducted under this alternative. The no-action alternative has been chosen for Site 12 based on soil excavation activities conducted by Foster Wheeler Environmental Corporation at the site in 1999.

The excavation and removal of surface soils in the vicinity of Site 12 conducted in 1999 was based on the RI delineation of metals concentrations. The site cleanup to NJDEP Residential Direct Contact Soil Cleanup Criteria was confirmed by NJDEP and EPA after the Navy performed soil excavation, off site removal and disposal, and verification sampling. The remedial activities were followed by restoration of the site after excavation.

The objectives of the remedial action taken in 1999 included minimizing the potential migration and mobilization of the contaminants to surface water, groundwater, and soils at the site. Approximately 262 tons of excavated soil was shipped offsite for disposal and recycling. Three rounds of confirmatory sampling were conducted to demonstrate compliance with State cleanup standards. The excavation of contaminated soils achieves the remediation goal for Site 12 for protection of human health and the environment, including prevention of human exposure to contaminated surface and subsurface soils and migration of contaminants to the adjacent marsh.

Based on EPA and NJDEP approval, Site 12 has met all the applicable requirements for closure, and the remediation for which Foster Wheeler Environmental Corporation was contracted by the Navy is complete (Foster Wheeler Environmental Corporation, 1999).

4.3 INDIVIDUAL ANALYSIS OF SITE 15 ALTERNATIVES

Detailed evaluations of the remedial alternatives retained for further evaluation in Section 3.0 are presented in this section. Detailed cost estimates and assumptions for each alternative are presented in Appendix A.

4.3.1 Site 15 - 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. Contaminated soils would remain, potentially acting as a continuing source of risk to future receptors.

The potential human health risks from ingestion, inhalation, and contact with contaminated surface and subsurface soils would not be reduced under Alternative 1. Alternative 1 would involve no active treatment of soils or implementation of institutional controls to restrict use of contaminated soils.

Compliance with ARARs

Because surface and subsurface soils at Site 15 exceed State residential direct contact cleanup criteria, and no actions would be taken to reduce contaminant concentrations, Alternative 1 would not comply with these standards.

Long-Term Effectiveness and Permanence

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

The risk assessment concluded that, under a future residential land use scenario, exposure to contaminated soils at the site would result in a potential RME carcinogenic risk of 3.5 E-05 and a potential non-carcinogenic risk (HI) greater than 1.0, mainly based on ingestion and dermal contact with surface

and subsurface soils. Exposure to contaminated groundwater under a future industrial land use scenario results in a risk within the EPA's target risk range, and did not result in exceedance of EPA's guideline for non-carcinogenic hazards. Because Alternative 1 would not include any remedial actions or institutional controls to reduce contaminant concentrations in soil, the risk for potential future exposure to site soils would remain unchanged.

Under ambient conditions, a gradual reduction of the contaminants in site soils would likely occur through physical, biological, and chemical mechanisms; however, the process is likely to take many 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 is used to address the contaminated media.

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.

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

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

4.3.2 Site 15 - Alternative 2: Institutional Controls and Long-Term Monitoring

Alternative 2 relies on institutional controls to achieve RAOs. Fencing around the perimeter would limit access to the site. Access restrictions would be placed to limit future uses of the site that may result in direct contact with contaminated media. Over time, soil 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 3-3.

Overall Protection of Human Health and the Environment

Alternative 2 would provide protection of human health and the environment by restricting access to contaminated site soil. Fencing and access restrictions would provide long-term protection by limiting access to the area. Evaluation of the fence currently separating the site from the remainder of the base will be made to determine its adequacy for this purpose.

Alternative 2 would also reduce the risks posed by future use of site soils. The human health risk assessment concluded that site soils pose low levels of carcinogenic and non-carcinogenic risks under a future residential exposure scenario. Soil contaminant concentrations should eventually decrease to acceptable levels (New Jersey residential direct contact cleanup criteria), reducing the long-term risk posed by future use of site soils. Implementing access restrictions and establishing long-term monitoring and five-year reviews would provide interim protection by prohibiting use of the site until soil cleanup criteria are achieved.

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 soils, the soil at Site 15 would not initially meet the New Jersey residential direct contact soil cleanup criteria. However, contaminants in the soils should gradually reduce naturally to cleanup criteria.

The potential effects of the proposed actions on wetlands, floodplains, water bodies, and other sensitive receptors would be identified, and all necessary measures would be taken to comply with the location-specific federal and State ARARs identified in Tables 2-3 and 2-4. The entire area of Site 15 is a red maple/sweetgum wetland and therefore, the sensitivity of the site must be taken into consideration. It is expected that Alternative 2 would comply with these ARARs.

Brief descriptions of the cited requirements are provided in Section 2.1 of this report.

Long-Term Effectiveness and Permanence

The risk assessment concluded that, under a future residential land use scenario, exposure to contaminated soils at the site would result in a potential carcinogenic risk of 3.5 E-05 and a HI of 0.88 for

non-carcinogenic exposures. These risk estimates do not exceed EPA's risk guideline. Implementing institutional controls to prohibit exposure to untreated soils would reduce these risks and provide long-term protection of human health. A gradual reduction of soil contamination should occur that would ultimately result in reduced risk as soil contaminant concentrations decrease to acceptable levels (New Jersey residential soil cleanup criteria) through natural, physical, and chemical mechanisms.

Alternative 2 would reduce the human health risk posed by direct exposure to contaminated site materials. Because contaminated soils and disposal materials would remain in place, long-term routine maintenance of the perimeter fencing would be required to ensure the long-term protectiveness. An evaluation will be made to determine if current fencing at the site could be utilized.

Periodic monitoring and evaluation of soils would allow the responsible agency to monitor the quality of soils at the site, assess potential impacts to the adjacent wetlands and downgradient receptors, and determine whether remedial actions are necessary. The monitoring 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 soils would likely occur through physical, biological, and chemical mechanisms; however, the process is likely to take many 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.

No difficulties or uncertainties are anticipated in performing the long-term maintenance or monitoring. All materials used in construction of the fencing are readily available. In the event of damage to the fencing, repairs would likely be performed without difficulty.

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 contaminated disposal materials or soils.

Short-Term Effectiveness

Implementation of Alternative 2 is not expected to pose any significant risks to base personnel or the local community. Workers who implement Alternative 2 would be adequately safeguarded by using appropriate PPE to prevent exposure to contaminated soils and contaminant-laden dusts. OSHA standards would be followed, and proper PPE would be used during all remedial activities.

Upon completion of the fencing, Alternative 2 would achieve the RAO for protection of human health by preventing exposure to contaminated soils.

Implementability

Alternative 2 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, 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 soils would be effective for detecting changes in media 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 (if needed) 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 of $19,490 have been included in the first-year O&M cost. The average annual O&M cost for long-term monitoring is $0, and five-year reviews (including sampling costs) are $14,500 per event. Over a 30-year period, the net present-worth cost is $50,760 (at a 7 percent discount rate).

4.3.3 Comparative Analysis of Site 15 Alternatives

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

Overall Protection of Human Health and the Environment

Alternative 2 would be more protective of human health than Alternative 1. Because no actions are conducted, Alternative 1 would not reduce human health or ecological risk. Alternative 2 includes access restrictions to reduce the human health risks by eliminating potential exposure to groundwater contaminated by site soils. It would also prevent exposure to surface and subsurface soils at the site (the driving concern in the human risk assessment).

Compliance with ARARs

Alternative 2 would comply with exposure limits and federal and State long-term monitoring requirements through periodic monitoring and evaluation of soils.

Alternative 1 would not comply with State ARARs for attainment of New Jersey residential direct contact soil cleanup criteria.

Long-Term Effectiveness and Permanence

Under Alternative 1, risks would remain unchanged.

Alternative 2 offers long-term protection of human health and the environment. Alternative 2 would mitigate long-term risks due to ingestion, inhalation, and dermal contact with site soils by implementing institutional controls to prohibit use and exposure to untreated, contaminated soils.

Reduction of Toxicity, Mobility, or Volume Through Treatment

Because neither of the alternatives includes treatment, they would not reduce the toxicity, mobility, or volume through treatment.

Short-Term Effectiveness

The short-term effectiveness of the alternatives would be similar because the use of appropriate engineering controls and PPE is expected to minimize adverse impacts to base residents and personnel, the local community, and workers during implementation.

TABLE 4-2
SITE 15 - COMPARATIVE ANALYSIS OF REMEDIAL ACTION ALTERNATIVES
OPERABLE UNIT 9 FEASIBILITY STUDY
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

CRITERION:	ALTERNATIVE 1: NO ACTION	ALTERNATIVE 2: INSTITUTIONAL CONTROLS AND LONG-TERM MONITORING
OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT		
Prevent Human Exposure to Metals Contaminants in Surface and Subsurface Soils	No action taken to prevent human exposure to contaminated soils. Carcinogenic and non-carcinogenic risks would remain. No institutional controls implemented to prohibit exposure to contaminated soils.	Institutional controls would minimize potential exposure to site soils by prohibiting use and access. In time, contaminants would gradually decrease until reaching levels that would not exceed NJDEP soil criteria.
Minimize Contaminant Migration	No actions taken (or needed) to reduce contaminant migration.	No actions taken (or needed) to reduce contaminant migration.
COMPLIANCE WITH ARARs		
Chemical-Specific ARARs	Would not comply with State soil cleanup criteria.	Soil contaminant concentrations would initially exceed State cleanup criteria; over time cleanup criteria would be achieved.
Location-Specific ARARs	Would comply with Federal and State ARARs for wetlands, floodplains, and other sensitive receptors.	Would comply with Federal and State ARARs for wetlands, floodplains, and other sensitive receptors.
Action-Specific ARARs	Not applicable.	Would comply with those ARARs pertaining to the proposed construction, maintenance, and monitoring activities.
LONG-TERM EFFECTIVENESS AND PERMANENCE		
Magnitude of Residual Risk	Existing risks would remain: cancer risk within EPA's target range and sum of HIs > 1 for non-carcinogenic risks from exposure to site soils assuming future residential land use and ingestion, inhalation, or dermal contact with contaminated soils.	Existing risks would remain: cancer risk within EPA's target range and sum of HIs > 1 for non-carcinogenic risks from exposure to site soils. Implementation and enforcement of fencing/institutional controls would block exposure to site soils.
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 contaminated soils.
Need for Five-Year Review	Not applicable.	Review would be required because soil contaminants would be left in place at levels above NJDEP guidelines.
REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT		
Reduction of Toxicity, Mobility, or Volume Through Treatment	No reduction, because no treatment would be employed.	No reduction, because no treatment would be employed.

TABLE 4-2
SITE 15 - COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES
OU-9 FEASIBILITY STUDY
NWS NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY
PAGE 2 OF 2

CRITERION:	ALTERNATIVE 1: NO ACTION	ALTERNATIVE 2: INSTITUTIONAL CONTROLS AND LONG-TERM MONITORING
SHORT-TERM EFFECTIVENESS		
Community Protection	No risk to community anticipated.	No significant risk to community anticipated. Engineering controls would be used during implementation to mitigate risks.
Worker Protection	No risk to workers anticipated.	No risk to workers anticipated if proper PPE is used during fence installation, maintenance, and long-term monitoring.
Environmental Impacts	No adverse impacts to the environment anticipated.	No adverse impacts to the environment anticipated.
Time Until Action is Complete	Not applicable.	Nearly immediate if existing fence is deemed sufficient for the purposes.
IMPLEMENTABILITY		
Ability to Construct and Operate	No construction or operation involved.	No difficulties anticipated. Fencing is a readily implementable technology.
Ease of Doing More Action if Needed	Additional actions would be easily implemented if required.	Additional actions would be easily implemented if required.
Ability to Monitor Effectiveness	Not applicable.	Monitoring would provide assessment of potential exposures, contaminant presence of, migration, or changes in site conditions.
Ability to Obtain Approvals and Coordinate with Other Agencies	Not applicable.	Coordination for 5-year reviews may be required and would be obtainable.
Availability of Treatment, Storage Capacities, and Disposal Services	None required.	None required.
Availability of Equipment, Specialists, and Materials	Not applicable.	Ample availability of equipment and personnel to install fencing and perform long-term monitoring, maintenance, and five-year reviews.
Availability of Technology	Not required.	Common techniques and materials required for implementation.
COST		
Capital Cost	$0	$19,490
First-Year Annual O&M Cost	$0	$0
Five-Year Reviews	$0	$14,500
Present Worth Cost*	$0	$50,760

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

Alternative 2 would present a greater opportunity for short-term impact due to installation of fencing (if needed) and long-term monitoring activities. Impacts to the environment are not anticipated under Alternatives 1 and 2 because minimal activities would be conducted.

Alternative 1 would not achieve any of the RAOs. Alternative 2 would achieve most RAOs.

Implementability

Alternative 1 is easily implemented because there are no activities proposed. Alternative 2 is also easily implemented because the only on-site activities would be installation of the fencing, long-term monitoring, and five-year reviews. If additional actions are warranted, they could be easily implemented under Alternatives 1 and 2.

Cost

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

4.4 INDIVIDUAL ANALYSIS OF SITE 17 ALTERNATIVES

Detailed evaluations of the remedial alternatives retained for further evaluation in Section 3.0 are presented in this section. Detailed cost estimates and assumptions for each alternative are presented in Appendix A.

4.4.1 Site 17 - 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 measures would be implemented to prevent future use of site groundwater. Contaminated groundwater would continue to pose a potential health risk until contaminant concentrations decreased naturally to guideline levels.

The potential human health risks from ingestion, inhalation, and contact with contaminated groundwater would not be reduced under Alternative 1. Alternative 1 would involve no active treatment of groundwater

and no implementation of institutional controls to restrict use of contaminated groundwater. The risks to future residential and industrial receptors from site groundwater would continue to exceed EPA's target levels.

Compliance with ARARs

Because groundwater beneath Site 17 exceeds New Jersey 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.

Long-Term Effectiveness and Permanence

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

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 carcinogenic risk of 4.4 E-04 and potential non-carcinogenic risk greater than 1.0 (HI 4.2), mainly based on ingestion of groundwater. Exposure to contaminated groundwater under a future industrial land use scenario results in a risk near the upper bound of EPA's target risk range, but did not exceed EPA's guideline risk for non-carcinogenic hazards. Because Alternative 1 would not include any remedial actions or institutional controls 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 17 is not currently used as a potable water supply and there are no existing plans for its use; however, public non-community wells and domestic wells are situated elsewhere on or near NWS Earle. If site land and groundwater usage 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 many years. Periodic monitoring and 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.

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 is used to address the contaminated media.

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.

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

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

4.4.2 Site 17 - Alternative 2: Institutional Controls and Long-Term Monitoring

Alternative 2 relies on institutional controls to achieve RAOs. A fence would be installed to limit access to the landfill area. Access restrictions would be implemented to limit future 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 3-5.

Overall Protection of Human Health and the Environment

Alternative 2 would provide protection of human health by instituting restrictions on 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 for 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 parts of the covered former 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 17 would not initially meet the constituent concentrations specified in the New Jersey GWQSs (N.J.A.C. 7:9-6). However, contaminants in the groundwater should gradually decrease to GWQSs. Alternative 2 includes a provision to seek a temporary exemption (CEA) from these requirements until the GWQSs are achieved. The CEA would be established to provide the State official notice that the constituent standards would not be met for a specified duration and to ensure that consumption of the untreated groundwater is prohibited.

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

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

Long-Term Effectiveness and Permanence

The risk assessment concluded that, under a future residential land use scenario, exposure to contaminated groundwater beneath the site would result in potential carcinogenic and non-carcinogenic risks. These risk estimates exceed EPA's guideline risk. Implementing institutional controls to prohibit use of untreated contaminated groundwater would reduce these risks 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 and chemical mechanisms.

The groundwater underlying Site 17 is not currently used as a potable water supply and there are no existing plans for its use as such; 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 institutional controls (access restrictions and 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 downgradient receptors, and determine whether additional remedial actions are necessary. The monitoring 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 many 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 new monitoring well and fencing (if needed) 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 significant risks to base personnel or the local community. Workers who implement Alternative 2 would be adequately safeguarded by using appropriate PPE to prevent exposure to groundwater, contaminant-laden dusts, and airborne VOCs. OSHA standards would be followed, and proper PPE would be used during all remedial activities.

Upon completion of the fencing, Alternative 2 would 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 a year or longer.

Implementability

Alternative 2 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, 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 of $44,360 have been included in the first-year O&M cost. The average annual O&M cost for long-term monitoring is $11,000, and five-year reviews are $15,500 per event. Over a 30-year period, the net present-worth cost is $214,280 (at a 7 percent discount rate).

4.4.3 Comparative Analysis of Site 17 Alternatives

As part of the detailed analysis, comparisons of the remedial alternatives are made to identify differences between the alternatives and how site contaminant threats are addressed. The alternatives are compared with respect to each of the evaluation criteria, and differences are identified. Table 4-3 presents summaries of the evaluations for each alternative.

Overall Protection of Human Health and the Environment

Alternative 2 would be considerably more protective than Alternative 1. Because no actions are conducted, Alternative 1 would not reduce human health or ecological risk.

Alternative 2 includes access restrictions and establishing a groundwater CEA that would reduce human health risks posed by potential contact with groundwater. Institutional controls would provide assurance that untreated contaminated groundwater is not used as a potable water source in the future. This would significantly reduce the human health risks by eliminating potential exposure to contaminated groundwater (the driving concern in the human health risk assessment).

Compliance with ARARs

Because Alternatives 1 does not include any remedial actions, it may not comply with State and federal ARARs pertaining to post-closure of municipal landfills (40 CFR 258.60 & 258.61 and N.J.A.C. 7:26-2A.9). Periodic monitoring of landfill cover conditions and access restrictions would ensure that alternative 2 complies with these ARARs.

Alternative 1 would not comply with State ARARs for attainment of groundwater quality standards (N.J.A.C. 7:9-6). Alternative 2 would comply by seeking a temporary exemption (CEA) from these requirements until the GWQSs are achieved. Alternative 2 would comply with federal and State monitoring requirements through periodic monitoring and evaluation, and five-year reviews.

Long-Term Effectiveness and Permanence

Alternative 2 offers long-term protection of human health and the environment. Under Alternative 1, risks would remain the same over time. Potential future users of site groundwater may be at risk under Alternative 1 because it lacks institutional controls that would prohibit use of untreated contaminated groundwater.

Alternative 2 would mitigate long-term risks due to potential ingestion of site groundwater by implementing institutional controls to prohibit use of untreated, contaminated groundwater. Alternative 2 would reduce human risks due to direct exposure to groundwater by eliminating the potential for exposure.

Reduction of Toxicity, Mobility, or Volume Through Treatment

Because neither of the alternatives includes treatment, they would not reduce the toxicity, mobility, or volume through treatment.

TABLE 4-3
SITE 17 - COMPARATIVE ANALYSIS OF REMEDIAL ACTION ALTERNATIVES
OPERABLE UNIT 9 FEASIBILITY STUDY
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

CRITERION:	ALTERNATIVE 1: NO ACTION	ALTERNATIVE 2: INSTITUTIONAL CONTROLS AND LONG-TERM MONITORING
OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT		
Prevent Human Exposure to Metals Contaminants in Groundwater	No action taken to prevent human exposure to contaminated groundwater. Carcinogenic and non-carcinogenic risks exceeding EPA's guideline would remain. No institutional controls implemented to prohibit use of untreated groundwater.	Institutional controls would minimize potential exposure to site groundwater by prohibiting its use. In time, contaminants would gradually decrease until reaching levels that would not pose excess risk.
COMPLIANCE WITH ARARs		
Chemical-Specific ARARs	Would not comply with State groundwater quality standards.	Groundwater contaminant concentrations would initially exceed State GWQS A CEA would be established to provide the State official notification that standards would not be met for a specified duration.
Location-Specific ARARs	Not applicable.	Would comply with federal and State ARARs for wetlands, floodplains, and other sensitive receptors.
Action-Specific ARARs	Would comply with all action-specific ARARs. Federal or State ARARs for post-closure maintenance of municipal landfills may not be met.	Would comply with all action-specific ARARs. Five-year review process would ensure Federal or State ARARs for post-closure maintenance of municipal landfills will be met.
LONG-TERM EFFECTIVENESS AND PERMANENCE		
Magnitude of Residual Risk	Existing risks would remain: approximately 6E-04 cancer risk and HI > 1 non-carcinogenic risk from exposure to site groundwater assuming future residential land use and consumption of contaminated groundwater.	Existing risks would remain: approximately 6E-04 cancer risk and HI > 1 non-carcinogenic risks from exposure to site groundwater. Implementation and enforcement of institutional controls would block exposure to site groundwater. Fencing would reduce potential contact with shallow groundwater.
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 and use of contaminated groundwater.
Need for Five-Year Review	Not applicable.	Review would be required because groundwater contaminants would be left in place.
REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT		
Reduction of Toxicity, Mobility, or Volume Through Treatment	No reduction, because no treatment would be employed.	No reduction, because no treatment would be employed.

TABLE 4-3
SITE 17 - COMPARATIVE ANALYSIS OF REMEDIAL ACTION ALTERNATIVES
OU-9 FEASIBILITY STUDY
NAVAL WEAPONS STATION EARLE
COLTS NECK, NEW JERSEY

CRITERION:	ALTERNATIVE 1: NO ACTION	ALTERNATIVE 2: INSTITUTIONAL CONTROLS AND LONG-TERM MONITORING
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.
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.
Environmental Impacts	No adverse impacts to the environment anticipated.	No adverse impacts to the environment anticipated.
Time Until Action is Complete	Not applicable.	Approximately 1 year to institute CEA.
IMPLEMENTABILITY		
Ability to Construct and Operate	No construction or operation involved.	No difficulties anticipated. Monitoring well and fencing installation are readily implementable technologies.
Ease of Doing More Action if Needed	Additional actions would be easily implemented if required.	Additional actions would be easily implemented if required.
Ability to Monitor Effectiveness	Not applicable.	Monitoring would provide assessment of potential exposures, contaminant presence, and migration, or changes in site conditions.
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.
Availability of Treatment, Storage Capacities, and Disposal Services	None required.	None required.
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.
Availability of Technology	Not required.	Common construction techniques and materials required for construction.
COST		
Capital Cost	$0	$44,360
First-Year Annual O&M Cost	$0	$11,000
Five-Year Reviews	$0	$15,500
Present Worth Cost*	$0	$214,280

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

Short-Term Effectiveness

The short-term effectiveness of the alternatives would be similar because the use of appropriate engineering controls and PPE under Alternative 2 is expected to minimize adverse impacts to base residents and personnel, the local community, and workers during implementation.

Under Alternative 1, no action is proposed so there would be no opportunity for short-term impact. Alternative 2 would present a greater opportunity for short-term impact due to monitoring well installation and fencing.

Impacts to the environment are not anticipated under Alternatives 1 and 2 because minimal activities would be conducted.

Alternative 1 would not achieve any of the RAOs. Alternative 2 would achieve most RAOs within approximately 1 year, which would be the time to implement the CEA.

Implementability

Alternative 1 is easily implemented because no activities are proposed. Alternative 2 is also easily implemented because the only activities would be installation of one monitoring well, fencing, long-term monitoring, and five-year reviews.

If additional actions are warranted, they could be easily implemented under Alternatives 1 and 2.

Cost

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

APPENDIX A

COSTS

NAVAL WEAPONS STATION EARLE
Colts Neck, New Jersey
Operable Unit 9 (Site 6)
Alternative 2 - Limited Action
Capital Cost

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Item	Subcontract	Material	Labor	Equipment	Total
1 MONITORING WELL and FENCE INSTALLATION	$7,000	$0	$0	$0	$7,000
2 OVERSIGHT	$0	$0	$1,700	$0	$1,700
4 INSTITUTIONAL CONTROLS	$15,000	$0	$0	$0	$15,000
	$22,000	$0	$1,700	$0	$23,700
Overhead on Labor Cost @ 30%			$510		$510
G & A on Labor Cost @ 10%			$170		$170
G & A on Material Cost @ 10%		$0			$0
G & A on Subcontract Cost @ 10%	$2,200				$2,200
Total Direct Cost	$24,200	$0	$2,380	$0	$26,580
Indirects on Total Direct Cost @ 75%			$1,785		$1,785
Profit on Total Direct Cost @ 10%					$2,658
Subtotal					$31,023
Health & Safety Monitoring @ 10%					$3,102
Total Field Cost					$34,125
Contingency on Total Field Costs @ 20%					$6,825
Engineering on Total Field Cost @ 10%					$3,412.53
TOTAL COST					$44,363

NAVAL WEAPONS STATION EARLE
Colts Neck, New Jersey
Operable Unit 9 (Site 6)
Alternative 2 - Limited Action
Capital Cost

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Total Cost Subcontract	Total Cost Material	Total Cost Labor	Total Cost Equipment	Total Direct Cost	Comments
1 MONITORING WELL and FENCE INSTALLATION												
1.1 Well Installation	1	ls	$1,200.00				$1,200	$0	$0	$0	$1,200	1 well / 25' deep
1.2 Install New 6' High Chain Link Fence	300	lf	$16.40				$4,920	$0	$0	$0	$4,920	includes 1 gate
1.3 Well Survey	1	ls	$880.00				$880	$0	$0	$0	$880	
							$7,000	$0	$0	$0	$7,000	
2 OVERSIGHT												
2.1 Engineering Oversight	1	ls			$1,700.00		$0	$0	$1,700	$0	$1,700	3 days
							$0	$0	$1,700	$0	$1,700	
3 INSTITUTIONAL CONTROLS												
3.1 CEA & Modify Base Master Plan	1	ls	$15,000.00				$15,000	$0	$0	$0	$15,000	
							$15,000	$0	$0	$0	$15,000	

NAVAL WEAPONS STATION EARLE
Colts Neck, New Jersey
Operable Unit 9 (Site 6)
Alternative 2 - Limited Action
Annual Cost

Item	Item Cost Annually	Item Cost per 5 years	Notes
Sampling	$5,000		Collect four groundwater samples, per sampling period, plus travel, living, and shipping cost
Analysis/Water	$2,000		Six water samples, per sampling period (including blanks and duplicates), metals
Annual Report	$4,000		Ten hours per sampling report plus other direct costs
Site Review		$15,500	Review of site conditions by 3 engineers for Years 5, 10, 15, 20, 25, and 30
TOTALS	$11,000	$15,500	

NAVAL WEAPONS STATION EARLE 1/3/2003 4:44 PM

Colts Neck, New Jersey

Operable Unit 9 (Site 6)

Alternative 2 - Limited Action

Present Worth Analysis

Year	Capital Cost	Annual Cost	Total Year Cost	Annual Discount Rate at 7%	Present Worth
0	$44,363		$44,363	1.000	$44,363
1		$11,000	$11,000	0.935	$10,285
2		$11,000	$11,000	0.873	$9,603
3		$11,000	$11,000	0.816	$8,976
4		$11,000	$11,000	0.763	$8,393
5		$26,500	$26,500	0.713	$18,895
6		$11,000	$11,000	0.666	$7,326
7		$11,000	$11,000	0.623	$6,853
8		$11,000	$11,000	0.582	$6,402
9		$11,000	$11,000	0.544	$5,984
10		$26,500	$26,500	0.508	$13,462
11		$11,000	$11,000	0.475	$5,225
12		$11,000	$11,000	0.444	$4,884
13		$11,000	$11,000	0.415	$4,565
14		$11,000	$11,000	0.388	$4,268
15		$26,500	$26,500	0.362	$9,593
16		$11,000	$11,000	0.339	$3,729
17		$11,000	$11,000	0.317	$3,487
18		$11,000	$11,000	0.296	$3,256
19		$11,000	$11,000	0.277	$3,047
20		$26,500	$26,500	0.258	$6,837
21		$11,000	$11,000	0.242	$2,662
22		$11,000	$11,000	0.226	$2,486
23		$11,000	$11,000	0.211	$2,321
24		$11,000	$11,000	0.197	$2,167
25		$26,500	$26,500	0.184	$4,876
26		$11,000	$11,000	0.172	$1,892
27		$11,000	$11,000	0.161	$1,771
28		$11,000	$11,000	0.150	$1,650
29		$11,000	$11,000	0.141	$1,551
30		$26,500	$26,500	0.131	$3,472
				TOTAL PRESENT WORTH	**$214,280**

NAVAL WEAPONS STATION EARLE
Colts Neck, New Jersey
Operable Unit 9 (Site 15)
Alternative 2 - Limited Action
Capital Cost

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Item	Subcontract	Material	Labor	Equipment	Total
1 OVERSIGHT	$0	$0	$1,000	$0	$1,000
2 SITE SECURITY	$9,125	$0	$0	$0	$9,125
3 INSTITUTIONAL CONTROLS	$0	$0	$0	$0	$0
	$9,125	$0	$1,000	$0	$10,125
Overhead on Labor Cost @ 30%			$300		$300
G & A on Labor Cost @ 10%			$100		$100
G & A on Material Cost @ 10%		$0			$0
G & A on Subcontract Cost @ 10%	$913				$913
Total Direct Cost	$10,038	$0	$1,400	$0	$11,438
Indirects on Total Direct Cost @ 75%			$1,050		$1,050
Profit on Total Direct Cost @ 10%					$1,144
Subtotal					$13,631
Health & Safety Monitoring @ 10%					$1,363
Total Field Cost					$14,994
Contingency on Total Field Costs @ 20%					$2,999
Engineering on Total Field Cost @ 10%					$1,499.44
TOTAL COST					$19,493

NAVAL WEAPONS STATION EARLE
Colts Neck, New Jersey
Operable Unit 9 (Site 15)
Alternative 2 - Limited Action
Capital Cost

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Total Cost Subcontract	Total Cost Material	Total Cost Labor	Total Cost Equipment	Total Direct Cost	Comments
1 OVERSIGHT												
1.1 Engineering Oversight	1	ls			$1,000.00		$0	$0	$1,000	$0	$1,000	Use existing fence ?
							$0	$0	$1,000	$0	$1,000	
2 SITE SECURITY												
2.1 Install New 6' High Chain Link Fence	500	lf	$16.40				$8,200	$0	$0	$0	$8,200	
2.2 Double Swing Gate	1	ea	$925.00				$925	$0	$0	$0	$925	
							$9,125	$0	$0	$0	$9,125	
3 INSTITUTIONAL CONTROLS												
3.1 Modify Base Master Plan	1	ls	$0.00				$0	$0	$0	$0	$0	
							$0	$0	$0	$0	$0	

NAVAL WEAPONS STATION EARLE
Colts Neck, New Jersey
Operable Unit 9 (Site 15)
Alternative 2 - Limited Action
Five-year Review Costs

Item	Item Cost per 5 years	Notes
Sampling	$3,000	Collect six surface soil samples and six subsurface soil samples per sampling period, plus travel, living, and shipping cost
Analysis/Soil	$2,500	Ten soil samples per sampling period (including blanks and duplicates for each) for metals analysis.
Annual Report	$4,000	Ten hours per sampling report plus other direct costs
Site Review	$5,000	Environmental engineer review and letter report
TOTALS	$14,500	Review of site conditions for Years 5, 10, 15, 20, 25, and 30

NAVAL WEAPONS STATION EARLE 1/3/2003 4:54 PM

Colts Neck, New Jersey

Operable Unit 9 (Site 15)

Alternative 2 - Limited Action

Present Worth Analysis

Year	Capital Cost	Annual Cost	Total Year Cost	Annual Discount Rate at 7%	Present Worth
0	$19,493		$19,493	1.000	$19,493
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		$14,500	$14,500	0.713	$10,339
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		$14,500	$14,500	0.508	$7,366
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		$14,500	$14,500	0.362	$5,249
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		$14,500	$14,500	0.258	$3,741
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		$14,500	$14,500	0.184	$2,668
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		$14,500	$14,500	0.131	$1,900
				TOTAL PRESENT WORTH	**$50,755**

NAVAL WEAPONS STATION EARLE
Colts Neck, New Jersey
Operable Unit 9 (Site17)
Alternative 2 - Limited Action
Capital Cost

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Item	Subcontract	Material	Labor	Equipment	Total
1 MONITORING WELL and FENCE INSTALLATION	$7,000	$0	$0	$0	$7,000
2 OVERSIGHT	$0	$0	$1,700	$0	$1,700
4 INSTITUTIONAL CONTROLS	$15,000	$0	$0	$0	$15,000
	$22,000	$0	$1,700	$0	$23,700
Overhead on Labor Cost @ 30%			$510		$510
G & A on Labor Cost @ 10%			$170		$170
G & A on Material Cost @ 10%		$0			$0
G & A on Subcontract Cost @ 10%	$2,200				$2,200
Total Direct Cost	$24,200	$0	$2,380	$0	$26,580
Indirects on Total Direct Cost @ 75%			$1,785		$1,785
Profit on Total Direct Cost @ 10%					$2,658
Subtotal					$31,023
Health & Safety Monitoring @ 10%					$3,102
Total Field Cost					$34,125
Contingency on Total Field Costs @ 20%					$6,825
Engineering on Total Field Cost @ 10%					$3,412.53
TOTAL COST					$44,363

NAVAL WEAPONS STATION EARLE
Colts Neck, New Jersey
Operable Unit 9 (Site17)
Alternative 2 - Limited Action
Capital Cost

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Total Cost Subcontract	Total Cost Material	Total Cost Labor	Total Cost Equipment	Total Direct Cost	Comments
1 MONITORING WELL and FENCE INSTALLATION												
1.1 Well Installation	1	ls	$1,200.00				$1,200	$0	$0	$0	$1,200	1 well / 25' deep
1.2 Install New 6' High Chain Link Fence	300	lf	$16.40				$4,920	$0	$0	$0	$4,920	includes 1 gate
1.3 Well Survey	1	ls	$880.00				$880	$0	$0	$0	$880	
							$7,000	$0	$0	$0	$7,000	
2 OVERSIGHT												
2.1 Engineering Oversight	1	ls			$1,700.00		$0	$0	$1,700	$0	$1,700	3 days
							$0	$0	$1,700	$0	$1,700	
3 INSTITUTIONAL CONTROLS												
3.1 CEA & Modify Base Master Plan	1	ls	$15,000.00				$15,000	$0	$0	$0	$15,000	
							$15,000	$0	$0	$0	$15,000	

NAVAL WEAPONS STATION EARLE 1/3/2003 4:47 PM

Colts Neck, New Jersey

Operable Unit 9 (Site 17)

Alternative 2 - Limited Action

Annual Cost

Item	Item Cost Annually	Item Cost per 5 years	Notes
Sampling	$5,000		Collect four groundwater samples, per sampling period, plus travel, living, and shipping cost
Analysis/Water	$2,000		Six water samples, per sampling period (including blanks and duplicates), metals
Annual Report	$4,000		Ten hours per sampling report plus other direct costs
Site Review		$15,500	Review of site conditions by 3 engineers for Years 5, 10, 15, 20, 25, and 30
TOTALS	$11,000	$15,500	

NAVAL WEAPONS STATION EARLE 1/3/2003 4:47 PM

Colts Neck, New Jersey

Operable Unit 9 (Site17)

Alternative 2 - Limited Action

Present Worth Analysis

Year	Capital Cost	Annual Cost	Total Year Cost	Annual Discount Rate at 7%	Present Worth
0	$44,363		$44,363	1.000	$44,363
1		$11,000	$11,000	0.935	$10,285
2		$11,000	$11,000	0.873	$9,603
3		$11,000	$11,000	0.816	$8,976
4		$11,000	$11,000	0.763	$8,393
5		$26,500	$26,500	0.713	$18,895
6		$11,000	$11,000	0.666	$7,326
7		$11,000	$11,000	0.623	$6,853
8		$11,000	$11,000	0.582	$6,402
9		$11,000	$11,000	0.544	$5,984
10		$26,500	$26,500	0.508	$13,462
11		$11,000	$11,000	0.475	$5,225
12		$11,000	$11,000	0.444	$4,884
13		$11,000	$11,000	0.415	$4,565
14		$11,000	$11,000	0.388	$4,268
15		$26,500	$26,500	0.362	$9,593
16		$11,000	$11,000	0.339	$3,729
17		$11,000	$11,000	0.317	$3,487
18		$11,000	$11,000	0.296	$3,256
19		$11,000	$11,000	0.277	$3,047
20		$26,500	$26,500	0.258	$6,837
21		$11,000	$11,000	0.242	$2,662
22		$11,000	$11,000	0.226	$2,486
23		$11,000	$11,000	0.211	$2,321
24		$11,000	$11,000	0.197	$2,167
25		$26,500	$26,500	0.184	$4,876
26		$11,000	$11,000	0.172	$1,892
27		$11,000	$11,000	0.161	$1,771
28		$11,000	$11,000	0.150	$1,650
29		$11,000	$11,000	0.141	$1,551
30		$26,500	$26,500	0.131	$3,472
				TOTAL PRESENT WORTH	**$214,280**

APPENDIX B

HUMAN HEALTH RISK/EXPOSURE SUMMARY TABLES

APPENDIX B-1

HUMAN HEALTH RISK/EXPOSURE SUMMARY TABLES

SITE 6

TABLE 5-21
SUMMARY OF RME ESTIMATED CANCER RISKS AND NONCARCINOGENIC HAZARD INDICIES - SITE 6
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		Future Recreational Child
								Child	Adult	
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	5.7E-07	N/A	N/A	N/A	N/A	1.5E-02
	Dermal Contact	N/A	N/A	N/A	1.6E-06	N/A	N/A	N/A	N/A	4.2E-05
Groundwater	Ingestion	N/A	1.4E-04	6.0E-04	N/A	N/A	8.7E-01	5.7E+00@	N/A	N/A
	Dermal Contact	N/A	2.8E-07	7.3E-06	N/A	N/A	1.8E-03	7.2E-02	N/A	N/A
	Inhalation of Volatiles*	N/A	N/A	3.9E-08	N/A	N/A	N/A	N/A	N/A**	N/A
Surface Water	Incidental Ingestion	N/A	N/A	N/A	5.6E-07	N/A	N/A	N/A	N/A	1.3E-01
	Dermal Contact	N/A	N/A	N/A	1.7E-07	N/A	N/A	N/A	N/A	4.5E-03
TOTAL		-	1.4E-04	6.1E-04	2.9E-06	-	8.8E-01	5.8E+00	-	1.5E-01

N/A = Not applicable because this media is not associated with this potential receptor
N/S = Not sampled
* = During Showering, Adult Residents Only
** = No volatile noncarcinogens were detected in groundwater
*** = Hazard Indicies (i.e., summation of hazard quotients) are used only for comparison purposes and do not reflect actual additive noncarcinogenic effects
@ - Result is the maximum of the HIs among the affected target organs from the amended risk assessment.

TABLE 5-22
SUMMARY OF CENTRAL TENDENCY CANCER RISKS AND NONCARCINOGENIC HAZARD INDICIES - SITE 6
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		Future Recreational Child
								Child	Adult	
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	1.6E-05	2.7E-04	N/A	N/A	N/R	2.7E+00@	N/A	N/A
	Dermal Contact	N/A	4.5E-08	7.5E-08	N/A	N/A	N/R	3.1E-03	N/A	N/A
	Inhalation of Volatiles*	N/A	N/A	2.2E-09	N/A	N/A	N/A	N/A	N/A**	N/A
Surface Water	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
TOTAL		-	1.6E-05	2.7E-04	-	-	-	2.7E+00	-	-

N/A = Not applicable because this media is not associated with this potential receptor
N/R - Central Tendency calculation not required
N/S = Not sampled
* = During Showering, Adult Residents Only
** = No volatile noncarcinogens were detected in groundwater
*** = Hazard Indicies (i.e., summation of hazard quotients) are used only for comparison purposes and do not reflect actual additive noncarcinogenic effects
@ - Result is the maximum of the HIs among the affected target organs from the amended risk assessment.

APPENDIX B-2

HUMAN HEALTH RISK/EXPOSURE SUMMARY TABLES

SITE 12

TABLE 4-4
NWS-EARLE
Site 12: 2nd Round Confirmatory Soil Sample Analytical Results
TAL Metals

SAMPLE ID		12SS08-99-02		12SS11-99-02		12SS12-99-02		12SS14-99-02	
LAB ID	**Residential**	92499		92500		92501		92502	
DATE COLLECTED	**Direct Contact**	11/2/1999		11/2/1999		11/2/1999		11/2/1999	
LOCATION	**Soil Cleanup**	SIDEWALL		BOTTOM		SIDEWALL		SIDEWALL	
MATRIX	**Criteria**	soil		soil		soil		soil	
UNITS	**mg/Kg**	mg/Kg		mg/Kg		mg/Kg		mg/Kg	
DEPTH BGS (ft)		2.5		4.0		4.0		2.0	
COMMENTS		POST-EX		POST-EX		POST-EX		POST-EX	
Aluminum	**NA**	N/A		N/A		N/A		N/A	
Antimony	**14**	N/A	U	N/A		N/A		N/A	
Arsenic	**20**	**25.69**		19.19		**27.67**		12.56	
Barium	**700**	26.05		ND		19.3		14.88	
Beryllium	**2**	N/A		N/A		N/A		N/A	
Cadmium	**39**	ND	U	ND	U	ND		N/A	
Calcium	**NA**	N/A		N/A		N/A		N/A	
Chromium	**240**	36.61		42.3		12.62		28.95	
Cobalt	**NA**	N/A		N/A		N/A		N/A	
Copper	**600**	3.6		7.58		10.44		29.07	
Iron	**NA**	N/A		N/A		N/A		N/A	
Lead	**400**	8.16		12.22		18.81		14.42	
Magnesium	**NA**	N/A		N/A		N/A		N/A	
Manganese	**NA**	N/A		N/A		N/A		N/A	
Mercury	**14**	0.048	U	0.073		0.073		0.07	
Nickel	**250**	7.2		7.58		5.2		4.07	
Potassium	**NA**	N/A		N/A		N/A		N/A	
Selenium	**63**	0.48		1.1		1.46		0.81	
Silver	**110**	ND	U	ND		ND		ND	
Sodium	**NA**	N/A		N/A		N/A		N/A	
Thallium	**2**	N/A	U	N/A		N/A		N/A	
Vanadium	**370**	N/A		N/A		N/A		N/A	
Zinc	**1500**	31.69		34.84		24.39		34.19	

U-concentration is less than detection limit.
NA-not applicable

TABLE 4-5
NWS-EARLE
Site 12: 3rd Round Confirmatory Soil Sample Analytical Results
TAL Metals

SAMPLE ID		12SS08-99-03		12SS12-99-03					
LAB ID	**Residential**	92499		92500					
DATE COLLECTED	**Direct Contact**	11/9/1999		11/2/1999					
LOCATION	**Soil Cleanup**	SIDEWALL		BOTTOM					
MATRIX	**Criteria**	soil		soil					
UNITS	**mg/Kg**	mg/Kg		mg/Kg					
DEPTH BGS (ft)		3.0		5.0					
COMMENTS		POST-EX		POST-EX					
Aluminum	NA	3350		3490					
Antimony	**14**	0.54	U	0.55	U				
Arsenic	**20**	16.8		8.1					
Barium	**700**	12.6		23					
Beryllium	**2**	0.4	B	0.3	B				
Cadmium	**39**	0.11	U	0.11	U				
Calcium	NA	545		1210					
Chromium	**240**	7.3		10.7					
Cobalt	NA	9.8		1.6	B				
Copper	**600**	6.1		10.8					
Iron	NA	26,600		12,900					
Lead	**400**	5.9		24.9					
Magnesium	NA	451		270	B				
Manganese	NA	172		21.6					
Mercury	**14**	0.11	U	0.11	U				
Nickel	**250**	3.2	B	4.2	B				
Potassium	NA	391		400	B				
Selenium	**63**	0.64		0.6	U				
Silver	**110**	0.11	U	0.11	U				
Sodium	NA	80.8	B	158	B				
Thallium	**2**	0.75	U	0.77	U				
Vanadium	**370**	32.2		21.2					
Zinc	**1500**	19		18.1					

U-concentration is less than detection limit.
NA-not applicable

APPENDIX B-3

HUMAN HEALTH RISK/EXPOSURE SUMMARY TABLES

SITE 15

TABLE 17-25
SUMMARY OF ESTIMATED RME CANCER RISKS AND NONCARCINOGENIC HAZARD INDICIES - SITE 15
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 Lifetime Resident	Future Recreational Child	Current Industrial Employee	Future Industrial Employee	Future Resident				Future Recreational Child
									Child	Adult	Child	Adult	
Surface Soil	Incidental Ingestion	1.2E-05	N/A	N/S	5.3E-05^	N/A	9.2E-02	N/A	N/S	N/A	8.2E-01@	N/A	N/A
	Dermal Contact	4.9E-05	N/A	N/S	3.3E-05^	N/A	2.1E-01	N/A	N/S	N/A	5.1E-01@	N/A	N/A
	Inhalation of Fugitive Dust	2.7E-08	N/A	N/S	3.8E-09^	N/A	1.9E-05	N/A	N/S	N/A	1.7E-05^	N/A	N/A
Subsurface Soil	Incidental Ingestion	N/A	1.1E-05	4.8E-05^	N/S	N/A	N/A	8.3E-02	8.8E-01@	N/A	N/S	N/A	N/A
	Dermal Contact	N/A	1.6E-05	3.5E-05^	N/S	N/A	N/A	1.2E-01	5.4E-01@	N/A	N/S	N/A	N/A
	Inhalation of Fugitive Dust	N/A	1.5E-08	3.8E-09^	N/S	N/A	N/A	1.7E-05	1.6E-05^	N/A	N/S	N/A	N/A
Sediment	Incidental Ingestion	N/A	N/A	N/A	N/A	7.0E-07	N/A	N/A	N/A	N/A	N/A	N/A	5.9E-02
	Dermal Contact	N/A	N/A	N/A	N/A	5.7E-07	N/A	N/A	N/A	N/A	N/A	N/A	4.3E-02
Groundwater	Ingestion	N/A	N/S	N/S	N/S	N/A	N/A	N/S	N/S	N/S	N/S	N/A	N/A
	Dermal Contact	N/A	N/S	N/S	N/S	N/A	N/A	N/S	N/S	N/S	N/S	N/A	N/A
	Inhalation of Volatiles*	N/A	N/S	N/S	N/S	N/A	N/A	N/S	N/S	N/S	N/S	N/S	N/A
Surface Water	Incidental Ingestion	N/A	N/A	N/A	N/A	4.1E-08	N/A	N/A	N/A	N/A	N/A	N/A	3.2E-02
	Dermal Contact	N/A	N/A	N/A	N/A	1.9E-07	N/A	N/A	N/A	N/A	N/A	N/A	4.8E-02
TOTAL		6.1E-05	2.8E-05	8.3E-05	8.6E-05	1.5E-06	3.1E-01	2.0E-01	1.4E+00	-	1.3E+00	-	1.8E-01

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.

TABLE 17-25a
SUMMARY OF CENTRAL TENDENCY CANCER RISKS AND NONCARCINOGENIC HAZARD INDICIES - SITE 15
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 Lifetime Resident	Future Recreational Child	Current Industrial Employee	Future Industrial Employee	Future Resident				Future Recreational Child
									Child	Adult	Child	Adult	
Surface Soil	Incidental Ingestion	N/R	N/A	N/S	N/R	N/A	N/R	N/A	N/S	N/A	3.1E-01@	N/A	N/A
	Dermal Contact	N/R	N/A	N/S	N/R	N/A	N/R	N/A	N/S	N/A	3.9E-01@	N/A	N/A
	Inhalation of Fugitive Dust	N/R	N/A	N/S	N/R	N/A	N/R	N/A	N/S	N/A	1.2E-05^	N/A	N/A
Subsurface Soil	Incidental Ingestion	N/A	N/R	N/R	N/S	N/A	N/A	N/R	2.7E-01@	N/A	N/S	N/A	N/A
	Dermal Contact	N/A	N/R	N/R	N/S	N/A	N/A	N/R	3.3E-01@	N/A	N/S	N/A	N/A
	Inhalation of Fugitive Dust	N/A	N/R	N/R	N/S	N/A	N/A	N/R	9.5E-06^	N/A	N/S	N/A	N/A
Sediment	Incidental Ingestion	N/A	N/A	N/A	N/A	N/R	N/A	N/A	N/A	N/A	N/A	N/A	N/R
	Dermal Contact	N/A	N/A	N/A	N/A	N/R	N/A	N/A	N/A	N/A	N/A	N/A	N/R
Groundwater	Ingestion	N/A	N/S	N/S	N/S	N/A	N/A	N/S	N/S	N/S	N/S	N/A	N/A
	Dermal Contact	N/A	N/S	N/S	N/S	N/A	N/A	N/S	N/S	N/S	N/S	N/A	N/A
	Inhalation of Volatiles*	N/A	N/S	N/S	N/S	N/A	N/A	N/S	N/S	N/S	N/S	N/S	N/A
Surface Water	Incidental Ingestion	N/A	N/A	N/A	N/A	N/R	N/A	N/A	N/A	N/A	N/A	N/A	N/R
	Dermal Contact	N/A	N/A	N/A	N/A	N/R	N/A	N/A	N/A	N/A	N/A	N/A	N/R
	TOTAL	-	-	-	-	-	-	-	6.0E-01	-	7.0E-01	-	-

N/A = Not applicable because this media is not associated with this potential receptor
N/R - Central Tendency calculation not required
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-4

HUMAN HEALTH RISK/EXPOSURE SUMMARY TABLES

SITE 17

TABLE 9-27
SUMMARY OF RME ESTIMATED CANCER RISKS AND NONCARCINOGENIC HAZARD INDICIES - SITE 17
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		Future Recreational Child
								Child	Adult	
Surface Soil	Incidental Ingestion	1.2E-06	N/A	5.4E-06	N/A	7.5E-03	N/A	9.8E-02	N/A	N/A
	Dermal Contact	4.0E-07	N/A	1.3E-06	N/A	2.4E-03	N/A	2.0E-02	N/A	N/A
	Inhalation of Fugitive Dust	6.7E-10	N/A	4.1E-10	N/A	1.0E-06	N/A	1.0E-06	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	2.5E-07	N/A	N/A	N/A	N/A	1.3E-02
	Dermal Contact	N/A	N/A	N/A	1.8E-06	N/A	N/A	N/A	N/A	4.8E-02
Groundwater	Ingestion	N/A	1.0E-04	4.4E-04	N/A	N/A	6.7E-01	4.2E+00@	N/A	N/A
	Dermal Contact	N/A	2.1E-07	5.4E-06	N/A	N/A	1.3E-03	5.3E-02	N/A	N/A
	Inhalation of Volatiles*	N/A	N/A	N/A**	N/A	N/A	N/A	N/A	N/A**	N/A
Surface Water	Incidental Ingestion	N/A	N/A	N/A	9.5E-07	N/A	N/A	N/A	N/A	2.7E-02
	Dermal Contact	N/A	N/A	N/A	2.9E-07	N/A	N/A	N/A	N/A	7.6E-03
TOTAL		1.6E-06	1.0E-04	4.5E-04	3.3E-06	9.9E-03	6.7E-01	4.4E+00	-	9.5E-02

N/A = Not applicable because this media is not associated with this potential receptor
N/S = Not sampled
* = During Showering, Adult Residents Only
** = No volatiles were detected in groundwater
*** = Hazard Indicies (i.e., summation of hazard quotients) are used only for comparison purposes and do not reflect actual additive noncarcinogenic effects
@ - Result is the maximum of the His among the affected target organs from the amended risk assessment.

TABLE 9-28
SUMMARY OF CENTRAL TENDENCY CANCER RISKS AND NONCARCINOGENIC HAZARD INDICIES - SITE 17
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		Future Recreational Child
								Child	Adult	
Surface Soil	Incidental Ingestion	N/R	N/A	N/R	N/A	N/R	N/A	N/R	N/A	N/A
	Dermal Contact	N/R	N/A	N/R	N/A	N/R	N/A	N/R	N/A	N/A
	Inhalation of Fugitive Dust	N/R	N/A	N/R	N/A	N/R	N/A	N/R	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	2.0E-04	N/A	N/A	N/R	2.0E+00@	N/A	N/A
	Dermal Contact	N/A	N/R	1.7E-08	N/A	N/A	N/R	2.2E-02	N/A	N/A
	Inhalation of Volatiles*	N/A	N/A	N/A**	N/A	N/A	N/A	N/A	N/A**	N/A
Surface Water	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
TOTAL		-	-	2.0E-04	-	-	-	2.0E+00	-	-

N/A = Not applicable because this media is not associated with this potential receptor
N/R - Central Tendencies calculation not required
N/S = Not sampled
* = During Showering, Adult Residents Only
** = No volatiles were detected in groundwater
*** = Hazard Indicies (i.e., summation of hazard quotients) are used only for comparison purposes and do not reflect actual additive noncarcinogenic effects
@ - Result is the maximum of the HIs among the affected target organs from the amended risk assessment.

APPENDIX C

SITE 12 SOIL REMEDIAL ACTION CLOSEOUT REPORT SUMMARY

REMEDIAL ACTION REPORT FOR SOIL EXCAVATION AT SITE 12, FORMER BATTERY STORAGE AREA

NAVAL WEAPONS STATION – EARLE COLTS NECK, NEW JERSEY

Issued:

December 21 1999

Prepared for:

Naval Facilities Engineering Command
10 Industrial Highway
Lester, PA 19113

Prepared by:

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Langhorne, PA 19047 - 1829

REMEDIAL ACTION CONTRACT N62472-94-D-0398
DELIVERY ORDER NO. 0034

REMEDIAL ACTION REPORT FOR SOIL EXCAVATION AT SITE 12, FORMER BATTERY STORAGE AREA

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REMEDIAL ACTION REPORT
FOR SOIL EXCAVATION AT SITE 12,
FORMER BATTERY STORAGE AREA

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1.0 INTRODUCTION

Foster Wheeler Environmental Corporation (Foster Wheeler Environmental) was contracted by the Northern Division, Naval Facilities Engineering Command (NORDIV) to excavate contaminated soils at Site 12 - Former Battery Storage Area, at the Naval Weapons Station (NWS) Earle, located in Colts Neck, NJ. This Close-Out Report is being submitted to satisfy the post-construction submittal requirements included in paragraph 1.2.1, Pre- and Post-Construction Documentation of the Statement of Services for Delivery Order No. 0034 under Remedial Action Contract No. N62472-94-D-0398.

1.1 PROJECT OBJECTIVES

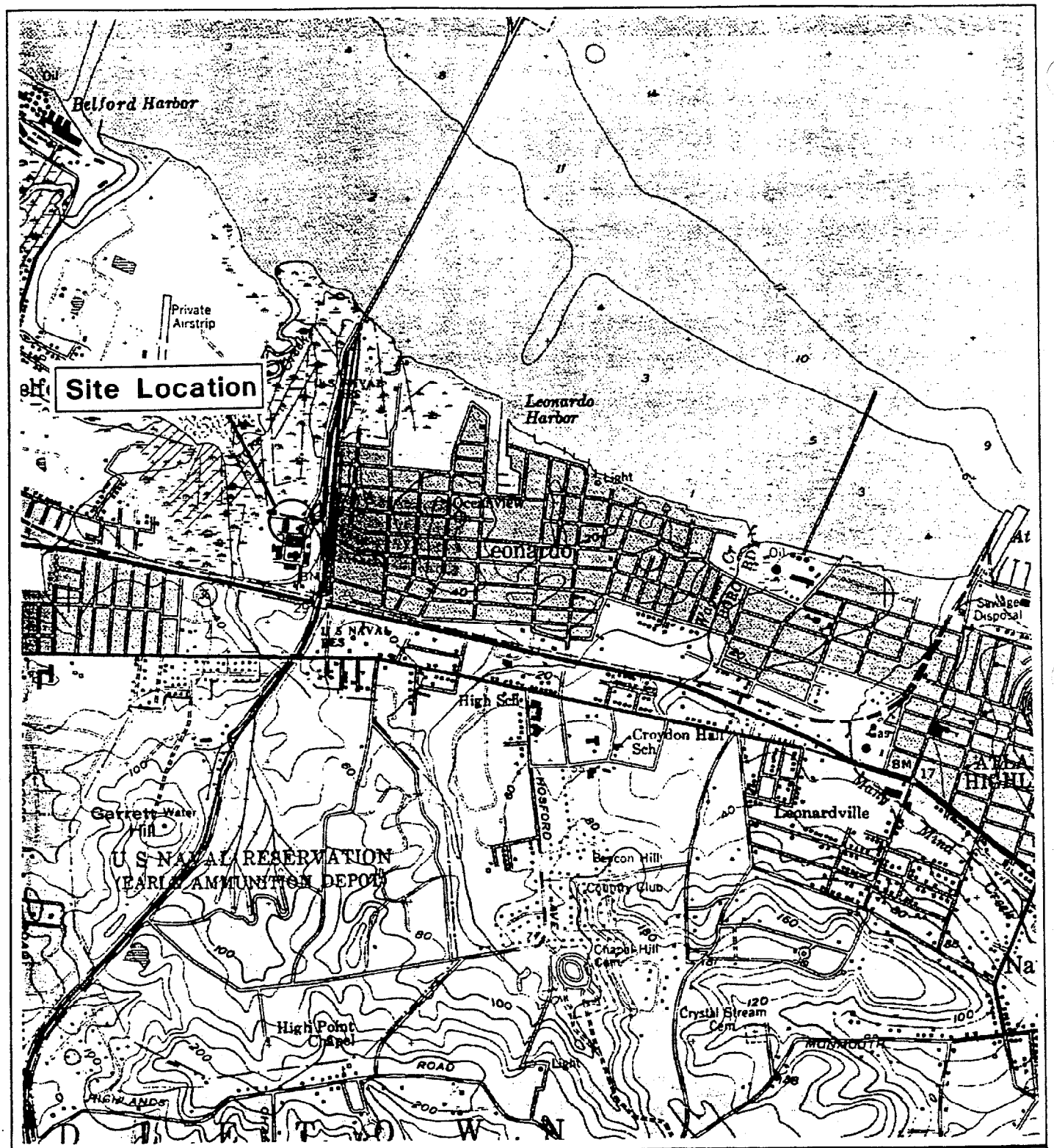
The project objective was the excavation, removal, and disposal of contaminated soils, sample collection to demonstrate that New Jersey Department of Environmental Protection (NJDEP) Residential Clean-Up Standards have been met, and restoration of the site after excavation. Removal of the impacted soils shall minimize the potential migration/mobilization of the contaminants to surface water, groundwater, and soils at the site. All work was completed in accordance with all applicable federal, state, and local regulations.

2.0 PROJECT LOCATION AND DESCRIPTION

Naval Weapons Station Earle (NWS-Earle) is located in Monmouth County in east-central New Jersey. The base consists of a Mainside area and a Water Front area occupying a total of approximately 11,134 acres. The Mainside of the base is located approximately 10 miles inland from the Atlantic Ocean. The Mainside and the Waterfront areas of the base are linked by a narrow tract of land that serves as a right-of-way for a government road and railroad line.

NWS Earle is responsible for furnishing ammunition to the naval fleet, and coordinates all port services and logistical support for home-ported and visiting ships. The base also conducts safety inspections, supervises ammunition loading for the United States Coast Guard, and provides marine fire fighting capability and standby tug services.

Site 12 is located at the Waterfront area of the NWS-Earle Base, as presented in Figure 2-1. The Waterfront consists of an ammunition depot and associated piers for loading and servicing the naval fleet. Site 12 is located adjacent to the loading dock north of Building R-10. The site layout of Site 12 – Former Battery Storage Area is shown as Figure 2-2.



0 2000 4000 FT

N

QUADRANGLE LOCATION

Source: U.S.G.S. Topographic Maps (7.5 Minute)
Sandy Hook, NJ Quadrangle

NWS – Earle

Colts Neck, N.J.

Figure 2–1
Site Location Map

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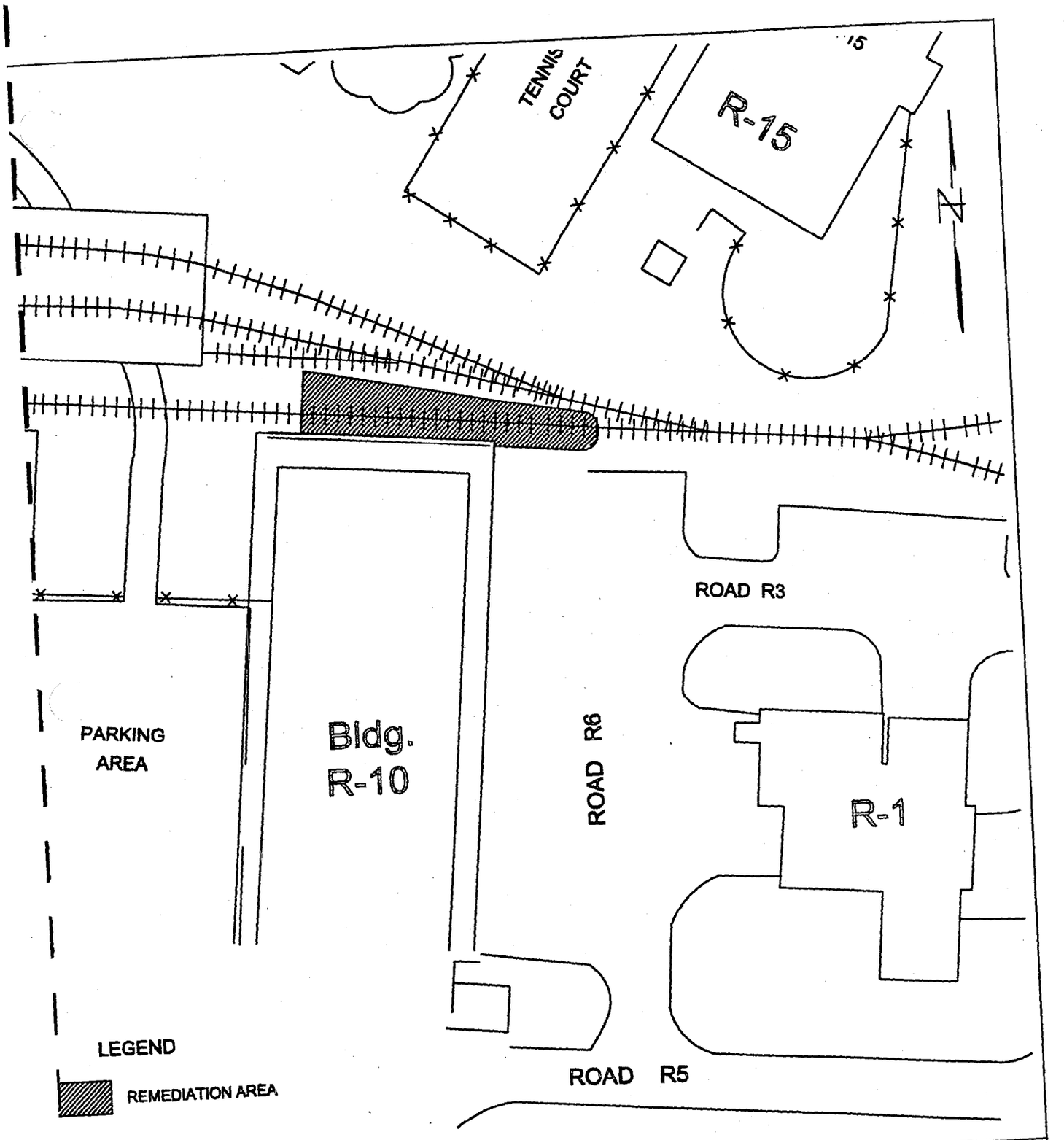

U.S. Navy RAC
NWS - Earle

Figure 2-2
Site 12 Battery Storage Area
Site Layout Map

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Source: Brown & Root Environmental, RI Report.

roc\earle\fig3-1

Site 12 was used as a temporary staging area for forklift batteries. The storage area encompassed an area of approximately 10,000 square feet. The area has not been in use for battery storage for some time. There was no visible source of contamination, such as staining or stressed vegetation.

2.1 PREVIOUS INVESTIGATIONS

Brown and Root Environmental conducted a Remedial Investigation of the Site 12 in 1996. Surface soils were obtained between the loading dock, on the northern side of Building R-10, and the railroad tracks. The soil samples were collected from 0 to six-inches below grade. The three soil samples were analyzed for total compound list (TCL) volatile organic compounds (VOCs), TCL semivolatile compounds (SVOCs), TCL pesticides/PCBs, and total analyte list (TAL) metals. The laboratory analyses of the surface soils revealed concentrations of SVOCs and inorganics above the NJDEP Residential Direct Contact Cleanup Criteria.

Brown and Root Environmental conducted additional sampling at Site 12, and submitted an Addendum to the RI. This sampling included the collection of an additional surface soil sample (12SS04) to the west of surface soil sample 12SS03, in order to delineate the western extent of contamination. Soil borings were also advance during the additional field work to delineate the vertical extent of the metals contamination. Four soil borings were advanced to a depth of approximately 3 feet below grade at surface soil sample locations, and four subsurface soil samples were analyzed for (TAL) metals. The laboratory analyses of the subsurface soil samples revealed that the concentrations of metals at 3 feet below grade were below all NJDEP Residential Clean-Up Criteria. Appendix A contains a summary of all the analytical data collected for the RI, and the Addendum to the RI.

3.0 REMEDIAL ACTIVITIES

3.1 COLLECTION OF ADDITIONAL DELINEATION SAMPLES

As part of Foster Wheeler Environmental's remedial action, two additional soil samples (12SS04 and 12SS05) were obtained north of the railroad tracks at Site 12. The additional delineation samples were obtained in order to determine the northern extent of the remediation. The soil samples were analyzed for Metals and SVOCs. The laboratory analytical results of soil sample 12SS04 contained arsenic at a concentration above the NJDEP Residential Cleanup Criteria of 20 mg/kg. The width of the excavation was extended north to include the area encompassing the 12SS04 sample areas. Table 3-1 summarized the laboratory analytical data of the additional delineation samples. Appendix B contains the laboratory analyses of these two samples.

3.2 WASTE CHARACTERIZATION

Following the additional delineation, waste characterization sampling was performed to characterize the soils for off-site transportation and disposal. Foster Wheeler Environmental collected three waste characterization samples (12WC01, 12WC02, 12WC03) from the area prior to excavation in order to evaluate the soils for off-site disposal. Soil sample 12WC01 was analyzed for Full TCLP, PCBs and RCRA Characteristics. Soil samples 12WC02 and 12-WC03 were analyzed for Full TCLP. The three soil samples, with the exception of the volatile fractions, were composited over the area of known contamination. The samples were collected with a decontaminated stainless steel auger at depths of 0 to 2 feet below grade. Each sample was composited from 5 separate locations. The volatile samples were collected as discrete grab samples. Appendix C contains the laboratory analyses of the waste characterization soil samples. Based on the laboratory results of the waste characterization samples, the soils were classified as non-hazardous.

The Navy and the disposal facility requested that additional waste characterization samples be obtained once the soils were stock-piled. Three additional waste characterization samples (12WC07, 12WC08 and 12WC09) were obtained from the stock-piled soils after excavation at Site 12. Each soil sample was composited from three locations in the stock-piled soils. A stainless steel hand auger was used to obtain composite samples from the middle of the piles. All three samples were analyzed to TCLP Metals and Total Petroleum Hydrocarbons (TPH). Sample 12WC07 was also analyzed for VOCs. The volatile organic compounds fraction for 12WC07 was collected from one location (not composited) to minimized volatilization. This sample was biased towards the oil-stained cinder excavated from the site. Appendix C contains the laboratory analyses of the waste characterization soil samples.

As per the laboratory analytical results of the soil samples obtained during the RI, samples taken of the stock-piled soils, and the pre-excavation waste characterization samples, the waste soil was classified as non-hazardous soil, contaminated with petroleum hydrocarbons and metals.

3.3 EXCAVATION OF CONTAMINATED SOIL

The contaminated soil from Site 12 was excavated with a Case 580 backhoe. Appendix D contains the Photo Log of site activities. The soils were excavated and stock-piled on plastic, and covered over with plastic at the end of each working day. The area around the excavation was secured with a temporary fence to prevent entrance to the exclusion zone.

Table 3-1
Site 12
Additional Delineation Sample Results

SAMPLE ID	Residential	12SS04		12SS05	
DATE COLLECTED	Direct Contact	8/3/1999		8/3/1999	
LOCATION	Soil Cleanup	SITE 12		SITE 12	
MATRIX	Criteria	soil		soil	
UNITS	mg/Kg	mg/Kg		mg/Kg	
COMMENTS		0-2' BGS		0-2' BGS	
Aluminum	NA	5780		9820	
Antimony	14	0.94	B	1.8	B
Arsenic	20	**26.6**		17.1	
Barium	700	20.7	B	72.5	
Beryllium	1	0.57		1.0	
Cadmium	1	0.11	U	0.11	U
Calcium	NA	1030		3190	
Chromium	240	30.6		36.2	
Cobalt	NA	3.4	B	5.1	B
Copper	600	20.4		42.3	
Iron	NA	27,600		38,000	
Lead	400	22.9		126	
Magnesium	NA	872		2160	
Manganese	NA	72.2		82.4	
Mercury	14	0.11	U	0.13	
Nickel	250	3.0	B	7.8	
Potassium	NA	1690		4250	
Selenium	63	0.53	U	0.55	U
Silver	110	0.11	U	0.17	B
Sodium	NA	154	B	318	B
Thallium	2	0.74	U	0.77	U
Vanadium	370	35.6		28.2	
Zinc	1500	42		95.5	

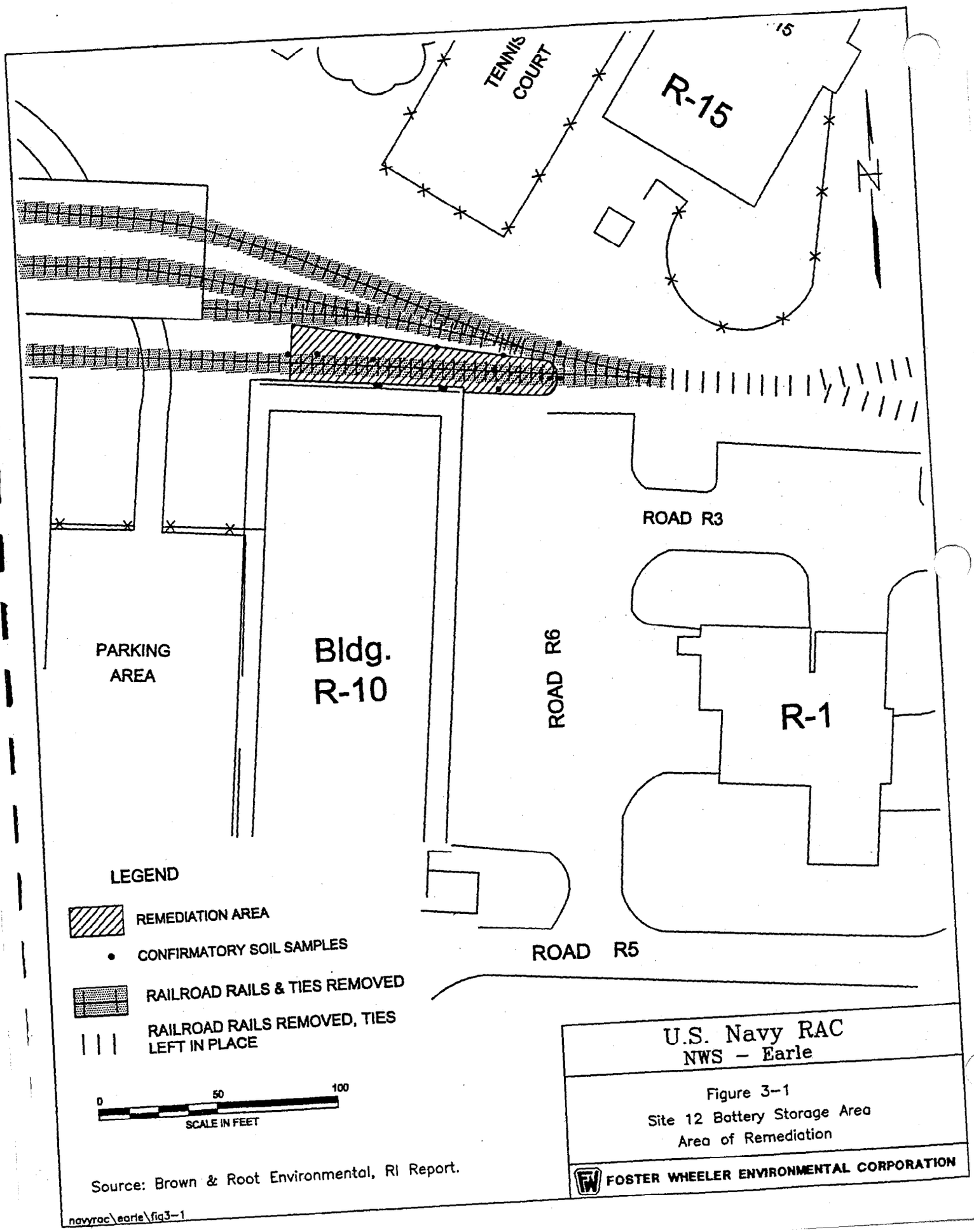
B GREATER THAN INSTRUMENT DL, LESS THAN CONTRACT REQUIRED DL

Based on the existing analytical results, the area of concern north of Building R-10 was initially excavated to a depth of approximately 1.5 to 2-feet below grade. Three separate excavation activities were conducted to ensure that all soils at the site were excavated to concentrations below the NJDEP Residential Cleanup Criteria. The following sections detail each excavation activity, and the confirmatory soil samples collected.

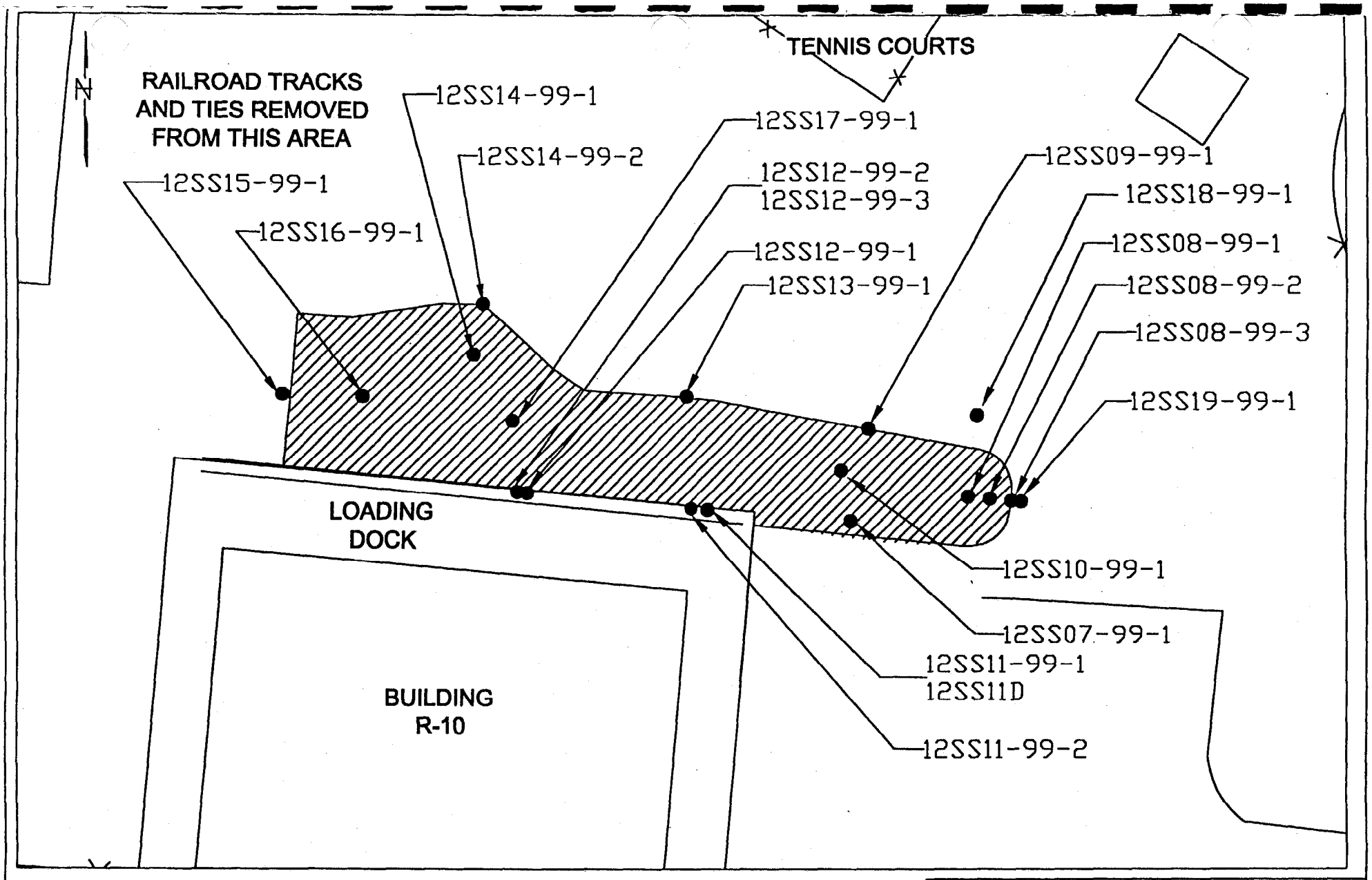
3.3.1 Initial Excavation Activities

The initial excavation at Site 12 occurred on October 20 and 21, 1999, to remove soils contaminated with Semi-Volatile Organic Compounds (SVOCs) and Metals. During the initial excavation activities, petroleum hydrocarbon contamination was detected at Site 12. Petroleum hydrocarbons were not identified as contaminants of concern during the RI. The Navy was notified and agreed that the confirmatory samples should also be analyzed for Total Petroleum Hydrocarbons-Diesel Range Organics (TPH-DRO). The samples were analyzed for diesel range organics due to the odor of the soil and the location of a former heating oil underground storage tank in the area. During the removal of soils adjacent to the loading dock of Building R-10, pipe outfalls were uncovered approximately 1.5 to 2 feet below grade. The three-inch diameter terra cotta pipes ended flush with the dock. The function of these pipes was not determined. Building R-10 is apparently a newer building that was built upon a former building slab. The pipes may have been associated with the former building at this location. The soils beneath the drain outfall located on the northeastern corner of the loading dock were stained with petroleum. Additional soils were excavated in the area of this pipe to remove all the petroleum contamination. The soils in the area of the northern pipe were excavated to a depth of approximately 4.5 feet below grade. Petroleum contamination was also noted in the cinders underlying the former railroad tracks, north of Building R-12. The petroleum contamination appeared to be limited to the cinders, and was not observed to extend deeper into the underlying silty sand and clay. The petroleum-contaminated cinders were excavated along with the other soils at the site.

On October 20 and 21, eleven confirmatory soil samples (12SS07-99-1 through 12SS17-99-1) and one duplicate sample (12SS11D-99-1) were collected from the initial excavation at Site 12. Based on NJDEP Final Regulations, one confirmatory sample was taken from each side-wall for every 30 linear feet of side-wall and one sample was be taken from the excavation bottom for every 900 square feet of bottom area. Eight side-wall samples were collected from 0 to 6 inches into the soil bank, approximately midway up the side-wall. Five samples (0-6 inches deep),including the duplicate sample, were collected at regularly-spaced intervals from the bottom of the excavation. If any visible staining or odor was present, samples were biased towards these areas. Figure 3-1 depicts the area of remediation at Site 12. Figure 3-2 depicts the confirmatory soil sample locations. Table 3-2 summarizes the soil sample descriptions of the confirmatory samples.



Source: Brown & Root Environmental, RI Report.



20 0 20 40

Scale in feet

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Figure 3-2
Site 12 Battery Storage Area
Confirmatory Soil Sampling Locations

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Table 3-2
NWS-Earle
Site 12: Soil Sample Description

SAMPLE ID	date collected	time	SAMPLE TYPE	APPROXIMATE DEPTH (feet below original grade)	SOIL DECRIPTION
12SS07-99-1	10/20/99	1420	SIDEWALL	1.5	Brown silty sand with minor clay
12SS08-99-1	10/20/99	1430	SIDEWALL	1.5	Black cinders, petroleum odor
12SS09-99-1	10/20/99	1435	SIDEWALL	1.5	Black cinders
12SS10-99-1	10/20/99	1445	BOTTOM	3.0	Brown silty fine sand
12SS11-99-1	10/21/99	905	BOTTOM	4.5	Brown silty sand with minor clay
12SS11D-99-1	10/21/99	905	BOTTOM	4.5	Blind duplicate
12SS12-99-1	10/21/99	915	SIDEWALL	2	Brown clay and sand
12SS13-99-1	10/21/99	900	SIDEWALL	1.5	Brown silty sand and clay
12SS14-99-1	10/21/99	1150	SIDEWALL	1.5	Brown silty sand
12SS15-99-1	10/21/99	1325	SIDEWALL	2.0	Brown silty sand with some black cinders
12SS16-99-1	10/21/99	1330	SIDEWALL	1.5	Black cinders, petroleum odor
12SS17-99-1	10/21/99	925	BOTTOM	2.0	Brown clay and silty sand
12SS18-99-1	10/21/99	1115	delineation	1.5-2.0	Black cinders with silty fine sand, no odor
12SS19-99-1	10/21/99	1130	delineation	1.5-2.0	Black cinders with petroleum odor
12SS08-99-02	11/2/99	10:15	SIDEWALL	2.5	Light brown, silty sand with some clay
12SS11-99-02	11/2/99	10:48	BOTTOM	4.0	Dense, dark-gray clay
12SS12-99-02	11/2/99	11:05	SIDEWALL	4.0	Dense, dark-gray clay
12SS14-99-02	11/2/99	11:20	SIDEWALL	2.0	Brown silty fine sand
12SS08-99-03	11/9/99	13:45	SIDEWALL	3.0	Brown sand with some clay, slight petroleum odor
12SS12-99-03	11/9/99	14:40	SIDEWALL	5.0	Dense, dark-gray clay

Samples were collected from 0 to 6 inches deep with a decontaminated stainless steel hand trowel. The soil was homogenized in a stainless steel bowl and then placed into the laboratory-prepared bottles. The bottles were labeled appropriately, and logged in a field logbook and on the laboratory chain of custody.

Confirmatory samples were analyzed for TCL SVOCs, TAL Metals and TPH-DRO and the results were compared to the NJDEP Residential Direct Contact Soil Cleanup Criteria (NJDEP Cleanup Criteria). The laboratory analytical results of all the samples were below the NJDEP Cleanup Criteria, with the exception of several samples, which contained concentrations of arsenic above the criteria. Table 4-1 and Table 4-2 summarize the SVOC and Metals data, respectively.

The arsenic concentrations detected in soil samples SS08-99-1, SS11D-99-1, SS12-99-1, and SS14-99-1 ranged from 22.9 to 32.0 ppm, and were in exceedance of the NJDEP Cleanup Criteria of 20 ppm for arsenic.

All initial confirmatory sample results were below the NJDEP Cleanup Criteria for TPH of 10,000 ppm. However, Sample 12SS08-99-1 had a TPH concentration of 1,100 ppm. Table 4-3 summarizes the TPH concentrations of the confirmatory soil samples.

3.3.2 Secondary Excavation Activities

Based on the first round of laboratory analytical results of the post excavation samples, additional excavation activities occurred at Site 12 on November 2, 1999. The areas around sample locations SS08-99-1, SS11-99-1, SS12-99-1, and SS14-99-1 were re-excavated and additional confirmatory soil samples were obtained and analyzed for metals. One soil sample was also obtained for Volatile Organic Compounds (VOCs). As per the New Jersey Technical Requirements for Site Remediation, a sample must be collected and analyzed for VOCs if a sample from the location in question exceeds 1,000 ppm for TPH. Since the laboratory analysis of Sample 12SS08-99-1 contained a TPH concentration of 1,100 ppm, the confirmatory soil sample collected after re-excavation was also analyzed for VOCs. The area at 12SS08 was excavated horizontally an additional 6-feet to the east, and vertically down to a depth of approximately 2 feet. The area of 12SS11-99-01 was excavated from the original 2 feet depth to 4 feet below grade. The area of 12SS12-99-01 was excavated from the original 2.5 feet depth to 4 feet below grade. The area of 12SS14-99-01 was excavated an additional 2 feet to the north at the original depth of 2 feet.

The second round of confirmatory soil samples were obtained after the additional excavation activities were complete. The soil samples were labeled to depict the second round sampling at that location (i.e., 12SS08-99-02). The ...99-02 portion of the sample identifier signifies that this was the second sample taken at this location. The second round of confirmatory samples were analyzed for TAL Metals. Two of the four areas re-excavated and sampled still revealed concentrations of arsenic in excess of the NJDEP Cleanup Criteria. Soil sample 12SS12-99-02 contained arsenic at a concentration of 27.67 ppm, and soil sample 12SS08-99-02 contained arsenic at a concentration of 25.69 ppm. Table 4-4 summarizes the metals

concentrations of the second round of confirmatory soil samples. The NJDEP Cleanup Criteria for arsenic is 20 ppm. The analytical results from the other two areas re-excavated and sampled did not exceed the NJDEP Cleanup Criteria.

The VOC analyses of soil sample 12SS08-99-02 revealed no detected concentrations of volatile organics. This area was sampled for VOCs because the original confirmatory soil sample (12SS08-99-01) had a TPH concentration greater than 1,000 ppm. Appendix A contains the complete laboratory data sheet.

3.3.3 Tertiary Excavation Activities

Based on the second round of laboratory analytical results of the post excavation samples, additional excavation activities occurred at Site 12 on November 9, 1999. The areas around soil sample locations 12SS08-99-2 and SS12-99-2 were re-excavated, and additional confirmatory soil samples were obtained and analyzed for metals. The area around 12SS08 was excavated another 8 feet to the east, and a total of approximately 3 feet below grade. The area around 12SS12 was excavated to a total depth of approximately 5 feet below original grade.

The third round of confirmatory soil samples were obtained after the additional excavation activities were complete. The soil samples were labeled to depict the second round sampling at that location (i.e.,12SS08-99-03). The ...99-03 portion of the sample identifier signifies that this was the third sample taken at this location. The third-round of confirmatory samples (12SS08-9903 and 12SS12-99-03) were analyzed for TAL Metals. The laboratory results of samples taken in both re-excavated areas revealed concentrations of arsenic, and all other metals, below the NJDEP Cleanup Criteria. Table 4-5 summarizes the metals concentrations of the third-round confirmatory soil samples.

4.0 LABORATORY ANALYTICAL RESULTS

The site-specific Standard Operating Procedures and laboratory analyses methods outlined in the approved Work Plan were used for the sampling and analysis procedures. Any modifications necessary to these SOPs, due to field conditions or other unforeseen situations were recorded in the site logbook, documented on the appropriate Change Request Forms (CRF) by site personnel, and approved by the Senior Project Engineer/Manager and the Navy. The only change in scope from the original approved Work Plan was the additional laboratory analyses of the soil samples for TPH, which was approved by the Navy utilizing the appropriate CRF.

The sample tracking system outlined in the approved Work Plan was used to label and track all samples.

4.1 CONFIRMATORY SOIL SAMPLES

In accordance with the approved Work Plan, confirmatory soil samples were collected from the excavation side-walls and base in order to verify that the contaminants of concern were excavated to concentrations below the NJDEP Residential Cleanup Criteria. All samples were sent to ChemTech Laboratory, in Englewood, New Jersey. The initial confirmatory soil samples were analyzed for TAL metals and TCL SVOCs. Since petroleum contamination was encountered during the excavation, the first-round of confirmatory soil samples were also analyzed for TPH-DRO. Tables 4-1 through 4-3 summarize the analytical results of the first round of confirmatory soil samples. Appendix E contains the laboratory analyses of the confirmatory soil samples.

After the initial excavation, two additional soil excavation and sampling events were conducted in order to ensure soils all soils with concentrations of arsenic above the NJDEP Cleanup Criteria were removed. Since arsenic was the only contaminant of concern for the two additional soil excavations, the second and third-round of confirmatory soil samples were only analyzed for TAL metals. Tables 4-4 and 4-5 summarize the analytical results of the second and third round of confirmatory soil samples. Appendix E contains the laboratory analyses of the confirmatory soil samples.

4.2 BLANK SAMPLES

In accordance with the approved Work Plan, field blank samples were obtained in the field and analyzed at the laboratory. The objective of rinse blank sampling was to ensure that the proper quality assurance and quality control procedures were used during the collection of the confirmatory soil samples. De-ionized water was poured over the decontaminated soil collection devices (trowel and hand auger), and the water was collected in a decontaminated stainless steel bowl under the sampling device. The water was then transferred from the stainless steel bowl to the appropriate sample container. The field blank was collected by pouring de-ionized water from the source bottle to a laboratory prepared bottle. The field blank is used to determine is site atmospheric conditions could possibly contaminate the samples. The field blank sample for the volatile organics is used to determine if any outside source of contamination effected the sample bottleware from the lab to the site, and the return to the lab. The laboratory analyses of the field blank (FB-01), rinsate blank (RB-01) and trip blank sample (Trip Blank-1) ensured that there was no cross-contamination associated with the sampling procedures at the site. Appendix E contains the laboratory analyses, which includes the field blanks.

TABLE 4-1
NWS-EARLE
Site 12: 1st Round Confirmatory Soil Sample Analytical Results
TCL Semi-Volatile Organic Compounds

SAMPLE ID			12SS13-99-1		12SS14-99-1		12SS15-99-1		12SS16-99-1		12SS17-99-1	
LAB ID	**Residential**		88442		88443		88444		88445		88446	
DATE COLLECTED	**Direct Contact**		10/21/99		10/21/99		10/21/99		10/21/99		10/21/99	
LOCATION	**Soil Cleanup**		SIDEWALL		SIDEWALL		SIDEWALL		SIDEWALL		BOTTOM	
MATRIX	**Criteria**		soil		soil		soil		soil		soil	
UNITS	**mg/Kg**		mg/Kg		ug/Kg		mg/Kg		mg/Kg		mg/Kg	
DEPTH BGS (ft)			1.5		1.5		2.0		1.5		2.0	
COMMENTS			POST-EX		POST-EX		POST-EX		POST-EX		POST-EX	
Acenaphthene	**10,000**		ND		ND		ND		ND		ND	
2,4-Dinitrophenol	**110**		ND		ND		ND		ND		ND	
4-Nitrophenol	**NA**		ND		ND		ND		ND		ND	
Dibenzofuran	**NA**		ND		ND		ND		ND		ND	
2,4-Dinitrotoluene	**1**		ND		ND		ND		ND		ND	
Diethylphthalate	**10,000**		ND		ND		ND		ND		ND	
4-Chlorophenyl-phenylether	**NA**		ND		ND		ND		ND		ND	
Fluorene	**2,300**		ND		ND		ND		ND		ND	
4-Nitroaniline	**NA**		ND		ND		ND		ND		ND	
4,6-Dinitro-2-methylphenol	**NA**		ND		ND		ND		ND		ND	
N-Nitrosodiphenylamine	**140**		ND		ND		ND		ND		ND	
4-Bromophenyl-phenylether	**NA**		ND		ND		ND		ND		ND	
Hexachlorobenzene	**0.66**		ND		ND		ND		ND		ND	
Pentachlorophenol	**6**		ND		ND		ND		ND		ND	
Phenanthrene	**NA**		ND		ND		ND		ND		0.20	
Anthracene	**10,000**		ND		ND		ND		ND		ND	
Carbazole	**NA**		ND		ND		ND		ND		0.086	
Di-n-butlyphtalate	**5,700**		ND		ND		ND		ND		ND	
Fluoranthene	**2,300**		ND		ND		0.079		ND		0.22	
Pyrene	**1,700**		ND		ND		0.11		ND		0.17	
Butlybenzylphthalate	**1,100**		ND		ND		ND		ND		ND	
3,3'-Dichlorobenzidine	**2**		ND		ND		ND		ND		ND	
Benzo(a)anthracene	**0.9**		ND		ND		0.06		ND		ND	
Chrysene	**9**		ND		ND		0.14		ND		0.07	
bis(2-Ethylhexyl)phthalate	**NA**		ND		ND		ND		ND		ND	
Di-n-octylphthalate	**1,100**		ND		ND		ND		ND		ND	
Benzo(b)fluoranthene	**0.9**		ND		ND		ND		ND		ND	
Benzo(k)fluoranthene	**0.9**		ND		ND		ND		ND		ND	
Benzo(a)pyrene	**0.66**		ND		ND		ND		ND		ND	
Indeno(1,2,3-cd)pyrene	**0.9**		ND		ND		ND		ND		ND	
Dibenz(a,h)anthracene	**0.66**		ND		ND		ND		ND		ND	
Benzo(g,h,I)perylene	**NA**		ND		ND		ND		ND		ND	
TOTAL TICs	**NA**	J	8.07	J	16.74	J	10.76	J	0.17	J	3.05	J

ND-concentration below the detection limit
J-estimated concentration
NA-not applicable

TAB 1
NWS LE

Site 12: 1st Round Confirmatory Soil Sample Analytical Results
TCL Semi-Volatile Organic Compounds

SAMPLE ID		12SS13-99-1	12SS14-99-1	12SS15-99-1	12SS16-99-1	12SS17-99-1
LAB ID	**Residential**	88442	88443	88444	88445	88446
DATE COLLECTED	**Direct Contact**	10/21/99	10/21/99	10/21/99	10/21/99	10/21/99
LOCATION	**Soil Cleanup**	SIDEWALL	SIDEWALL	SIDEWALL	SIDEWALL	BOTTOM
MATRIX	**Criteria**	soil	soil	soil	soil	soil
UNITS	**mg/Kg**	mg/Kg	ug/Kg	mg/Kg	mg/Kg	mg/Kg
DEPTH BGS (ft)		1.5	1.5	2.0	1.5	2.0
COMMENTS		POST-EX	POST-EX	POST-EX	POST-EX	POST-EX
Phenol	**10,000**	ND	ND	ND	ND	ND
bis(2-Chloroethyl)ether	**0.66**	ND	ND	ND	ND	ND
bis(2-Chloroisopropyl)ether	**NA**	ND	ND	ND	ND	ND
2-Chlorophenol	**280**	ND	ND	ND	ND	ND
1,2-Dichlorobenzene	**5,100**	ND	ND	ND	ND	ND
1,3-Dichlorobenzene	**5,100**	ND	ND	ND	ND	ND
1,4-Dichlorobenzene	**570**	ND	ND	ND	ND	ND
2-Methylphenol	**2,800**	ND	ND	ND	ND	ND
3+4-Methylphenols	**2,800**	ND	ND	ND	ND	ND
n-Nitroso-di-n-propylamine	**0.66**	ND	ND	ND	ND	ND
Hexachloroethane	**6**	ND	ND	ND	ND	ND
Nitrobenzene	**28**	ND	ND	ND	ND	ND
Isophorone	**1,100**	ND	ND	ND	ND	ND
2-Nitrophenol	**NA**	ND	ND	ND	ND	ND
2,4-Dimethylphenol	**1,100**	ND	ND	ND	ND	ND
bis(2-Chloroethoxy)methane	**NA**	ND	ND	ND	ND	ND
2,4-Dichlorophenol	**170**	ND	ND	ND	ND	ND
1,2,4-Trichlorobenzene	**68**	ND	ND	ND	ND	ND
Naphthalene	**230**	ND	ND	ND	ND	ND
4-Chloroaniline	**230**	ND	ND	ND	ND	ND
Hexaclorobutadiene	**1**	ND	ND	ND	ND	ND
4-Chloro-3-methylphenol	**10,000**	ND	ND	ND	ND	ND
2-Methylnaphthalene	**NA**	ND	ND	ND	ND	ND
Hexachlorocyclopentadiene	**400**	ND	ND	ND	ND	ND
2,4,6-Trichlorophenol	**62**	ND	ND	ND	ND	ND
2,4,5-Trichlorophenol	**5,600**	ND	ND	ND	ND	ND
2-Chloronaphthalene	**NA**	ND	ND	ND	ND	ND
2-Nitroaniline	**NA**	ND	ND	ND	ND	ND
Dimethylphthalate	**10,000**	ND	ND	ND	ND	ND
Acenaphthylene	**NA**	ND	ND	ND	ND	ND
2,6-Dinitrotoluene	**1**	ND	ND	ND	ND	ND
3-Nitroaniline	**NA**	ND	ND	ND	ND	ND

ND-concentration below the detection limit
J-estimated concentration
NA-not applicable

TABLE 4-1
NWS-EARLE
Site 12: 1st Round Confirmatory Soil Sample Analytical Results
TCL Semi-Volatile Organic Compounds

SAMPLE ID		12SS07-99-1		12SS08-99-1		12SS09-99-1		12SS10-99-1		12SS11-99-1		12SS11D-99-1		12SS12-99-1
LAB ID	**Residential**	88435		88436		88437		88438		88439		88440		88441
DATE COLLECTED	**Direct Contact**	10/20/1999		10/20/1999		10/20/1999		10/20/1999		10/21/1999		10/21/1999		10/21/99
LOCATION	**Soil Cleanup**	SIDEWALL		SIDEWALL		SIDEWALL		SIDEWALL		BOTTOM		BOTTOM		SIDEWALL
MATRIX	**Criteria**	soil		soil		soil		soil		soil		soil		soil
UNITS	**mg/Kg**	mg/Kg		mg/Kg		mg/Kg		mg/Kg		mg/Kg		mg/Kg		mg/Kg
DEPTH BGS (ft)		1.5		1.5		1.5		3.0		4.5		4.5		2.0
COMMENTS		POST-EX		POST-EX		POST-EX		POST-EX		POST-EX		POST-EX/DUPLICATE		POST-EX
Acenaphthene	**3,400**	ND		ND		0.11		ND		ND		ND		ND
2,4-Dinitrophenol	**110**	ND		ND		ND		ND		ND		ND		ND
4-Nitrophenol	**NA**	ND		ND		ND		ND		ND		ND		ND
Dibenzofuran	**NA**	ND		ND		ND		ND		ND		ND		ND
2,4-Dinitrotoluene	**1**	ND		ND		ND		ND		ND		ND		ND
Diethylphthalate	**10,000**	ND		ND		ND		ND		ND		ND		ND
4-Chlorophenyl-phenylether	**NA**	ND		ND		ND		ND		ND		ND		ND
Fluorene	**2,300**	ND		ND		ND		ND		ND		ND		ND
4-Nitroaniline	**NA**	ND		ND		ND		ND		ND		ND		ND
4,6-Dinitro-2-methylphenol	**NA**	ND		ND		ND		ND		ND		ND		ND
N-Nitrosodiphenylamine	**140**	ND		ND		ND		ND		ND		ND		ND
4-Bromophenyl-phenylether	**NA**	ND		ND		ND		ND		ND		ND		ND
Hexachlorobenzene	**0.66**	ND		ND		ND		ND		ND		ND		ND
Pentachlorophenol	**6**	ND		ND		ND		ND		ND		ND		ND
Phenanthrene	**NA**	ND		ND		0.35		ND		ND		ND		ND
Anthracene	**10,000**	ND		ND		0.053		ND		ND		ND		ND
Carbazole	**NA**	ND		ND		0.11		ND		ND		ND		ND
Di-n-butlyphtalate	**5,700**	ND		ND		ND		ND		ND		ND		ND
Fluoranthene	**2,300**	ND		ND		0.89		ND		ND		ND		ND
Pyrene	**1,700**	ND		ND		0.05		ND		ND		ND		ND
Butlybenzylphthalate	**1,100**	ND		ND		ND		ND		ND		ND		ND
3,3'-Dichlorobenzidine	**2**	ND		ND		ND		ND		ND		ND		ND
Benzo(a)anthracene	**0.9**	ND		ND		0.28		ND		ND		ND		ND
Chrysene	**9**	ND		ND		0.44		ND		ND		ND		ND
bis(2-Ethylhexyl)phthalate	**NA**	ND		ND		ND		ND		ND		ND		ND
Di-n-octylphthalate	**1,100**	ND		ND		ND		ND		ND		ND		ND
Benzo(b)fluoranthene	**0.9**	ND		ND		0.39		ND		ND		ND		ND
Benzo(k)fluoranthene	**0.9**	ND		ND		0.28		ND		ND		ND		ND
Benzo(a)pyrene	**0.66**	ND		ND		0.20		ND		ND		ND		ND
Indeno(1,2,3-cd)pyrene	**0.9**	ND		ND		ND		ND		ND		ND		ND
Dibenz(a,h)anthracene	**0.66**	ND		ND		ND		ND		ND		ND		ND
Benzo(g,h,l)perylene	**NA**	ND		ND		0.089		ND		ND		ND		ND
TOTAL TICs	**NA**	0.19	J	31.68	J	4.5	J	0.29	J	0.18	J	2.18	J	0.21

ND-concentration below the detection limit
J-estimated concentration
NA-not applicable

TABLE 4-1
NWS-EARLE
Site 12: 1st Round Confirmatory Soil Sample Analytical Results
TCL Semi-Volatile Organic Compounds

SAMPLE ID		12SS07-99-1	12SS08-99-1	12SS09-99-1	12SS10-99-1	12SS11-99-1	12SS11D-99-1	12SS12-99-1
LAB ID	**Residential**	88435	88436	88437	88438	88439	88440	88441
DATE COLLECTED	**Direct Contact**	10/20/1999	10/20/1999	10/20/1999	10/20/1999	10/21/1999	10/21/1999	10/21/99
LOCATION	**Soil Cleanup**	SIDEWALL	SIDEWALL	SIDEWALL	SIDEWALL	BOTTOM	BOTTOM	SIDEWALL
MATRIX	**Criteria**	soil	soil	soil	soil	soil	soil	soil
UNITS	**mg/Kg**	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
DEPTH BGS (ft)		1.5	1.5	1.5	3.0	4.5	4.5	2.0
COMMENTS		POST-EX	POST-EX	POST-EX	POST-EX	POST-EX	POST-EX/DUPLICATE	POST-EX
Phenol	**10,000**	ND	ND	ND	ND	ND	ND	ND
bis(2-Chloroethyl)ether	**0.66**	ND	ND	ND	ND	ND	ND	ND
bis(2-Chloroisopropyl)ether	**NA**	ND	ND	ND	ND	ND	ND	ND
2-Chlorophenol	**280**	ND	ND	ND	ND	ND	ND	ND
1,2-Dichlorobenzene	**5,100**	ND	ND	ND	ND	ND	ND	ND
1,3-Dichlorobenzene	**5,100**	ND	ND	ND	ND	ND	ND	ND
1,4-Dichlorobenzene	**570**	ND	ND	ND	ND	ND	ND	ND
2-Methylphenol	**2,800**	ND	ND	ND	ND	ND	ND	ND
3+4-Methylphenols	**2,800**	ND	ND	ND	ND	ND	ND	ND
n-Nitroso-di-n-propylamine	**0.66**	ND	ND	ND	ND	ND	ND	ND
Hexachloroethane	**6**	ND	ND	ND	ND	ND	ND	ND
Nitrobenzene	**28**	ND	ND	ND	ND	ND	ND	ND
Isophorone	**1,100**	ND	ND	ND	ND	ND	ND	ND
2-Nitrophenol	**NA**	ND	ND	ND	ND	ND	ND	ND
2,4-Dimethylphenol	**1,100**	ND	ND	ND	ND	ND	ND	ND
bis(2-Chloroethoxy)methane	**NA**	ND	ND	ND	ND	ND	ND	ND
2,4-Dichlorophenol	**170**	ND	ND	ND	ND	ND	ND	ND
1,2,4-Trichlorobenzene	**68**	ND	ND	ND	ND	ND	ND	ND
Naphthalene	**230**	ND	ND	ND	ND	ND	ND	ND
4-Chloroaniline	**230**	ND	ND	ND	ND	ND	ND	ND
Hexaclorobutadiene	**1**	ND	ND	ND	ND	ND	ND	ND
4-Chloro-3-methylphenol	**10,000**	ND	ND	ND	ND	ND	ND	ND
2-Methylnaphthalene	**NA**	ND	ND	0.049 J	ND	ND	ND	ND
Hexachlorocyclopentadiene	**400**	ND	ND	ND	ND	ND	ND	ND
2,4,6-Trichlorophenol	**62**	ND	ND	ND	ND	ND	ND	ND
2,4,5-Trichlorophenol	**5,600**	ND	ND	ND	ND	ND	ND	ND
2-Chloronaphthalene	**NA**	ND	ND	ND	ND	ND	ND	ND
2-Nitroaniline	**NA**	ND	ND	ND	ND	ND	ND	ND
Dimethylphthalate	**10,000**	ND	ND	ND	ND	ND	ND	ND
Acenaphthylene	**NA**	ND	ND	ND	ND	ND	ND	ND
2,6-Dinitrotoluene	**1**	ND	ND	ND	ND	ND	ND	ND
3-Nitroaniline	**NA**	ND	ND	ND	ND	ND	ND	ND

ND-concentration below the detection limit
J-estimated concentration
NA-not applicable

TABLE 4-2
NWS-EARLE
Site 12: 1st Round Confirmatory Soil Sample Analytical Results
TAL Metals

SAMPLE ID		12SS15-99-1		12SS16-99-1		12SS17-99-1	
LAB ID	**Residential**	88444		88445		88446	
DATE COLLECTED	**Direct Contact**	10/21/99		10/21/99		10/21/99	
LOCATION	**Soil Cleanup**	SIDEWALL		SIDEWALL		BOTTOM	
MATRIX	**Criteria**	soil		soil		soil	
UNITS	**mg/Kg**	mg/Kg		mg/Kg		mg/Kg	
DEPTH BGS (ft)		2.0		1.5		2.0	
COMMENTS		POST-EX		POST-EX		POST-EX	
Aluminum	**NA**	13300		933		2710	
Antimony	**14**	0.65	U	0.57	U	0.59	U
Arsenic	**20**	17.7		2.2		5.2	
Barium	**700**	25.9		4.3		8.4	
Beryllium	**2**	1.6		0.18		0.3	
Cadmium	**39**	0.13	U	0.11	U	0.12	U
Calcium	**NA**	809		134		250	
Chromium	**240**	50.5		2.2		6.1	
Cobalt	**NA**	6.3	U	0.39		0.79	
Copper	**600**	7.8		3		7.2	
Iron	**NA**	50,600		20,700		40,300	
Lead	**400**	11.8		1.5		25.2	
Magnesium	**NA**	3270		19.5		120	
Manganese	**NA**	138		22.1		18.6	
Mercury	**14**	0.13	U	0.12	U	0.12	U
Nickel	**250**	4.8		0.2	U	0.23	U
Potassium	**NA**	8930		26.5		243	
Selenium	**63**	0.65	U	0.57	U	0.59	U
Silver	**110**	0.53		0.15		0.34	
Sodium	**NA**	283		61.5		72.2	
Thallium	**2**	0.92	U	0.8	U	0.82	U
Vanadium	**370**	35		2.7		7.9	
Zinc	**1500**	66		4.3		13.7	

U-concentration is less than detection limit.
NA-not applicable

p

TABLE 4-2
NWS-EARLE
Site 12: 1st Round Confirmatory Soil Sample Analytical Results
TAL Metals

SAMPLE ID			12SS11D-99-1		12SS12-99-1		12SS13-99-1		12SS14-99-1	
LAB ID	**Residential**		88440		88441		88442		88443	
DATE COLLECTED	**Direct Contact**		10/21/1999		10/21/99		10/21/99		10/21/99	
LOCATION	**Soil Cleanup**		BOTTOM		SIDEWALL		SIDEWALL		SIDEWALL	
MATRIX	**Criteria**		soil		soil		soil		soil	
UNITS	**mg/Kg**		mg/Kg		mg/Kg		mg/Kg		ug/Kg	
DEPTH BGS (ft)			4.5		2.0		1.5		1.5	
COMMENTS			POST-EX DUPLICATE		POST-EX		POST-EX		POST-EX	
Aluminum	**NA**		11400		13000		4020		7350	
Antimony	**14**	U	1.3		0.61	U	0.61	U	0.73	
Arsenic	**20**		**32.9**		**22.9**		7.9		**23.5**	
Barium	**700**		33.7		52.3		17.7		26.5	
Beryllium	**2**		1.3		1.2		0.4		0.68	
Cadmium	**39**	U	0.13	U	0.12	U	0.12	U	0.12	U
Calcium	**NA**		925		2620		1110		1080	
Chromium	**240**		75.2		47.4		10.2		32	
Cobalt	**NA**		3.6		3.8		2.1		2.6	
Copper	**600**		10.3		9.5		9.8		11.7	
Iron	**NA**		52,900		54,600		38,400		38,000	
Lead	**400**		15.8		12.9		14.1		14.3	
Magnesium	**NA**		2030		2180		390		1340	
Manganese	**NA**		82.5		75.2		48.9		52.3	
Mercury	**14**	U	0.13	U	0.13	U	0.12	U	0.12	U
Nickel	**250**		2.7		2.2		0.24	U	1.4	
Potassium	**NA**		4630		6110		655		3060	
Selenium	**63**	U	0.63	U	0.61	U	0.61	U	0.61	U
Silver	**110**		0.56		0.27		0.4		0.23	
Sodium	**NA**		392		438		108		118	
Thallium	**2**	U	0.88	U	0.86	U	0.85	U	0.85	U
Vanadium	**370**		64		43.9		12		31.5	
Zinc	**1500**		40.7		38.6		19.9		28.4	

U-concentration is less than detection limit.
NA-not applicable

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TABLE 4-2
NWS-EARLE
Site 12: 1st Round Confirmatory Soil Sample Analytical Results
TAL Metals

SAMPLE ID		12SS07-99-1		12SS08-99-1		12SS09-99-1		12SS10-99-1		12SS11-99-1
LAB ID	**Residential**	88435		88436		88437		88438		88439
DATE COLLECTED	**Direct Contact**	10/20/1999		10/20/1999		10/20/1999		10/20/1999		10/21/1999
LOCATION	**Soil Cleanup**	SIDEWALL		SIDEWALL		SIDEWALL		SIDEWALL		BOTTOM
MATRIX	**Criteria**	soil		soil		soil		soil		soil
UNITS	**mg/Kg**	mg/Kg		mg/Kg		mg/Kg		mg/Kg		mg/Kg
DEPTH BGS (ft)		1.5		1.5		1.5		3.0		4.5
COMMENTS		POST-EX		POST-EX		POST-EX		POST-EX		POST-EX
Aluminum	**NA**	3590		13400		1200		4600		6210
Antimony	**14**	0.56	U	0.64	U	1.2		0.61	U	0.63
Arsenic	**20**	6.4		**23.7**		17.1		8.1		10.6
Barium	**700**	9.5		87.9		111		13.1		23.5
Beryllium	**2**	0.28		1.0		0.96		0.6		0.62
Cadmium	**39**	0.57		0.13	U	1.3		0.12	U	0.13
Calcium	**NA**	1940		2160		1940		198		956
Chromium	**240**	14.3		25.9		26.9		13.3		24.1
Cobalt	**NA**	1.8		8.3		8		1.3		2.1
Copper	**600**	9.2		50		44.6		8.9		11.7
Iron	**NA**	16,900		38,100		34,100		4,100		28,400
Lead	**400**	12.4		36.6		37.4		5.7		18.9
Magnesium	**NA**	826		417		435		434		1020
Manganese	**NA**	42.3		51.4		51.1		32.5		63.4
Mercury	**14**	0.12	U	0.13	U	0.12	U	0.12	U	0.13
Nickel	**250**	3.0		17.3		13.6		0.24	U	3.8
Potassium	**NA**	578		1400		1390		820		2080
Selenium	**63**	0.56	U	0.64	U	0.89		0.61	U	0.63
Silver	**110**	0.11	U	0.4		0.53		0.17		0.16
Sodium	**NA**	171		384		413		81.2		292
Thallium	**2**	0.78	U	1.4		0.89	U	0.85	U	0.89
Vanadium	**370**	20.6		24.2		29.6		17		25.1
Zinc	**1500**	41.8		17.3		36.9		21.5		58.2

U-concentration is less than detection limit.
NA-n[illegible]plicable

TABLE 4-3
NWS-EARLE
Site 12 Soil Sample Analytical Results Total Petroleum Hydrocarbons (Diesel Range)

SAMPLE ID	NJDEP CLEANUP CRITERIA	12SS07-99-1	12SS08-99-1	12SS09-99-1	12SS10-99-1	12SS11-99-1	12SS11D-99-1	12SS12-99-1
LAB ID		88435/91634	88436/91635	88437/91636	88438/91637	88439/91638	88440/91639	88441/91640
ATE COLLECTED		10/20/1999	10/20/1999	10/20/1999	10/20/1999	10/21/1999	10/21/1999	10/21/99
LOCATION		SIDEWALL	SIDEWALL	SIDEWALL	SIDEWALL	BOTTOM	BOTTOM	SIDEWALL
MATRIX		soil	soil	soil	soil	soil	soil	soil
UNITS		mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
DEPTH BGS (ft)		1.5	1.5	1.5	3.0	4.5	4.5	2
COMMENTS		Post-excavation	Post-excavation	Post-excavation	Post-excavation	Post-excavation	Post-excavation duplicate	Post-excavation
Total Petroleum Hydrocarbons	**10,000 mg/Kg**	<19	1100	<22	<2.0	<2.2	<2.1	<2.1

SAMPLE ID	NJDEP CLEANUP CRITERIA	12SS13-99-1	12SS14-99-1	12SS15-99-1	12SS16-99-1	12SS17-99-1	12SS18-99-1	12SS19-99-1
LAB ID		88442/91641	88443/91642	88444/91643	88445/91644	88446/91645	91649	91650
LOCATION		10/21/99	10/21/99	10/21/99	10/21/99	10/21/99	10/21/99	10/21/99
LOCATION		SIDEWALL	SIDEWALL	SIDEWALL	SIDEWALL	BOTTOM	SUBSURFACE	SUBSURFACE
MATRIX		soil	soil	soil	soil	soil	soil	soil
UNITS		mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
DEPTH BGS (ft)		1.5	1.5	2.0	1.5	2.0	1.5-2.0	1.5-2.0
COMMENTS		Post-excavation	Post-excavation	Post-excavation	Post-excavation	Post-excavation	Delineation	Delineation
Total Petroleum Hydrocarbons	**10,000 mg/Kg**	<2.0	<2.1	36	<2.0	5.7	<20	118

TABLE 4-4
NWS-EARLE
Site 12: 2nd Round Confirmatory Soil Sample Analytical Results
TAL Metals

SAMPLE ID		12SS08-99-02		12SS11-99-02		12SS12-99-02		12SS14-99-02	
LAB ID	**Residential**	92499		92500		92501		92502	
DATE COLLECTED	**Direct Contact**	11/2/1999		11/2/1999		11/2/1999		11/2/1999	
LOCATION	**Soil Cleanup**	SIDEWALL		BOTTOM		SIDEWALL		SIDEWALL	
MATRIX	**Criteria**	soil		soil		soil		soil	
UNITS	**mg/Kg**	mg/Kg		mg/Kg		mg/Kg		mg/Kg	
DEPTH BGS (ft)		2.5		4.0		4.0		2.0	
COMMENTS		POST-EX		POST-EX		POST-EX		POST-EX	
Aluminum	**NA**	N/A		N/A		N/A		N/A	
Antimony	**14**	N/A	U	N/A		N/A		N/A	
Arsenic	**20**	**25.69**		19.19		**27.67**		12.56	
Barium	**700**	26.05		ND		19.3		14.88	
Beryllium	**2**	N/A		N/A		N/A		N/A	
Cadmium	**39**	ND	U	ND	U	ND		N/A	
Calcium	**NA**	N/A		N/A		N/A		N/A	
Chromium	**240**	36.61		42.3		12.62		28.95	
Cobalt	**NA**	N/A		N/A		N/A		N/A	
Copper	**600**	3.6		7.58		10.44		29.07	
Iron	**NA**	N/A		N/A		N/A		N/A	
Lead	**400**	8.16		12.22		18.81		14.42	
Magnesium	**NA**	N/A		N/A		N/A		N/A	
Manganese	**NA**	N/A		N/A		N/A		N/A	
Mercury	**14**	0.048	U	0.073		0.073		0.07	
Nickel	**250**	7.2		7.58		5.2		4.07	
Potassium	**NA**	N/A		N/A		N/A		N/A	
Selenium	**63**	0.48		1.1		1.46		0.81	
Silver	**110**	ND	U	ND		ND		ND	
Sodium	**NA**	N/A		N/A		N/A		N/A	
Thallium	**2**	N/A	U	N/A		N/A		N/A	
Vanadium	**370**	N/A		N/A		N/A		N/A	
Zinc	**1500**	31.69		34.84		24.39		34.19	

U-concentration is less than detection limit.
NA-not applicable

TA 4-5
NWS-EARLE
Site 12: 3rd Round Confirmatory Soil Sample Analytical Results
TAL Metals

SAMPLE ID		12SS08-99-03		12SS12-99-03					
LAB ID	**Residential**	92499		92500					
DATE COLLECTED	**Direct Contact**	11/9/1999		11/2/1999					
LOCATION	**Soil Cleanup**	SIDEWALL		BOTTOM					
MATRIX	**Criteria**	soil		soil					
UNITS	**mg/Kg**	mg/Kg		mg/Kg					
DEPTH BGS (ft)		3.0		5.0					
COMMENTS		POST-EX		POST-EX					
Aluminum	**NA**	3350		3490					
Antimony	**14**	0.54	U	0.55	U				
Arsenic	**20**	16.8		8.1					
Barium	**700**	12.6		23					
Beryllium	**2**	0.4	B	0.3	B				
Cadmium	**39**	0.11	U	0.11	U				
Calcium	**NA**	545		1210					
Chromium	**240**	7.3		10.7					
Cobalt	**NA**	9.8		1.6	B				
Copper	**600**	6.1		10.8					
Iron	**NA**	26,600		12,900					
Lead	**400**	5.9		24.9					
Magnesium	**NA**	451		270	B				
Manganese	**NA**	172		21.6					
Mercury	**14**	0.11	U	0.11	U				
Nickel	**250**	3.2	B	4.2	B				
Potassium	**NA**	391		400	B				
Selenium	**63**	0.64		0.6	U				
Silver	**110**	0.11	U	0.11	U				
Sodium	**NA**	80.8	B	158	B				
Thallium	**2**	0.75	U	0.77	U				
Vanadium	**370**	32.2		21.2					
Zinc	**1500**	19		18.1					

U-concentration is less than detection limit.
NA-not applicable

5.0 WASTE DISPOSAL

All excavated soil and waste resulting from the Site 12 remediation were transported and disposed of as non-hazardous materials in accordance with all applicable federal, state and local regulations. Prior to the wastes being shipped off site, all transporters and disposal facilities were approved by the Navy and Foster Wheeler Environmental.

Railroad ties were excavated from the area north of Building R-10. Several sets of railroad tracks ran from east to west, north of Building R-10. Another Navy Contractor removed the rails associated with the railroad tracks, but the railroad ties were left in place. The soil excavation, stock-piling and loading activities at Site 12 necessitated the removal of the railroad ties. The former railroad ties were placed in four 20 cubic yard roll-off containers and transported off-site for disposal. The railroad ties were analyzed for TCLP Extractables prior to shipment to ensure non-hazardous classification. Appendix C contains the analytical results of the railroad tie characterization sample (12WC10). The railroad ties were transported to Modern Landfill in York, Pennsylvania by Clean Harbors Environmental Services. Appendix F contains copies of the Non-Hazardous Manifests or Bill-Of-Ladings.

Approximately 262 tons of excavated soil was shipped off-site to Soil Safe Inc. in Salem, New Jersey, under proper non-hazardous manifests for disposal/recycling. Hermans Trucking Company transported the soils to Soil Safe. Shipping occurred from November 10, 1999 to November 11, 1999. Appendix F contains certificate of recycling and copies of the Non-Hazardous Waste Manifests for the soils removed from Site12.

5.1 MATERIAL LOAD-OUT

Plastic sheeting was placed on the asphalt loading area adjacent to the staged soil to catch contaminated soil spilled during loading. The loading and staging area was located west of the excavation area. The trucks backed up onto the plastic sheeting for loading. The soil was loaded into trucks equipped with covers. Any soil that fell onto the plastic or trucks while loading was promptly removed to ensure that the trucks did not track soil off the plastic. The trucks did not require any additional decontamination.

6.0 BACKFILLING OPERATIONS

The Site 12 excavation was backfilled upon confirmation that all soils were excavated to concentrations less than the NJDEP Residential Cleanup Criteria for metal, semi-volatile organic compounds, and total petroleum hydrocarbons. Certified clean select fill was placed in the excavation and compacted with a 1.5 ton roller in 6-inch lifts. Approximately 195 tons of select fill was obtained from Tomkat Construction to backfill Site 12. Appendix G contains Certificate of Clean Letter from the Tomkat Construction for the select fill. Appendix G also contains the weight tickets for the select fill transported to Site 12. The area

was brought to within three inches of the surrounding grade, and then covered with 1.5-inch clean stone. Approximately 64 tons of 1.5 inch-stone was placed atop the Site 12 area.

Some minor areas disturbed north of Site 12 during the remedial activities were repaired with topsoil and re-seeded with perennial ryegrass. Approximately 24 tons of topsoil were placed and graded north of Site 12.

7.0 CONCLUSION

All remediation activities pertaining to Site 12 have been completed in accordance with the Final Work Plan and all federal, state, and local regulations. Based on U.S.EPA and NJDEP approval, Site 12 has met all the applicable requirements for closure, and the remediation for which Foster Wheeler Environmental was contracted by the Northern Division, Naval Facilities Engineering Command is complete.

This Remedial Action Report satisfies the post-construction submittal requirements included in paragraph 1.2.1, Pre- and Post-Construction Documentation of the Statement of Services for Delivery Order No. 0034, under Remedial Action Contract No. N62472-94-D-0398.

APPENDIX D

INTEGRATED EXPOSURE AND UPTAKE BIOKINETIC MODEL RESULTS

SITE 12 AFTER REMEDIAL ACTION

LEAD MODEL FOR WINDOWS Version 1.0

==========
Model Version: 1.0
User Name: Tetra Tech NUS, Inc.
Date: 10/9/2003
Site Name: NWS Earle
Operable Unit: Site 12 - Former Battery Storage Area
Run Mode: Site Risk Assessment

Soil/Dust Data
Input value is an average of the concentrations from six post-excavation confirmation samples (second round in November 1999).
GSD, Cutoff and Age Type

GSD, Cutoff and Age Type

Air Data
No air sampled.
Diet Data
Not sampled.
Water Data
Not sampled.
Soil/Dust Data
Outdoor soil value derived from taking an average of six post-excavation confirmatory soil samples (November 1999 second round).
Average = 14.1 mg/Kg
# Maternal Data
Not sampled.
Air Data
Not sampled.
==========
The time step used in this model run: 1 - Every 4 Hours (6 times a day).

******Air******

Indoor Air Pb Concentration: 0.000 percent of outdoor.
Other Air Parameters:

Age	Time Outdoors (hours)	Ventilation Rate (m^3/day)	Lung Absorption (%)	Outdoor Air Pb Conc ug Pb/m^3
.5-1	1.000	2.000	32.000	0.000
1-2	2.000	3.000	32.000	0.000
2-3	3.000	5.000	32.000	0.000
3-4	4.000	5.000	32.000	0.000
4-5	4.000	5.000	32.000	0.000
5-6	4.000	7.000	32.000	0.000
6-7	4.000	7.000	32.000	0.000

******Diet******

Age	Diet Intake(ug/day)
.5-1	0.000
1-2	0.000
2-3	0.000
3-4	0.000
4-5	0.000
5-6	0.000
6-7	0.000

******Drinking Water******

Water Consumption:

Age	Water (L/day)
.5-1	0.000
1-2	0.000
2-3	0.000
3-4	0.000
4-5	0.000
5-6	0.000
6-7	0.000

Drinking Water Concentration: 4.000 ug Pb/L

******Soil& Dust******

Age	Soil (ug Pb/g)	House Dust (ug Pb/g)
.5-1	14.100	0.000
1-2	14.100	0.000
2-3	14.100	0.000
3-4	14.100	0.000
4-5	14.100	0.000
5-6	14.100	0.000
6-7	14.100	0.000

******Alternate Intake******

Age	Alternate (ug Pb/day)
.5-1	0.000
1-2	0.000
2-3	0.000
3-4	0.000
4-5	0.000
5-6	0.000
6-7	0.000

******Maternal Contribution: Infant Model******

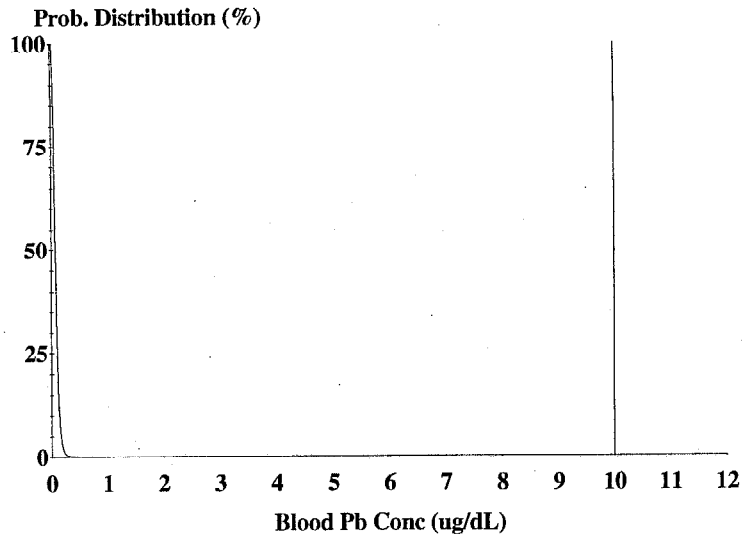
Maternal Blood Concentration: 0.000 ug Pb/dL

****
CALCULATED BLOOD LEAD AND LEAD UPTAKES:

****

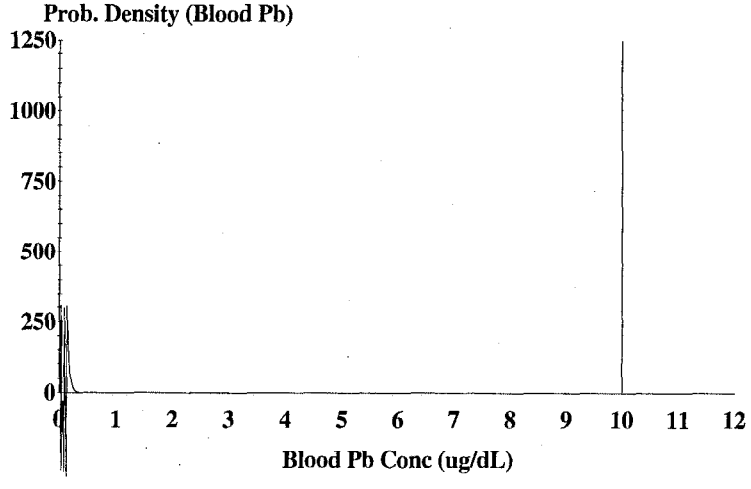
Year	Air (ug/dL)	Diet (ug/day)	Alternate (ug/day)	Water (ug/day)
5-1	0.000	0.000	0.000	0.000
1-2	0.000	0.000	0.000	0.000
2-3	0.000	0.000	0.000	0.000
3-4	0.000	0.000	0.000	0.000
4-5	0.000	0.000	0.000	0.000
5-6	0.000	0.000	0.000	0.000
6-7	0.000	0.000	0.000	0.000

Year	Soil+Dust (ug/day)	Total (ug/day)	Blood (ug/dL)
.5-1	0.162	0.162	0.1
1-2	0.256	0.256	0.1
2-3	0.256	0.256	0.1
3-4	0.257	0.257	0.1
4-5	0.190	0.190	0.1
5-6	0.171	0.171	0.1
6-7	0.162	0.162	0.0



Cutoff = 10.000 ug/dl
Geo Mean = 0.078
% Above = 0.000

Age Range = 0 to 84 months
Time Step = Every 4 Hours
Run Mode = Site Risk Assessment



Cutoff = 10.000 ug/dl
Geo Mean = 0.078
% Above = 0.000
% Below = 100.000

Age Range = 0 to 84 months
Time Step = Every 4 Hours
Run Mode = Site Risk Assessment

APPENDIX E

HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT EVALUATION

HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT EVALUATION

The human health risk assessments (HHRAs) for the sites were 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 and RI Addendum were selected by agreement of the USEPA, NJDEP, and Navy and reflect similar methodologies that would be used at this time. However, the methodology for the background comparison test has changed. There have been no significant revisions in the methodology for human health risk assessments since the RI and RI Addendum was prepared and the methodologies used were considered sufficient to adequately characterize the potential risks at the sites.

The benchmarks used to select COPCs for groundwater included USEPA Region III Risk-Based Concentrations (RBCs), USEPA Maximum Contaminant Levels (MCLs), and the NJDEP Ground Water Quality Standards (N.J.A.C. 7:9-6). The USEPA Region III RBCs are usually updated twice a year (October 2003 was last update). The NJDEP Ground Water Quality Standards were last updated in January 1993.

The benchmarks used to select COPCs for surface water included USEPA Ambient Water Quality Criteria (AWQCs) and New Jersey State Surface Water Quality Standards (N.J.A.C. 7:9B). The USEPA AWQCs were last updated in November 2002. The NJDEP Surface Water Quality Standards were published in May 2003.

The benchmarks used to evaluate chemicals of potential concern (COPCs) for direct contact with soil included USEPA Region III RBCs and NJDEP Cleanup Standards for Contaminated Sites. In addition, USEPA Soil Screening Levels for the protection of migration from soil to groundwater and soil to air and NJDEP Cleanup Standards for Contaminated Sites for pollutant mobility and volatilization from soil to indoor air were used to select COPCs for soil migration pathways. The USEPA Region III RBCs are usually updated twice a year (October 2003 was last update). The NJDEP Cleanup Standards for Contaminated Sites rule (N.J.A.C. 7:26D) was issued on February 3, 1992 and revised in May 1999. The best available ecological risk criteria available were selected in agreement with all parties.

The benchmarks used to calculate cancer and noncancer risks include USEPA's Integrated Risk Information System (IRIS), USEPA's Health Effects Assessment Summary Tables (HEAST), and USEPA's National Center for Exposure Analysis (NCEA) Regional Support Provisional Service.

In general, most of the changes in the updated documents are not expected to significantly change the overall conclusions of the HHRAs. Some of the RBC criteria for tap water ingestion or direct contact with soil are lower in the updated documents, and some of the values are higher. Therefore, different chemicals might be retained as COPCs during the screening if it was conducted at present. However, the decision to remediate a site is typically not based on screening benchmarks because of their conservative nature.

Some of the cancer slope factors (SFs) and noncancer reference doses (RfDs) have been changed, withdrawn, or added. Therefore, risks might be slightly different if the HHRAs were conducted at present. Also, some of the dermal exposure parameters have been changed slightly with the issuance of the 2001 update to 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 and AWQCs and NJDEP criteria for surface water.

ARARs and TBCs were reviewed to determine whether there have been changes since the RI was completed. The chemical-specific ARARs, advisories, and guidance values (TBCs) that have changed are provided in the table below.

Contaminant	ARAR/Site-Specific Level		Source
GROUNDWATER			
Arsenic	Previous	50 µg/L	Primary Drinking Water Standard
	Previous	8 µg/L	NJDEP Groundwater Quality Standard
	New	10 µg/L	Primary Drinking Water Standard
Surface Water			
Aluminum	Previous	87 µg/L	USEPA AWQC
	New	Reserved	NJDEP Surface Water Quality Standards
Cadmium	Previous	1.1 µg/L	USEPA AWQC
	New	10 µg/L	NJDEP Surface Water Quality Standards
Copper	Previous	11 µg/L	USEPA AWQC
	New	Reserved/7.9 µg/L	NJDEP Surface Water Quality Standards
Lead	Previous	3.2 µg/L	USEPA AWQC
	Previous	5 µg/L	NJDEP Surface Water Quality Standards

Contaminant	ARAR/Site-Specific Level		Source
	New	5.4 µg/L	NJDEP Surface Water Quality Standards
Manganese	Previous	80 µg/L	USEPA Tier II
	New	100 µg/L	NJDEP Surface Water Quality Standards
Mercury	Previous	0.012 µg/L	USEPA AWQC
	New	0.144 µg/L	NJDEP Surface Water Quality Standards
Nickel	Previous	160 µg/L	USEPA AWQC
	Previous	516 µg/L	NJDEP Surface Water Quality Standards
	New	516 µg/L	NJDEP Surface Water Quality Standards
Silver	Previous	0.01 µg/L	USEPA Region 4 Screening Criteria
	New	164 µg/L	NJDEP Surface Water Quality Standards
Zinc	Previous	101 µg/L	USEPA AWQC
	New	120 µg/L	USEPA AWQC
	New	Reserved	NJDEP Surface Water Quality Standards

Soil

Arsenic	Previous	20 mg/kg	NJDEP Cleanup Standards for Contaminated Sites
	New	0.4 mg/kg	USEPA RBC
Beryllium	Previous	1 mg/kg	NJDEP Cleanup Standards for Contaminated Sites
	New	2 mg/kg	USEPA RBC
	New	160 mg/kg	NJDEP Cleanup Standards for Contaminated Sites
Cadmium	Previous	1 mg/kg	NJDEP Cleanup Standards for Contaminated Sites
	New	39 mg/kg	NJDEP Cleanup Standards for Contaminated Sites
Chromium	Previous	None	NJDEP Cleanup Standards for Contaminated Sites
	New	240 mg/kg	NJDEP Cleanup Standards for Contaminated Sites
Vanadium	Previous	370 mg/kg	NJDEP Cleanup Standards for Contaminated Sites
	New	2.3 mg/kg	USEPA RBC
4,4-DDD	Previous	3000 ug/kg	NJDEP Cleanup Standards for Contaminated Sites
	New	2700 ug/kg	USEPA RBC
4,4-DDE	Previous	2000 ug/kg	NJDEP Cleanup Standards for Contaminated Sites
	New	1900 ug/kg	USEPA RBC
4,4-DDT	Previous	2000 ug/kg	NJDEP Cleanup Standards for Contaminated Sites
	New	1900 ug/kg	USEPA RBC
Aldrin	Previous	40 ug/kg	NJDEP Cleanup Standards for Contaminated Sites
	New	38 ug/kg	USEPA RBC
Alpha-Chlordane	Previous	None	
	New	1800 ug/kg	USEPA RBC
Gamma-Chlordane	Previous	None	
	New	1800 ug/kg	USEPA RBC
2-Methyl naphthalene	Previous	None	
	New	1600000 ug/kg	USEPA RBC
Benzo(a) anthracene	Previous	900 ug/kg	NJDEP Cleanup Standards for Contaminated Sites
	New	870 ug/kg	USEPA RBC

Contaminant	ARAR/Site-Specific Level		Source
Benzo(a) pyrene	Previous	660 ug/kg	NJDEP Cleanup Standards for Contaminated Sites
	New	87 ug/kg	USEPA RBC
Benzo(b) fluoranthene	Previous	900 ug/kg	NJDEP Cleanup Standards for Contaminated Sites
	New	870 ug/kg	USEPA RBC
Bis(2-ethyl hexyl) phthalate	Previous	49000 ug/kg	NJDEP Cleanup Standards for Contaminated Sites
	New	46000 ug/kg	USEPA RBC
Carbazole	Previous	None	
	New	32000 ug/kg	USEPA RBC
Dibenz(a,h) anthracene	Previous	660 ug/kg	NJDEP Cleanup Standards for Contaminated Sites
	New	87 ug/kg	USEPA RBC
Dibenzofuran	Previous	None	
	New	160000 ug/kg	USEPA RBC
Indeno(1,2,3-cd) pyrene	Previous	900 ug/kg	NJDEP Cleanup Standards for Contaminated Sites
	New	870 ug/kg	USEPA RBC
Tetrachloro ethene	Previous	4000 ug/kg	NJDEP Cleanup Standards for Contaminated Sites
	New	1200 ug/kg	USEPA RBC

Sediment

Arsenic	Previous	8.2 mg/kg	Environmental Management
	New	0.4 mg/kg	USEPA RBC
	New	6 mg/kg	NJDEP Guidance For Sediment Quality Evaluations
Antimony	Previous	2 mg/kg	NOAA Technical Memorandum NOS OMA 52
	New	None	NJDEP Guidance For Sediment Quality Evaluations
Barium	Previous	40 mg/kg	Sediments: Chemistry and Toxicity of In-Place Pollutants
	New	None	NJDEP Guidance For Sediment Quality Evaluations
Cadmium	Previous	1.2 mg/kg	Environmental Management
	New	0.6 mg/kg	NJDEP Guidance For Sediment Quality Evaluations
Chromium	Previous	81 mg/kg	Environmental Management
	New	26 mg/kg	NJDEP Guidance For Sediment Quality Evaluations
Cobalt	Previous	50 mg/kg	Contaminated Sites Rehabilitation Policy
	New	None	NJDEP Guidance For Sediment Quality Evaluations
Copper	Previous	34 mg/kg	Environmental Management
	New	16 mg/kg	NJDEP Guidance For Sediment Quality Evaluations
Lead	Previous	47 mg/kg	Environmental Management
	New	31 mg/kg	NJDEP Guidance For Sediment Quality Evaluations
Manganese	Previous	460 mg/kg	Guidelines for the Protection and Management of the Aquatic Sediment Quality in Ontario (1992)
	New	None	NJDEP Guidance For Sediment Quality Evaluations
Mercury	Previous	0.15 mg/kg	Environmental Management
	New	0.2 mg/kg	NJDEP Guidance For Sediment Quality Evaluations
Nickel	Previous	21 mg/kg	Environmental Management

Contaminant	ARAR/Site-Specific Level		Source
	New	16 mg/kg	NJDEP Guidance For Sediment Quality Evaluations
Silver	Previous	None	
	New	1 mg/kg	NJDEP Guidance For Sediment Quality Evaluations
Zinc	Previous	150 mg/kg	Environmental Management
	New	120 mg/kg	NJDEP Guidance For Sediment Quality Evaluations
4,4-DDD	Previous	1.6 ug/kg	Environmental Management
	New	8 ug/kg	NJDEP Guidance For Sediment Quality Evaluations
4,4-DDE	Previous	2.2 ug/kg	Environmental Management
	New	5 ug/kg	NJDEP Guidance For Sediment Quality Evaluations
4,4-DDT	Previous	1.6 ug/kg	Environmental Management
	New	7 ug/kg	NJDEP Guidance For Sediment Quality Evaluations
Dieldrin	Previous	52 ug/kg	USEPA ECO Update
	New	2 ug/kg	NJDEP Guidance For Sediment Quality Evaluations
Endosulfan II	Previous	5.4 ug/kg	USEPA ECO Update
	New	None	NJDEP Guidance For Sediment Quality Evaluations
Endrin	Previous	20 ug/kg	USEPA ECO Update
	New	3 ug/kg	NJDEP Guidance For Sediment Quality Evaluations
Endrin Ketone	Previous	20 ug/kg	USEPA ECO Update
	New	None	NJDEP Guidance For Sediment Quality Evaluations
Heptachlor	Previous	5 ug/kg	Ontario Ministry of the Environment
	New	None	NJDEP Guidance For Sediment Quality Evaluations
Anthracene	Previous	330 ug/kg	USEPA Region IV Sediment Screening Values for Hazardous Waste Sites
	New	220 ug/kg	NJDEP Guidance For Sediment Quality Evaluations
Benzo(a) anthracene	Previous	330 ug/kg	USEPA Region IV Sediment Screening Values for Hazardous Waste Sites
	New	320 ug/kg	NJDEP Guidance For Sediment Quality Evaluations
Benzo(a) pyrene	Previous	430 ug/kg	Environmental Management
	New	370 ug/kg	NJDEP Guidance For Sediment Quality Evaluations
Benzo(b) fluoranthene	Previous	330 ug/kg	USEPA Region IV Sediment Screening Values for Hazardous Waste Sites
	New	None	NJDEP Guidance For Sediment Quality Evaluations
Benzo(g,h,i) perylene	Previous	330 ug/kg	USEPA Region IV Sediment Screening Values for Hazardous Waste Sites
	New	170 ug/kg	NJDEP Guidance For Sediment Quality Evaluations
Benzo(k) fluoranthene	Previous	330 ug/kg	USEPA Region IV Sediment Screening Values for Hazardous Waste Sites
	New	240 ug/kg	NJDEP Guidance For Sediment Quality Evaluations
Bis(2-ethyl hexyl) phthalate	Previous	890000000 ug/kg	Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota
	New	None	NJDEP Guidance For Sediment Quality Evaluations

Contaminant	ARAR/Site-Specific Level		Source
Carbazole	Previous	330 ug/kg	USEPA Region IV Sediment Screening Values for Hazardous Waste Sites
	New	None	NJDEP Guidance For Sediment Quality Evaluations
Chrysene	Previous	330 ug/kg	USEPA Region IV Sediment Screening Values for Hazardous Waste Sites
	New	340 ug/kg	NJDEP Guidance For Sediment Quality Evaluations
Dibenz(a,h) anthracene	Previous	330 ug/kg	USEPA Region IV Sediment Screening Values for Hazardous Waste Sites
	New	600 ug/kg	NJDEP Guidance For Sediment Quality Evaluations
Dibenzofuran	Previous	2000 ug/kg	USEPA ECO Update
	New	None	NJDEP Guidance For Sediment Quality Evaluations
Fluoranthene	Previous	2900 ug/kg	USEPA ECO Update
	New	750 ug/kg	NJDEP Guidance For Sediment Quality Evaluations
Fluorene	Previous	540 ug/kg	USEPA ECO Update
	New	190 ug/kg	NJDEP Guidance For Sediment Quality Evaluations
Indeno(1,2,3-cd) pyrene	Previous	330 ug/kg	USEPA Region IV Sediment Screening Values for Hazardous Waste Sites
	New	200 ug/kg	NJDEP Guidance For Sediment Quality Evaluations
Naphthalene	Previous	480 ug/kg	USEPA ECO Update
	New	160 ug/kg	NJDEP Guidance For Sediment Quality Evaluations
Phenanthrene	Previous	850 ug/kg	USEPA ECO Update
	New	5560 ug/kg	NJDEP Guidance For Sediment Quality Evaluations
Pyrene	Previous	660 ug/kg	Environmental Management
	New	490 ug/kg	NJDEP Guidance For Sediment Quality Evaluations
Toluene	Previous	670 ug/kg	USEPA ECO Update
	New	2 ug/kg	NJDEP Guidance For Sediment Quality Evaluations
Xylene	Previous	250 ug/kg	USEPA ECO Update
	New	None	NJDEP Guidance For Sediment Quality Evaluations